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Mayflower Wind Project Draft Environmental Impact Statement

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Mayflower Wind Project Environmental Impact Statement

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ABSTRACT

This Draft Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction and installation, operations and maintenance, and conceptual decommissioning of the Mayflower Wind Project (Project) proposed by Mayflower Wind Energy LLC (Mayflower Wind), in its Construction and Operations Plan (COP). The proposed Project described in the COP and this Draft EIS would have a capacity of up to 2,400 megawatts (MW) and would be sited offshore Massachusetts, within Commercial Lease OCS-A 0521 (Lease Area). The Project is designed to provide renewable wind energy to the northeast United States, including Massachusetts.

This Draft EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321 et seq.) and implementing regulations (40 Code of Federal Regulations [CFR] Parts 1500–1508). This Draft EIS will inform the Bureau of Ocean Energy Management in deciding whether to approve, approve with modifications, or disapprove the COP (30 CFR 585.628). Publication of the Draft EIS initiates a 45-day public comment period open to all, after which all the comments received will be assessed and considered by BOEM in preparation of a Final EIS.

Additional copies of this Draft EIS may be obtained by writing the Bureau of Ocean Energy Management, Attn: Genevieve Brune (address above); by telephone at (703) 787-1553; or by downloading from the BOEM website at https://www.boem.gov/renewable-energy/state-activities/mayflower-wind.

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Abbreviations and Acronyms

Abbreviation	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	micrograms per liter
µT	microteslas
AAQS	ambient air quality standards
AC	alternating current
ADLS	Aircraft Detection Lighting System
aerial HD	Aerial high-definition
AIS	Automatic Identification System
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMM	avoidance, minimization, and mitigation measure
APE	area of potential effect
ASLF	Ancient submerged landform feature
ASMFC	Atlantic States Marine Fisheries Commission
AVEHP	Analysis of Visual Effects to Historic Properties
AVERT	Avoided Emissions and Generation Tool
BA	Biological Assessment
BCC	Birds of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
BUAR	Board of Underwater Archaeological Resources
CAA	Clean Air Act
CCS	Center for Coastal Studies
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHRVEA	Cumulative Historic Resources Visual Effects Assessment
CMECS	Coastal and Marine Ecological Classification Standard
CO	carbon monoxide
CO_2	carbon dioxide
COBRA	CO-Benefits Risk Assessment
COP	Construction and Operations Plan
CPA	closest point of approach
CWA	Clean Water Act
DAS	Days-At-Sea
dB	decibels

Abbreviation	Definition
dB re 1 µPa	decibels referenced to a pressure of 1 micropascal
DC	Direct Current
DME	distance measuring equipment
DO	dissolved oxygen
DoD	Department of Defense
DOI	U.S. Department of the Interior
DPS	distinct population segment
DWT	deadweight tonnage
EA	Environmental Assessment
ECC	export cable corridor
EDCs	electric distribution companies
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJSCREEN	Environmental Justice Screening and Mapping Tool
EMF	electromagnetic field
EO	Executive Order
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FFR	far-field region
FMP	Fishery Management Plan
FOV	field of view
FTE	full-time equivalent
FUDS	Formerly Used Defense Sites
GBS	gravity-based structure
GDP	Gross Domestic Product
GHG	greenhouse gas
GSC HMA	Great South Channel Habitat Management Area
GW	gigawatts
HAP	hazardous air pollutant
HAPC	Habitat Areas of Particular Concern
HDD	horizontal directional drilling
HFC	high-frequency cetacean
HPTP	Historic Property Treatment Plan
HRG	High-resolution geophysical
HUC	Hydrologic Unit Code
HVAC	high-voltage alternating current
HVDC	High-voltage direct current
Hz	hertz

Abbreviation	Definition
IBA	Important Bird Area
IOOS	Integrated Ocean Observing System
IPaC	Information for Planning and Consultation
ISO-NE	ISO New England Inc.
IWG	Interagency Working Group
JBCC	Joint Base Cape Cod
kHz	kilohertz
km^2	square kilometers
KOP	key observation point
kV	kilovolt
lb/gal	pounds per gallon
Lease Area	Commercial Lease OCS-A 0521
LFC	low-frequency cetaceans
LME	Large Marine Ecosystem
L_{pk}	peak sound pressure level
M-weighted SEL	1 µPa squared per second
MAFMC	Mid-Atlantic Fishery Management Council
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
Mayflower Wind	Mayflower Wind Energy LLC
MCEC	Massachusetts Clean Energy Center
MDAT	Marine-life Data and Analysis Team
MESA	Massachusetts Endangered Species Act
MFC	mid-frequency cetaceans
m/s	meters per second
mg/L	milligrams per liter
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW	megawatt
M-weighted SEL	1 µPa squared per second
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NARW	North Atlantic right whale
NBFSMN	Narragansett Bay Fixed-Site Monitoring Network
NCCA	National Coastal Condition Assessment
NDBC	National Data Buoy Center

Abbreviation	Definition
NEAq	New England Aquarium
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NFR	Near-field region
NHL	National Historic Landmark
NHESP	Natural Heritage & Endangered Species Program
NHPA	National Historic Preservation Act
NLPS	Northeast Large Pelagic Survey
nm	nautical miles
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_X	nitrogen oxides
NRHP	National Register of Historic Places
NSRA	Navigation Safety Risk Assessment
NTU	nephelometric turbidity units
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSPs	Offshore Substation Platforms
OSRP	Oil Spill Response Plan
PATON	private aids to navigation
PDE	Project Design Envelope
PM_{10}	particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
POI	points-of-interconnection
PPA	power purchase agreement
ppb	parts per billion
Project	Mayflower Wind Project
PSD	Prevention of Significant Deterioration
PSO	Protected Species Observer
psu	salinity units
PTS	permanent threshold shift
PV	Plan View

Abbreviation	Definition
RFA	Regional Fisheries Area
RHA	Rivers and Harbors Act of 1899
RIDEM	Rhode Island Department of Environmental Management
RIGIS	Rhode Island Geographic Information System
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance
ROV	remotely operated vessel
ROW	right-of-way
RSZ	rotor-swept zone
SAR	search and rescue
SAROPS	Search and Rescue Optimal Planning System
SAV	Submerged aquatic vegetation
SC-GHG	social cost of greenhouse gases
SEL	sound exposure level
SGCN	Species of Greatest Conservation Need
SHPO	state historic preservation office
SIL	significant impact levels
SLVIA	seascape, landscape, and visual impact assessment
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control And Countermeasure
SPI	Sediment Profile Imaging
SPL or L_{rms}	sound pressure level
STSSN	Sea Turtle Stranding and Salvage Network
SWPPP	Stormwater Pollution Prevention Plan
TARA	Terrestrial Archaeological Resources Assessment
TCP	traditional cultural property
TOC	Total organic carbon
TRACON	Terminal Radar Approach Control
TSS	total suspended solids
TTS	temporary threshold shift
UME	Unusual Mortality Event
URI	University of Rhode Island
U.S. Navy	U.S. Department of the Navy
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
UXO	Unexploded ordnances

Abbreviation	Definition
VIA	Visual Impact Assessment
VMS	Vessel Monitoring System
VOC	volatile organic compound
VTR	Vessel Trip Report
WEA	Wind Energy Area
WNS	White Nose Syndrome
WQI	Water Quality Index
WTG	wind turbine generator

Executive Summary

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, operations and maintenance (O&M), and conceptual decommissioning of the Mayflower Wind Project (Project) proposed by Mayflower Wind Energy LLC (Mayflower Wind), in its Construction and Operations Plan (COP) (Mayflower Wind 2022).[1] The Bureau of Ocean Energy Management (BOEM) has prepared the Draft EIS under the National Environmental Policy Act (NEPA) (42 U.S. Code [USC] 4321–4370f). This Draft EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the Project's COP.

Cooperating agencies may rely on this Draft EIS to support their decision-making. In conjunction with submitting its COP, Mayflower Wind (the Applicant) applied to the National Marine Fisheries Service (NMFS) for an incidental take authorization under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC 1361 et seq.), for incidental take of marine mammals during Project construction. NMFS is required to review applications and, if appropriate, issue an incidental take authorization under the MMPA. NMFS intends to adopt the Final EIS if, after independent review and analysis, it determines the Final EIS to be sufficient to support the authorization. The U.S. Army Corps of Engineers (USACE) similarly intends to adopt the EIS to meet its responsibilities under Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899 (RHA).

ES.2 Purpose and Need for the Proposed Action

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

Through a competitive leasing process under 30 Code of Federal Regulations (CFR) 585.211, Mayflower Wind was awarded commercial Renewable Energy Lease OCS-A 0521 covering an area offshore Massachusetts (Lease Area). Under the terms of the lease, Mayflower Wind has the exclusive right to

[1] The Mayflower Wind Project COP and appendices are available on BOEM's website: https://www.boem.gov/southcoast-wind. On February 1, 2023, Mayflower Wind Energy LLC changed its name to SouthCoast Wind Energy LLC and changed the project name from the Mayflower Wind Project to the SouthCoast Wind Project. Because the name change occurred immediately prior to the release of the Draft EIS, this document still refers to Mayflower Wind.

submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of an up to 2,400-megawatt (MW) offshore wind energy facility in the Lease Area in accordance with BOEM's COP regulations under 30 CFR 585.626, et seq (Figure ES-1).

Mayflower Wind's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area with up to 149 foundation locations to be occupied by a combination of up to 147 wind turbine generators (WTGs) and up to five Offshore Substation Platforms (OSPs). The Project would include two export cable corridors. One corridor would be used by multiple export cables making landfall and interconnecting to the ISO New England Inc. (ISO-NE) grid in Falmouth, Massachusetts, and the other corridor would be used by multiple export cables making landfall and interconnecting to the ISO-NE grid at Brayton Point in Somerset, Massachusetts (Figure ES-1). The Project would provide up to 2,400 MW of clean, renewable wind energy to the northeast United States, including Massachusetts, in accordance with Section 83C of the Massachusetts' Green Communities Act as added by Chapter 188 of the Acts of 2016, An Act to Promote Energy Diversity (Section 83C), which allows electric distribution companies (EDCs) to solicit proposals for offshore wind energy generation.

In October 2019, the EDCs selected Mayflower Wind's low-cost bid for a power purchase agreement (PPA) to generate 804 MW of offshore wind energy that will serve Massachusetts customers. In December 2021, Massachusetts awarded an additional 400 MW PPA to Mayflower Wind. The Project is intended to address the needs identified by the Massachusetts EDCs for new sources of power generation that are cost-effective and reliable, as well as to contribute to the Section 83C offshore wind mandate. In addition to the 804 MW PPA and the 400 MW PPA, Mayflower Wind is actively exploring additional offtake opportunities, including planned solicitations from other ISO-NE member states, as well as contracts with private entities.

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the Outer Continental Shelf (OCS); EO 14008; the 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;[2] and in consideration of the goals of the Applicant, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove Mayflower Wind's COP. BOEM will make this determination after weighing the factors in Subsection 8(p)(4) of the OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which require BOEM to make a decision on the lessee's plans to construct and operate a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action) (30 CFR 585.628).

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[2] Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

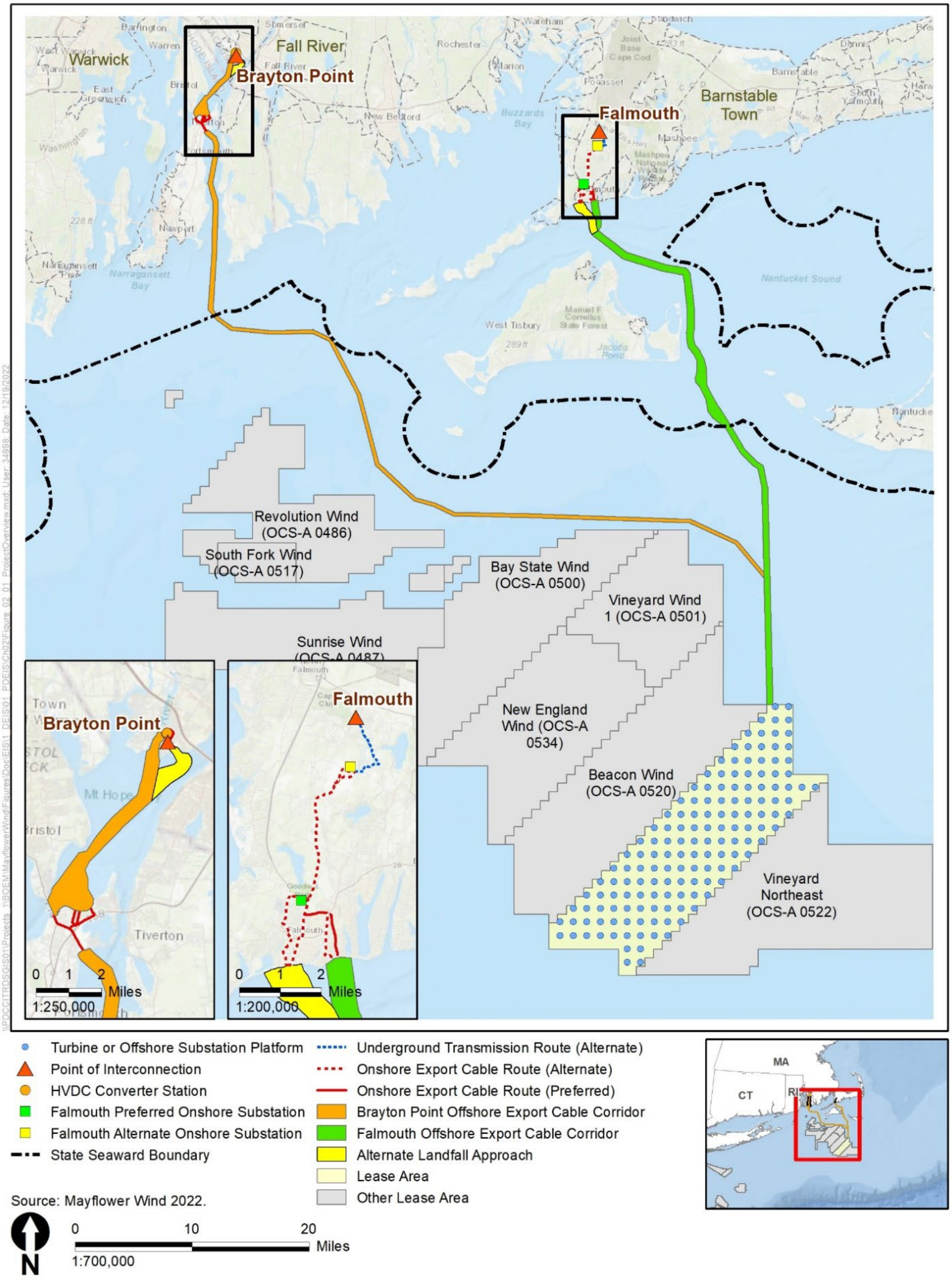

Figure ES-1. Mayflower Wind Project

In addition, NMFS received a request for authorization under the MMPA to take marine mammals incidental to construction activities related to the Project. NMFS's issuance of an MMPA incidental take authorization would be a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of Mayflower Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate Mayflower Wind'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)(A and D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's EIS to support that decision and to 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, under Section 10 of the RHA (33 USC 403) and CWA Section 404 (33 USC 1344). In addition, it is anticipated that a Section 408 permission will be required pursuant to Section 14 of the RHA (33 USC 408) for any proposed alterations that have the potential to alter, occupy, or use any federally authorized civil works projects. USACE considers issuance of permits/permission under these three delegated authorities a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)). The need for the Project as provided by the Applicant in Mayflower Wind's COP Volume 1, Section 1.3, and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project (up to 2,400 MW) within the Lease Area to help the state of Massachusetts achieve renewable energy goals. The basic Project purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy project for renewable energy generation in Lease Area OCS-A 0521 and transmission/distribution to the New England energy grid.

The purpose of USACE Section 408 action as determined by Engineer Circular 1165-2-220 is to evaluate the Applicant's request and determine whether the proposed alterations would be injurious to the public interest or would impair the usefulness of the USACE project. USACE Section 408 permission is needed to ensure that congressionally authorized projects continue to provide their intended benefits to the public. USACE intends to adopt BOEM's EIS to support its decision on any permits and permissions requested under Sections 10 and 14 of the RHA and Section 404 of the CWA. USACE would adopt the EIS per 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 November 1, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS consistent with NEPA regulations (42 USC 4321 et seq.), initiating a 30-day public scoping period from November 1 to December 1, 2021 (86 *Federal Register* 60270). The NOI solicited public input on the significant resources and issues, impact-producing factors, reasonable alternatives, and potential mitigation measures to analyze in the EIS. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the National Historic Preservation Act (54 USC 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), and sought public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the Mayflower Wind COP. BOEM held three virtual public scoping meetings on November 10, November 15, and November 18, 2021, to present information on the Project and NEPA process, answer questions from meeting attendees, and to solicit public comments. Scoping comments were received through Regulations.gov on docket number BOEM-2021-0062, via email to a BOEM representative, and through oral testimony at each of the three public scoping meetings. BOEM received 51 comment submissions from federal and state agencies, local governments, non-governmental organizations, and the general public during the scoping period. The topics most referenced in the scoping comments included mitigation and monitoring; marine mammals; planned activities scenario and cumulative impacts; commercial fisheries and for-hire recreational fishing; finfish, invertebrates, and Essential Fish Habitat (EFH); public involvement; alternatives; employment and job creation; benthic resources; and birds. BOEM considered all scoping comments while preparing this Draft EIS. Publication of this Draft EIS initiates a 45-day public comment period. BOEM will consider the comments received on the Draft EIS during preparation of the Final EIS.

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 five action alternatives (two of which have sub-alternatives). The action alternatives are not mutually exclusive; BOEM may select a combination of alternatives that meet the purpose and need of the proposed Project. The alternatives are as follows:

- Alternative A—No Action Alternative
- Alternative B—Proposed Action
- Alternative C—Fisheries Habitat Impact Minimization
  - Alternative C-1—Aquidneck Island, Rhode Island Route
  - Alternative C-2— Little Compton/Tiverton, Rhode Island Route
- Alternative D—Nantucket Shoals
- Alternative E—Foundation Structures

  - Alternative E-1—Pile Foundations (monopile and piled jacket) only
  - Alternative E-2—Suction Bucket Foundations only
  - Alternative E-3—Gravity-based Foundations only
- Alternative F—Muskeget Channel Cable Modification

Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Chapter 2, Section 2.2.

ES.4.1 Alternative A – No Action Alternative

Under Alternative A, BOEM would not approve the COP, the Project's construction and installation, O&M, and decommissioning would not occur; and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the applicant. The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serves as the existing baseline against which the direct and indirect impacts from action alternatives are evaluated.

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

ES.4.2 Alternative B—Proposed Action

The Proposed Action is to construct, operate, maintain, and eventually decommission an up to 2,400-MW wind energy facility on the OCS offshore Massachusetts within the range of design parameters described in Volume 1 of the Mayflower Wind COP (Mayflower Wind 2022), subject to applicable mitigation measures. The Project would have a capacity of up to 2,400 MW and would consist of up to 149 structure positions to be occupied by up to 147 WTGs and up to five OSPs connected by interarray cables within the Lease Area, and two offshore export cable corridors with landfalls at Falmouth and Brayton Point, Massachusetts and an intermediate landfall on Aquidneck Island, Rhode Island, along the corridor to Brayton Point. Onshore facilities would include landfall locations, onshore export cables, one substation, one converter station, underground transmission lines, and the utilities' points of interconnection. The Proposed Action is summarized in Table ES-1 and Appendix C, *Project Design Envelope and Maximum-Case Scenario*. Refer to Volume 1 of the Mayflower Wind COP (Mayflower Wind 2022) for additional details on Project design.

Table ES-1. Summary of Project Design Envelope parameters

Project Parameter Details
General (Layout and Project Size)
• Up to 147 WTGs • Up to 5 OSPs • Up to a total of 149 WTG/OSP positions • 1 nm x 1 nm (1.9 kilometers x 1.9 kilometers) grid layout with east-west and north–south orientation
Foundations
• Monopile, piled jacket, suction-bucket jacket, and/or gravity-based structure (up to two different foundation concepts would be installed) • Scour protection for up to all foundations • Seabed penetration up to 295.3 feet (90 meters) depth • Foundation piles would be installed using a pile-driving hammer and/or drilling techniques such as using a hydraulic impact hammer, vibratory hammer, or water jetting
Wind Turbine Generators
• Rotor diameter up to 918.6 feet (280 meters) • Blade length up to 452.8 feet (138 meters) • Hub height up to 605.1 feet (184.4 meters) above MLLW • Upper blade tip height up to 1,066.3 feet (325 meters) above MLLW • Lowest blade tip height (air gap) 53.8 feet (16.4 meters) above highest astronomical tide
Offshore Substation Platforms
• Up to 5 OSPs • OSPs installed atop a monopile, piled jacket, suction-bucket jacket, and/or gravity-based structure • Total OSP structure height up to 344.5 feet (105 meters) above MLLW • Scour protection for all foundations • Maximum length and width of topside structure 360.9 feet by 328.1 feet (110 meters by 100 meters; with ancillary facilities) • Foundation piles to be installed using a pile-driving hammer and/or drilling techniques such as using a hydraulic impact hammer, vibratory hammer, or water jetting • Up to 10 million gallons per day of once-through non-contact cooling water, with a maximum intake velocity of 0.5 foot per second, with a maximum anticipated temperature change of 18°F (10°C) from ambient water, and a maximum end-of-pipe discharge temperature of 90°F (32.2°C) • Depth of withdrawal for cooling water ranging from approximately 25 to 115 ft (7.6 to 35.0 meters) below the surface
Interarray Cables
• Target burial depth of 3.2 to 8.2 feet (1 to 2.5 meters) • Nominal interarray cable voltage: 60 kV to 72.5 kV • Maximum total interarray cable length is 497.1 miles (800 kilometers) • Preliminary layout available; however, final layout pending • Cable lay, installation, and burial: Activities may involve use of a jetting ROV, mechanical cutting ROV system, plowing (pre-cut and mechanical)
Falmouth Offshore Export Cables
• Up to 5 offshore export cables • Nominal export cable voltage: 200 kV to 345 kV HVAC or ±525 kV HVDC • Maximum total cable corridor length is 87 miles (140 kilometers) • Anticipated burial depth of 3.2 to 13.1 feet (1 to 4 meters) • Up to 9 cable/pipeline crossings

Project Parameter Details
• Cable lay, installation, and burial: Activities may involve use of a jetting tool (jetting ROV or jetting sled), vertical injection, mechanical cutting ROV system, plowing (pre-cut and mechanical)
Brayton Point Offshore Export Cables
• Up to 6 offshore export cables • Nominal export cable voltage: ±320 kV HVDC • Maximum total cable corridor length is 124 miles (200 kilometers) • Anticipated burial depth of 3.2 to 13.1 feet (1 to 4 meters) • Up to 16 cable / pipeline crossings • Cable lay, installation, and burial: Activities may involve use of a jetting tool (jetting ROV or jetting sled), vertical injection, mechanical cutting ROV system, plowing (pre-cut and mechanical)
Falmouth Landfall Site
• Three landfall locations under consideration: Worcester Avenue (preferred), Central Park, and Shore Street
Brayton Point Landfall Site
• Two landfall locations under consideration: the western (preferred) and eastern (alternate) shorelines of Brayton Point • Aquidneck Island, Portsmouth, Rhode Island; several locations under consideration for intermediate landfall across the island
Falmouth Onshore Export Cable Corridor
• Up to 12 onshore export cables and up to 5 communications cables • Nominal underground onshore export cable voltage: 200 kV to 345 kV HVAC • Maximum onshore export cable length is 6.4 statute miles (10.3 kilometers)
Brayton Point Onshore Export Cable Corridor
• Up to 6 onshore export cables and up to 2 communications cables • Nominal underground onshore export cable voltage: ±320 kV HVDC • Maximum onshore export cable length is 0.6 mile (1.0 kilometer)
Brayton Point Onshore Export Cable Corridor on Aquidneck Island (intermediate landfall)
• Up to 4 onshore export cables and up to 2 communications cables • Nominal underground onshore export cable voltage: ±320 kV HVDC • Onshore export cable corridor length is 3 miles (4.8 kilometers) across Aquidneck Island
Falmouth Onshore Substation/Interconnection
• Two Falmouth locations under consideration - Lawrence Lynch (preferred) and Cape Cod Aggregates (alternate) • Up to 26 acres (10.5 hectares) permanent area • New 345-kV overhead (preferred) or underground (alternate) transmission line in existing right-of-way up to 2.1 miles (3.4 kilometers) in length • Transmission line to Falmouth Point of Interconnection would be designed, permitted, and constructed by interconnection transmission owner
Brayton Point Converter Station/Interconnection
• One Brayton Point location under consideration – existing National Grid substation • Up to 7.5 acres (3 hectares) permanent area • New 345-kV underground transmission route to existing Brayton Point point of interconnection, up to 0.2 mile (0.3 kilometer) on Brayton Point property

WTG = wind turbine generator; OSP = offshore substation platform; MLLW = mean lower low water; °C = degrees Celsius; kV = kilovolt; ROV = remotely operated vehicle; HVAC = high voltage alternating current; HVDC = high voltage direct current

ES.4.3 Alternative C – Fisheries Habitat Impact Minimization

Alternative C was developed through the scoping process for the Draft EIS in response to comments received from NMFS and other agencies expressing concern with the potential impact of the offshore export cable on fisheries, EFH, and Habitat Areas of Particular Concern (HAPC) in the Sakonnet River. The Sakonnet River supports EFH for 16 fish species and has HAPCs for summer flounder and Atlantic Cod. To address this concern, BOEM developed onshore cable route options that would avoid placing the offshore export cable in the Sakonnet River. Under this alternative, the construction, O&M, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, subject to applicable mitigation measures. Alternative C includes two possible onshore export cable routes to Brayton Point:

- **Alternative C-1:** Aquidneck Island, Rhode Island Route
- **Alternative C-2:** Little Compton/Tiverton, Rhode Island Route

ES.4.4 Alternative D – Nantucket Shoals

Alternative D was developed through the scoping process for the Draft EIS to address potential impacts on protected species in the northeastern portion of the Lease Area. Following installation of foundations, a commenter speculated that the presence of WTGs in the northeastern portion of the Lease Area may alter the foraging habitat associated with the physical hydrodynamic features along the western edge of Nantucket Shoals. However, modeling of the full build out of the entire southern New England lease areas indicates that minor, local changes to the physical hydrodynamic features may occur on the western side of Nantucket Shoals adjacent to the BOEM lease areas. Based on best available science, BOEM believes there is a lack of conclusive evidence that the removal of proposed turbine locations in the northeastern portion of the Lease Area would measurably lessen these minor impacts on the hydrodynamic features. If the potential hydrodynamic effects are consistent with the modeling of the southern New England lease areas and other hydrodynamic studies of wind facilities in the North Sea, the effects would be local to the immediate vicinity of the turbine array and not extend to Nantucket Shoals. If the potential hydrodynamic effects are as extensive as potential wind wakes that could extend tens of kilometers under stable conditions, which has not been demonstrated, then the removal of turbines would not remove this potential range of effects from extending far enough from the turbine array to overlap with Nantucket Shoals. Nonetheless, Nantucket Shoals is an area of high productivity with higher abundances of amphipods, chlorophyll, birds, and North Atlantic right whale (NARW). Nantucket Shoals has high foraging value for several species, including NARW at different times of the year as well as seabirds and seaducks. Consequently, BOEM has developed this alternative to address the environmental concern that wildlife may be subject to increased impacts in this area. Under Alternative D, up to six WTGs (AZ-47, BA-47, BB-47, BC-47, BC-48, and BF-49) in the northeastern portion of the Lease Area would be eliminated to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals.

ES.4.5 Alternative E – Foundation Structures

Alternative E was developed through the scoping process for the Draft EIS to address options posed in the Mayflower Wind COP and in response to comments received from multiple commenters on construction noise related to foundation installation. Under Alternative E, the construction and installation, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, which includes a range of foundation types (monopile, piled jacket, suction bucket, and gravity based), subject to applicable mitigation measures. This alternative assumes the maximum use of piled (monopile and piled jacket), suction bucket, and gravity-based foundation structures to assess the extent of potential impacts from each foundation type.

- **Alternative E-1:** Piled Foundations (monopile and piled jacket) only
- **Alternative E-2:** Suction Bucket Foundations only
- **Alternative E-3:** Gravity-based Foundations only

ES.4.6 Alternative F – Muskeget Channel Cable Modification

Alternative F was developed to minimize impacts on complex habitats and reduce seabed disturbance in the Muskeget Channel east of Martha's Vineyard in response to concerns from NMFS. Under Alternative F, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, subject to applicable mitigation measures. However, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use ±525kV HVDC cables connected to one HVDC converter OSP, instead of HVAC cables connected to one or more HVAC OSPs as proposed under the Proposed Action. The OSP design for the offshore export cables connecting to Brayton Point would remain unchanged from the Proposed Action. As a result, there would be two HVDC converter OSPs under Alternative F: one HVDC converter OSP for Brayton Point and one HVDC converter OSP for Falmouth. In addition, Alternative F would use up to three offshore export cables to Falmouth, instead of up to five offshore export cables under the Proposed Action.

ES.5 Environmental Impacts

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

BOEM analyzes the impacts of past and ongoing activities in the absence of the Project as the No Action Alternative. The No Action Alternative serves as the existing baseline against which all action alternatives are evaluated. BOEM also separately analyzes cumulative impacts of the No Action Alternative, which considers all other ongoing and reasonably foreseeable future activities described in

Appendix D, *Planned Activities Scenario*. In this analysis, the cumulative impacts of the No Action Alternative serve as the baseline against which the cumulative impacts of all action alternatives are evaluated. Table ES-2 summarizes the impacts of each alternative and the cumulative impacts of each alternative. Under the No Action Alternative, the environmental and socioeconomic impacts and benefits of the action alternatives would not occur.

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

Chapter 4, *Other Required Impact Analyses*, describes potential unavoidable adverse impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. Chapter 4 also describes irreversible and irretrievable commitment of resources by resource area. The most notable such commitments could include effects on habitat or individual members of protected species, as well as potential loss of use of commercial fishing areas.

Appendix E, *Analysis of Incomplete and Unavailable Information* describes the incomplete or unavailable information that has been identified. BOEM considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed.

Table ES-2. Summary and comparison of impacts among alternatives with no mitigation measures

Resource	Alternative A No Action Alternative	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization [a]	Alternative D Nantucket Shoals	Alternative E Foundation Structures [a]	Alternative F Muskeget Channel Cable Modification
3.4.1 Air Quality						
Alternative Impacts	Moderate	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Cumulative Impacts	Moderate; minor to moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.4.2 Water Quality						
Alternative Impacts	Minor	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts	Minor	Minor	Minor	Minor	Minor	Minor
3.5.1 Bats						
Alternative Impacts	Minor	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts	Minor	Minor	Minor	Minor	Minor	Minor
3.5.2 Benthic Resources						
Alternative Impacts	Negligible to moderate	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial
Cumulative Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.5.3 Birds						
Alternative Impacts	Minor	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Cumulative Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial

Resource	Alternative A No Action Alternative	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization [a]	Alternative D Nantucket Shoals	Alternative E Foundation Structures [a]	Alternative F Muskeget Channel Cable Modification
3.5.4 Coastal Habitats and Fauna						
Alternative Impacts	Moderate	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.5.5 Finfish, Invertebrates, and Essential Fish Habitat						
Alternative Impacts	Minor to moderate	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Cumulative Impacts	Moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.5.6 Marine Mammals						
Alternative Impacts	Minor	Negligible to major; potentially beneficial	Negligible to major; potentially beneficial	Negligible to major; potentially beneficial	Negligible to major; potentially beneficial	Negligible to major; potentially beneficial
Cumulative Impacts	Moderate to major; minor beneficial	Negligible to major; minor beneficial	Moderate to major	Negligible to major; minor beneficial	Minor to major	Moderate to major
3.5.7 Sea Turtles						
Alternative Impacts	Minor	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
Cumulative Impacts	Minor	Minor	Minor	Minor	Minor	Minor
3.5.8 Wetlands						
Alternative Impacts	Moderate	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Resource	Alternative A No Action Alternative	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization [a]	Alternative D Nantucket Shoals	Alternative E Foundation Structures [a]	Alternative F Muskeget Channel Cable Modification
3.6.1 Commercial Fisheries and For-Hire Recreational Fishing						
Alternative Impacts	Moderate to major	Minor to major	Minor to major	Minor to major	Minor to major	Minor to major
Cumulative Impacts	Minor to major; moderate beneficial	Major	Major	Major	Major	Major
3.6.2 Cultural Resources						
Alternative Impacts	Moderate	Major	Major	Major	Major	Major
Cumulative Impacts	Major	Minor to major	Major	Major	Major	Major
3.6.3 Demographics, Employment, and Economics						
Alternative Impacts	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Cumulative Impacts	Minor; minor beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial
3.6.4 Environmental Justice						
Alternative Impacts	Minor	Negligible to major; minor beneficial	Negligible to major; minor beneficial	Negligible to major; minor beneficial	Negligible to major; minor beneficial	Negligible to major; minor beneficial
Cumulative Impacts	Minor; minor beneficial	Moderate	Moderate	Moderate	Moderate	Moderate
3.6.5 Land Use and Coastal Infrastructure						
Alternative Impacts	Minor; minor beneficial	Negligible to moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial
Cumulative Impacts	Minor; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial

Resource	Alternative A No Action Alternative	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization [a]	Alternative D Nantucket Shoals	Alternative E Foundation Structures [a]	Alternative F Muskeget Channel Cable Modification
3.6.6 Navigation and Vessel Traffic						
Alternative Impacts	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
Cumulative Impacts	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)						
Alternative Impacts	Marine Mineral Extraction, Marine and National Security Uses, Aviation and Air Traffic, Cables and Pipelines, Radar Systems: negligible; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic, Radar Systems: minor; Military and National Security: minor for most but moderate for search and rescue activities; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic, Radar Systems: minor; Military and National Security: minor for most but moderate for search and rescue activities; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic, Radar Systems: minor; Military and National Security: minor for most but moderate for search and rescue activities; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic, Radar Systems: minor; Military and National Security: minor for most but moderate for search and rescue activities; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic, Radar Systems: minor; Military and National Security: minor for most but moderate for search and rescue activities; Scientific Research and Surveys: major

Resource	Alternative A No Action Alternative	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization [a]	Alternative D Nantucket Shoals	Alternative E Foundation Structures [a]	Alternative F Muskeget Channel Cable Modification
Cumulative Impacts	Marine Mineral Extraction: negligible; Aviation and Air Traffic, Cables and Pipelines: minor; Military and National Security: minor for most but moderate for search and rescue activities; Radar Systems: moderate; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Military and National Security: minor for most but moderate for search and rescue activities; Radar Systems: moderate; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Military and National Security: minor for most but moderate for search and rescue activities; Radar Systems: moderate; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Military and National Security: minor for most but moderate for search and rescue activities; Radar Systems: moderate; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Military and National Security: minor for most but moderate for search and rescue activities; Radar Systems: moderate; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Military and National Security: minor for most but moderate for search and rescue activities; Radar Systems: moderate; Scientific Research and Surveys: major
3.6.8 Recreation and Tourism						
Alternative Impacts	Minor	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Cumulative Impacts	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial
3.6.9 Scenic and Visual Resources						
Alternative Impacts	Negligible to major	Minor to major	Minor to major	Minor to major	Minor to major	Minor to major
Cumulative Impacts	Minor to major	Negligible to major	Major	Major	Major	Major

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor; light green = negligible or beneficial to any degree. All impact levels are assumed to be adverse unless otherwise specified as beneficial. Where impacts are presented as multiple levels, the color representing the most adverse level of impact has been applied.
[a] Impacts are the same under Alternatives C1 and C2 and Alternatives E1, E2, and E3 unless otherwise noted in the table.

Chapter 1

Introduction

This Draft Environmental Impact Statement (EIS) assesses the reasonably foreseeable environmental, social, economic, historic, and cultural impacts that could result from the construction and installation, operations and maintenance (O&M), and conceptual decommissioning of the Mayflower Wind Project (Project) proposed by Mayflower Wind Energy LLC (Mayflower Wind), in its Construction and Operations Plan (COP) (Mayflower Wind 2022).[1] The proposed Project described in the COP and this Draft EIS would be up to 2,400 megawatts (MW) in scale and sited 30 miles (26 nautical miles [nm]) south of Martha's Vineyard, Massachusetts, and 23 miles (20 nm) south of Nantucket, Massachusetts within Lease Area OCS-A 0521 (Lease Area). The Project is designed to generate renewable energy for the northeast United States, including Massachusetts. This Draft EIS will inform the Bureau of Ocean Energy Management (BOEM) in deciding whether to approve, approve with modifications, or disapprove the COP (30 Code of Federal Regulations [CFR] 585.628). Publication of this Draft EIS initiates a 45-day public comment period. BOEM will use the comments received during the public review period to inform preparation of the Final EIS.

This Draft EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321–4370f) and implementing regulations. On July 16, 2020, the Council on Environmental Quality (CEQ), which is responsible for federal agency implementation of NEPA, revised the regulations for implementing the procedural provisions of NEPA (40 CFR Part 1500-1508). CEQ's new regulations, effective September 14, 2020, establish a presumptive time limit of 2 years for completing EISs, and a presumptive page limit of 150 pages or fewer, or up to 300 pages for proposals of unusual scope or complexity. BOEM has prepared this Draft EIS in accordance with the new regulations. Additionally, this Draft EIS was prepared consistent with the U.S. Department of the Interior (DOI) NEPA regulations (43 CFR 46); longstanding federal judicial and regulatory interpretations; and Administration priorities and policies, including Secretary's Order No. 3399 entitled *Department-Wide Approach to the Climate Crisis and Restoring Transparency and Integrity to the Decision-Making Process*, dated April 16, 2021, requiring bureaus and offices to "not apply the 2020 Rule in a manner that would change the application or level of NEPA that would have been applied to a proposed action before the 2020 Rule went into effect."[2]

1.1 Background

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

[1] The Mayflower Wind COP is available on BOEM's website: https://www.boem.gov/southcoast-wind. On February 1, 2023, Mayflower Wind Energy LLC changed its name to SouthCoast Wind Energy LLC and changed the project name from the Mayflower Wind Project to the SouthCoast Wind Project. Because the name change occurred immediately prior to the release of the Draft EIS, this document still refers to Mayflower Wind.
[2] Secretarial Order 3399 is available on the Department of Interior's website: https://www.doi.gov/sites/doi.gov/files/elips/documents/so-3399-508_0.pdf.

assessment, and (4) construction and operations. The history of BOEM's planning and leasing activities offshore Massachusetts is summarized in Table 1-1.

Table 1-1. History of BOEM planning and leasing activities offshore Massachusetts

Year	Milestone
2010	On December 29, 2010, BOEM published a Request for Interest (RFI) in the *Federal Register* to gage commercial interest in wind energy development offshore Massachusetts (75 *Federal Register* 82055). BOEM also invited the public to comment and provide information on environmental issues and data that should be considered in the development of the area of interest for wind energy development offshore Massachusetts. The public comment period closed on April 18, 2011, and BOEM received 11 indications of interest from 10 companies wishing to obtain a commercial lease for a wind energy project, and received approximately 260 public comments. After consideration of public comments and input from BOEM's intergovernmental Massachusetts Renewable Energy Task Force, BOEM modified the area of interest for commercial development offshore Massachusetts.
2012	On February 6, 2012, BOEM published a Call for Information and Nominations (Call) for commercial leasing for wind power on the OCS offshore Massachusetts in the *Federal Register* (77 *Federal Register* 5820). The public comment period for the Call closed on March 22, 2012. In response, BOEM received 32 comments and ten nominations of interest. After considering comments, BOEM excluded an area of high sea duck concentration, as well as an area of high-value fisheries to reduce conflict with commercial and recreational fishing activities.
2014	On June 18, 2014, BOEM published in the *Federal Register* a Notice of Availability of a Revised Environmental Assessment and Finding of No Significant Impact for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore Massachusetts (79 *Federal Register* 34781).
2014	On June 18, 2014, BOEM published a Proposed Sale Notice (PSN) for Commercial Leasing for Wind Power on the Outer OCS Offshore Massachusetts in the *Federal Register* for Leases OCS-A 0500, OCS-A 0501, OCS-A 0502, and OCS-A 0503 (79 *Federal Register* 34771).
2014/ 2015	On November 26, 2014, BOEM published a Final Sale Notice (FSN) for Commercial Leasing for Wind Power on the OCS Offshore Massachusetts in the *Federal Register* for Atlantic Wind Lease Sale-4 (ATLW-4) that covered the same four lease areas covered by the 2014 PSN (79 *Federal Register* 70545). The sale for ATLW-4 was held on January 29, 2015. Lease areas OCS-A 0502 and OCS-A 0503 went unsold during the lease sale.
2018	On April 11, 2018, BOEM published a PSN requesting public comments on the proposal to auction Leases OCS-A 0502 and OCS-A 0503 offshore Massachusetts for commercial wind energy development, the same lease areas unsold during the ATLW-4 lease sale (83 *Federal Register* 15618).
2018	On October 19, 2018, BOEM published an FSN in the *Federal Register*, which stated a commercial lease sale would be held December 13, 2018, for the Wind Energy Area offshore Massachusetts (83 *Federal Register* 53089). BOEM offered three leases, including OCS-A 0521, which are located within the former Leases OCS-A 0502 and OCS-A 0503 that were unsold during the ATLW-4 sale on January 29, 2015. Mayflower Wind was the winner of Lease OCS-A 0521.
2019	On April 1, 2019, BOEM and Mayflower Wind executed the lease agreement for Lease OCS-A 0521.
2019	On July 29, 2019, Mayflower Wind submitted a Site Assessment Plan for commercial wind Lease OCS-A 0521, which was subsequently revised with a complete Site Assessment Plan submitted on December 12, 2019. BOEM approved the Site Assessment Plan on May 26, 2020.
2021	On February 15, 2021, Mayflower Wind submitted its COP for the construction, operations, and conceptual decommissioning of the Project within the Lease Area. Mayflower Wind submitted two updated versions of the COP in 2021, one on August 30 and another on October 28.

Year	Milestone
2021	On November 1, 2021, BOEM published a Notice of Intent to Prepare an EIS for Mayflower Wind's Proposed Wind Energy Facility Offshore Massachusetts (86 *Federal Register* 60270).
2022	On March 17, 2022 and December 22, 2022, Mayflower Wind submitted updated versions of the COP.

1.2 Purpose and Need of 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:

> [T]o 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.

As discussed in Table 1-1, Mayflower Wind was awarded the Commercial Lease Area offshore Massachusetts. Mayflower Wind has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of an offshore wind energy facility in the Lease Area (the Project).

Mayflower Wind's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area with up to 149 total foundation locations to be occupied by a combination of up to 147 wind turbine generators (WTGs) and up to five Offshore Substation Platforms (OSPs). The Project would include two export cable corridors. One corridor would be used by multiple export cables making landfall and interconnecting to the ISO New England Inc. (ISO-NE) grid in Falmouth, Massachusetts, and the other corridor would be used by multiple export cables making landfall and interconnecting to the ISO-NE grid at Brayton Point in Somerset, Massachusetts (Figure 1-1). The Project would provide up to 2,400 MW of clean, renewable wind energy to the northeast United States, including Massachusetts, in accordance with Section 83C of the Massachusetts' Green Communities Act as added by Chapter 188 of the Acts of 2016, An Act to Promote Energy Diversity (Section 83C), which allows electric distribution companies (EDCs) to solicit proposals for offshore wind energy generation.

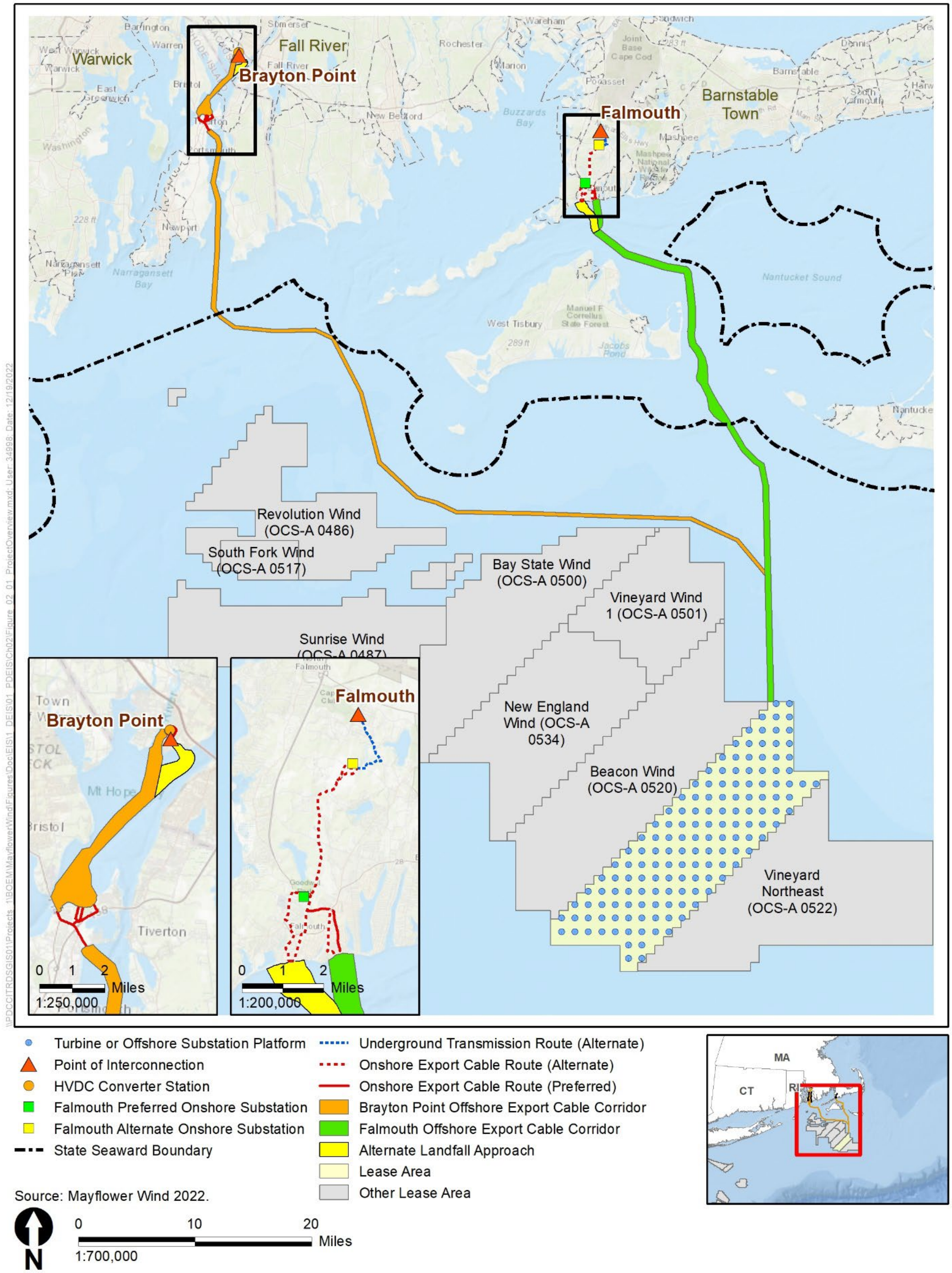

Figure 1-1. Mayflower Wind Project area

In October 2019, the EDCs selected Mayflower Wind's low-cost bid for a power purchase agreement (PPA) to generate 804 MW of offshore wind energy that will serve Massachusetts customers. In December 2021, Massachusetts awarded an additional 400 MW PPA to Mayflower Wind. The Project is intended to address the needs identified by the Massachusetts EDCs for new sources of power generation that are cost-effective and reliable, as well as to contribute to the Section 83C offshore wind mandate. In addition to the 804 MW PPA and the 400 MW PPA, Mayflower Wind is actively exploring additional offtake opportunities, including planned solicitations from other ISO-NE member states, as well as contracts with private entities.

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the OCS; EO 14008; the 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,[3] 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 Mayflower Wind's COP. BOEM will make this determination after weighing the factors in subsection 8(p)(4) of the OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which requires BOEM to make a decision on the lessee's plan to construct and operate a commercial-scale, offshore wind energy facility in the Lease Area (Proposed Action) (30 CFR 585.628).

In addition, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) received a request for authorization under the Marine Mammal Protection Act (MMPA) to take marine mammals incidental to construction activities related to the Project. NMFS's issuance of an MMPA incidental take authorization would be a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)).[4] The purpose of the NMFS action—which is a direct outcome of Mayflower Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate Mayflower Wind'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)(A and D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's EIS to support that decision and fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (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, 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). In addition, it is anticipated that a Section 408 permission will be

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[3] *FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs* | The White House https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/

[4] Under the MMPA, *take* means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 USC 1362).

required pursuant to Section 14 of the RHA (33 USC 408) for any proposed alterations that have the potential to alter, occupy, or use any federally authorized Civil Works projects. USACE considers issuance of permits/permissions under these three delegated authorities a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)). The need for the Project as provided by the applicant in COP Volume 1, Section 1.3, and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project (up to 2,400 MW) within the Lease Area to help the state of Massachusetts achieve renewable energy goals. The basic Project purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy project for renewable energy generation in Lease Area OCS-A 0521 and transmission/distribution to the New England energy grid. Appendix F, *USACE 404(b)(1) Analysis*, contains USACE's Section 404(b)(1) alternatives analysis information.

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

1.3 Regulatory Framework

The Energy Policy Act of 2005, Public Law 109-58, amended OCSLA (43 USC 1331 et seq.)[5] by adding a new subsection 8(p) that authorizes the Secretary of the Interior to issue leases, easements, and rights-of-way (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 delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under the OCSLA (30 CFR 585) were promulgated on April 22, 2009.[6] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove Mayflower Wind's COP (30 CFR 585.628).

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

[6] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009).

Subsection 8(p)(4) of OCSLA states the following:

> The Secretary shall ensure that any activity under [subsection 8(p)] is carried out in a manner that provides for:
>
> (A) safety;
>
> (B) protection of the environment;
>
> (C) prevention of waste;
>
> (D) conservation of the natural resources of the Outer Continental Shelf;
>
> (E) coordination with relevant Federal agencies;
>
> (F) protection of national security interests of the United States;
>
> (G) protection of correlative rights in the outer Continental Shelf;
>
> (H) a fair return to the United States for any lease, easement, or right-of-way under this subsection;
>
> (I) prevention of interference with reasonable uses (as determined by the Secretary) of the exclusive economic zone, the high seas, and the territorial seas;
>
> (J) consideration of:
>
> (i) the location of, and any schedule relating to, a lease, easement, or right-of-way for an area of the outer Continental Shelf; and
>
> (ii) any other use of the sea or seabed, including use for a fishery, a sealane, a potential site of a deepwater port, or navigation;
>
> (K) public notice and comment on any proposal submitted for a lease, easement, or right of-way under this subsection; and
>
> (L) oversight, inspection, research, monitoring, and enforcement relating to a lease, easement, or right-of-way under this subsection.

As stated in M-Opinion 37067, ". . . subsection 8(p)(4) of the OCSLA imposes a general duty on the Secretary to act in a manner providing for the subsection's enumerated goals. The subsection does not require the Secretary to ensure that the goals are achieved to a particular degree, and she retains wide discretion to determine the appropriate balance between two or more goals that conflict or are otherwise in tension."[7]

Section 2 of BOEM's lease form provides the lessee with an exclusive right to submit a COP to BOEM for approval. Section 3 provides that BOEM will decide whether to approve a COP in accordance with applicable regulations in 30 CFR 585, noting that BOEM retains the right to disapprove a COP based on its determination that the proposed activities would have unacceptable environmental consequences, would conflict with one or more of the requirements set forth in 43 USC 1337(p)(4), or for other reasons provided by BOEM under 30 CFR 585.613(e)(2) or 585.628(f). BOEM reserves the right to approve a COP

[7] M-Opinion 37067 at page 5, http://doi.gov/sites/doi.gov/files/m-37067.pdf.

with modifications and to authorize other uses within the leased area that will not unreasonably interfere with activities described in Addendum A, *Description of Leased Area and Lease Activities*.

BOEM's evaluation and decision on the COP are also governed by other applicable federal statutes and implementing regulations, such as NEPA and the Endangered Species Act (ESA) (16 USC 1531–1544). The analyses in this Draft EIS will inform BOEM's decision under 30 CFR 585.628 for the COP that was initially submitted to BOEM in February 2021, and later updated with new information on August 30, 2021, October 28, 2021, March 17, 2022, and December 22, 2022.

BOEM is required to coordinate with federal agencies and state and local governments and ensure that renewable energy development occurs in a safe and environmentally responsible manner. In addition, BOEM's authority to approve activities under the OCSLA extends only to approval of activities on the OCS. Appendix A, *Required Environmental Permits and Consultations,* outlines the federal, state, regional, and local permits and authorizations that are required for the Project and the status of each permit and authorization. Appendix A also provides a description of BOEM's consultation efforts during development of the Draft EIS.

1.4 Relevant Existing NEPA and Consulting Documents

BOEM previously prepared the following NEPA documents, which it used to inform preparation of this Draft EIS. The following documents are incorporated in their entirety by reference.

- Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, OCS EIS/EA MMS 2007-046 (MMS 2007).

  This programmatic EIS examined the potential environmental consequences of implementing the Alternative Energy and Alternate Use Program on the OCS and established initial measures to mitigate environmental consequences. As the program evolves and more is learned, the mitigation measures may be modified or new measures developed.

- Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts Revised Environmental Assessment, OCS EIS/EA BOEM 2014-603 (BOEM 2014).

  BOEM prepared this Environmental Assessment (EA) to determine whether issuance of leases and approval of Site Assessment Plans within areas offshore Massachusetts would have a significant effect on the environment and, thus, whether an EIS should be prepared before a lease is issued.

Additional environmental studies performed to support decisions concerning offshore wind energy development are available on BOEM's website at https://www.boem.gov/renewable-energy-research-completed-studies.

1.5 Methodology for Assessing the Project Design Envelope

Mayflower Wind would implement a Project Design Envelope (PDE) concept. This concept allows Mayflower Wind to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components, such as WTGs, foundations, submarine cables, and OSPs.

This Draft EIS assesses the impacts of the PDE that are described in the Mayflower Wind COP and presented in Appendix C, *Project Design Envelope and Maximum-Case Scenario*, by using the "maximum-case scenario" process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Draft EIS evaluates potential impacts of the Proposed Action and each alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource.[8] This Draft EIS considers the interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Appendix C explains the PDE approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area.

1.6 Methodology for Assessing Impacts

This Draft EIS also assesses past, present (ongoing), and reasonably foreseeable future (planned) actions that could occur during the life of the Project. Ongoing and planned actions occurring within the geographic analysis 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) dredging and port improvement projects; (5) marine minerals use and ocean-dredged material disposal; (6) military use; (7) marine transportation (commercial, recreational, and research-related); (8) fisheries use, management, and monitoring surveys; (9) global climate change; (10) oil and gas activities; and (11) onshore development activities. Appendix D, *Planned Activities Scenario,* describes the past and ongoing actions that BOEM has identified as potentially contributing to the existing baseline, and the planned actions 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 Baseline)

Each resource-specific environmental consequences section in Chapter 3, *Affected Environment and Environmental Consequences,* of this Draft EIS includes a description of the baseline conditions of the affected environment. The existing baseline considers past and present activities in the geographic analysis area, including those related to offshore wind projects with an approved COP (e.g., Vineyard Wind 1 and South Fork) and approved past and ongoing site assessment surveys, as well as other non-

[8] BOEM's draft guidance on the use of design envelopes in a COP is available at https://www.boem.gov/sites/default/files/renewable-energy-program/Draft-Design-Envelope-Guidance.pdf.

wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources as influenced by past and ongoing activities and trends represents the existing baseline condition for impact analysis. Other factors currently affecting the resource, including climate change, are also acknowledged for that resource and are included in the impact-level conclusion.

1.6.2 Planned Activities

It is reasonable to predict that future activities may occur over time, and that cumulatively, those activities would impact the existing baseline conditions discussed in Section 1.6.1, *Past and Ongoing Activities and Trends (Existing Baseline)*. Cumulative impacts are analyzed and concluded separately in each resource-specific environmental consequences section in Chapter 3 of this Draft EIS. The existing baseline conditions as influenced by future planned activities evaluated in Appendix D and the Proposed Action represent the sum of the cumulative impacts expected if the Project is approved. The impacts of future planned offshore wind projects are predicted using information from and assumptions based on COPs submitted to BOEM that are currently undergoing independent review.

Chapter 2

Alternatives

This chapter (1) describes the alternatives carried forward for detailed analysis in this Draft EIS, including the No Action, Proposed Action, and other action alternatives; (2) describes alternatives considered but not analyzed in detail; (3) describes the non-routine activities and low-probability events that could occur during construction, O&M, and decommissioning of the proposed Project; and (4) presents a summary and comparison of impacts among alternatives and resource affected.

2.1 Alternatives

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. The alternatives analyzed in detail were carried forward for analysis after being reviewed using BOEM's screening criteria presented in Section 2.2, *Alternatives Considered but Not Analyzed in Detail*. The alternatives carried forward for detailed analysis in this Draft EIS are summarized in Table 2-1 and described in detail in Sections 2.1.1 through 2.1.6. Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2.

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

The alternatives listed in Table 2-1 are not mutually exclusive. BOEM may "mix and match" multiple listed Draft EIS alternatives to result in a preferred alternative that will be identified in the Final EIS provided that (1) the design parameters are compatible; and (2) and the preferred alternative still meets the purpose and need.

Mayflower Wind has committed to measures as part of its Project to avoid or minimize impacts on physical, biological, socioeconomic, and cultural resources (Mayflower COP Volume 2, Table 16-1; Mayflower Wind 2022). These measures are described in Appendix G, *Mitigation and Monitoring*, and are incorporated as part of the Proposed Action and applicable action alternatives in the Draft EIS. Consultations under the MMPA, ESA Section 7, and the Magnuson–Stevens Fishery Conservation and Management Act (MSA), as well as the submission for and issuance of other necessary permits and authorizations under applicable statutes may result in additional measures or changes to these measures.

BOEM decided to use the NEPA substitution process for National Historic Preservation Act (NHPA) Section 106 purposes, pursuant to 36 CFR 800.8(c), during its review of the Project. Section 106 of the NHPA regulations, Protection of Historic Properties (36 CFR 800), provides for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. Draft avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties are presented in Appendix G. Ongoing consultation with consulting parties may result in additional measures or changes to these measures.

Table 2-1. Alternatives considered for analysis

Alternative	Description
Alternative A – No Action Alternative	Under Alternative A, BOEM would not approve the COP; the Project's construction and installation, operations and maintenance, and conceptual decommissioning would not occur; and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the applicant. The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serve as the baseline 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 are expected to occur, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario,* without the Proposed Action serves as the baseline for the evaluation of cumulative impacts.
Alternative B – Proposed Action	Under Alternative B, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore of Massachusetts would occur within the range of design parameters outlined in the Mayflower Offshore Wind COP (Mayflower Wind 2022), subject to applicable mitigation measures. The Project would have a capacity of up to 2,400 MW and would consist of up to 147 WTGs in the Lease Area, up to 5 OSPs and associated export cables. Mayflower Wind would space WTGs in a 1-by-1-nm offset grid pattern (east–west-by-north–south-gridded layout). The Project would include two export cable corridors, one making landfall and interconnecting to the power grid in Falmouth, Massachusetts, and one making landfall and interconnecting to the power grid at Brayton Point, in Somerset, Massachusetts. The export cable corridor to Brayton Point would have an intermediate landfall on Aquidneck Island, Rhode Island.
Alternative C – Fisheries Habitat Impact Minimization	Under Alternative C, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, subject to applicable mitigation measures. However, the Project would include an onshore export cable route that would avoid placing the offshore export cable in the Sakonnet River to avoid impacts on fisheries habitats. Alternative C includes two possible onshore export cable routes. • Alternative C-1: Aquidneck Island, Rhode Island Route • Alternative C-2: Little Compton/Tiverton, Rhode Island Route
Alternative D – Nantucket Shoals	Under Alternative D, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, subject to applicable mitigation measures. However, up to six WTGs (AZ-47, BA-47, BB-47, BC-47, BC-48, and BF-49) would be eliminated in the northeastern portion of the Lease Area to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals.

Alternative	Description
Alternative E – Foundation Structures	Under Alternative E, the construction and installation, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters, which includes a range of foundation types (monopile, piled jacket, suction bucket, and gravity based), subject to applicable mitigation measures. This alternative includes three foundation options, which assume the maximum use of piled (monopile and piled jacket), suction bucket, and gravity-based foundation structures to assess the extent of potential impacts from each foundation type. • Alternative E-1: Piled Foundations (monopile and piled jacket) only • Alternative E-2: Suction Bucket Foundations only • Alternative E-3: Gravity-based Foundations only
Alternative F – Muskeget Channel Cable Modification	Under Alternative F, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, subject to applicable mitigation measures. However, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use ±525kV HVDC cables connected to an HVDC converter station, instead of HVAC cables connected to offshore substations, and would only use up to 3 offshore export cables, instead of up to 5 offshore export cables.

HVDC = high voltage direct current; HVAC = high voltage alternating current

2.1.1 Alternative A – No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP. Project construction and installation, O&M, and decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the applicant. The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serve as the existing baseline against which the direct and indirect impacts from 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 the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario,* without the Proposed Action serves as the future baseline for the evaluation of cumulative impacts.

2.1.2 Alternative B – Proposed Action

The Proposed Action is to construct, operate, maintain, and eventually decommission an up to 2,400-MW wind energy facility on the OCS offshore Massachusetts within the range of design parameters described in Volume 1 of the Mayflower Wind COP (Mayflower Wind 2022) and summarized in Appendix C, *Project Design Envelope and Maximum-Case Scenario*. Mayflower Wind would consist of up to 149 structure positions to be occupied by up to 147 WTGs and up to 5 OSPs connected by inter-array cables within the Lease Area, and two offshore export cable corridors (ECCs) with landfalls at Falmouth and Brayton Point, Massachusetts and an intermediate landfall on Aquidneck Island, Rhode Island, along the corridor to Brayton Point. Onshore facilities would include landfall locations, onshore export cables, one substation, one converter station, underground transmission lines, and the utilities' points-of-interconnection (POI). Figure 2-1 presents the elements of the Proposed Action in the Mayflower Wind project area and a description of construction and installation, O&M, and decommissioning activities to be undertaken for the Proposed Action is provided in Sections 2.1.2.1 through 2.1.2.3. Refer to Volume 1 of the Mayflower Wind COP (Mayflower Wind 2022) for additional details on Project design.

2.1.2.1 Construction and Installation

The Proposed Action would include the construction and installation of both onshore and offshore facilities. Construction and installation would begin in Quarter 1 of 2024 and would be completed in Quarter 4 of 2030. Mayflower Wind anticipates initiating construction with onshore components followed by seabed preparations and concurrent construction of offshore components. An indicative project schedule that shows the timeline for construction activities for onshore and offshore project components is included in the Mayflower COP Volume 1, Chapter 3.2, Figure 3-6 (Mayflower Wind 2022) and is summarized below.

Scour Protection, Seabed Preparation, and Substructure Installation	Q1 of 2025 to Q3 of 2030
Onshore Export Cables and Onshore Substations	Q1 of 2024 to Q4 of 2030
OSP Installation and Commissioning	Q3 of 2027 to Q3 of 2029
Offshore Export Cable Installation	Q4 of 2024 to Q2 of 2029
Inter-array Cable Installation	Q2 of 2026 to Q3 of 2030
WTG Installation and Commissioning	Q2 of 2029 to Q4 of 2030

Onshore Activities and Facilities

Proposed onshore project elements include the landfall sites, the sea-to-shore transition that connects the offshore export cable to the onshore export cable, onshore export cable routes to the onshore substation and converter station, and the connection from the onshore substation and converter station to the existing grid. Appendix C describes the PDE for onshore activities and facilities, and the Mayflower COP Volume 1, Section 3.3 provides additional details on construction and installation methods (Mayflower Wind 2022). The onshore elements of the Proposed Action are included in BOEM's analysis in the EIS to support the analysis of a complete project; however, BOEM's authority under OCSLA extends only to the activities on the OCS.

Multiple landfall sites for the two offshore export cables are under consideration as part of the PDE, though only one landfall site would be needed for each export cable. Landfall at three potential locations in Falmouth, Massachusetts, and two potential locations at Brayton Point in Somerset, Massachusetts, are under consideration. Appendix B, *Supplemental Information and Additional Figures and Tables*, contains detailed maps of the Proposed Action onshore cable routes.

Three locations in Falmouth, Massachusetts, are considered feasible landfall locations for the Falmouth offshore ECC (Figure 2-2).

- **Worcester Avenue:** This landfall site would be located on a previously disturbed, off-road, grassy median strip known as Worcester Park. This location is protected by a short seawall, a broad beach, and Surf Drive.
- **Central Park:** This landfall site would occur at a public recreational park at Central Park on Falmouth Heights Beach north of Grand Avenue. This landfall site is flanked on the southern side by paved parking spaces, which could be used for construction staging.
- **Shore Street:** This landfall site would be located on Surf Drive Beach at the intersection of Surf Drive and Shore Street. This location involves the potential crossing of two existing submarine cables that make landfall at Shore Street.

Two locations at Brayton Point in Somerset, Massachusetts, are considered feasible landfall locations for the Brayton Point offshore ECC (Figure 2-3). The Brayton Point Landfall Option A approaches the former Brayton Point Power Station from the west near the Lee River. This landfall occurs on previously disturbed property adjacent to the existing cooling towers and includes an open paved area to the south, which would be used for construction staging. The Brayton Point Landfall Option B approaches the former Brayton Point Power Station from the east near the Taunton River. This landfall would occur on the previously disturbed Brayton Point property at a paved parking lot.

The offshore export cable route to Brayton Point would include an intermediate landfall on Aquidneck Island, Rhode Island, where several potential landfall locations are under consideration. The purpose of the intermediate landfall on Aquidneck Island is to avoid a narrow and highly constrained area of the Sakonnet River at the old Stone Bridge and Sakonnet River Bridge. This area is being avoided because surveying, cable installation, burial, and operation is significantly challenging. One location at the intersection of Boyds Lane and Park Avenue is being considered for the entry horizontal directional drilling (HDD) to Aquidneck Island. The export cables would exit Aquidneck Island into Mount Hope Bay following one of three cable route options (Figure 2-4). HDD exit locations under consideration include one location northeast of the Mount Hope Bridge (Route Option 1), one location in the parking lot of Roger Williams University Baypoint Residence Hall and Conference Center on Anthony Road or along an existing overhead utility line corridor (Route Option 2), and one location on the northeastern side of the Montaup Country Club golf course (Route Option 3). After exiting Aquidneck Island into Mount Hope Bay, the Brayton Point offshore ECC would then continue to make final landfall at one of the locations under consideration at Brayton Point in Somerset, Massachusetts.

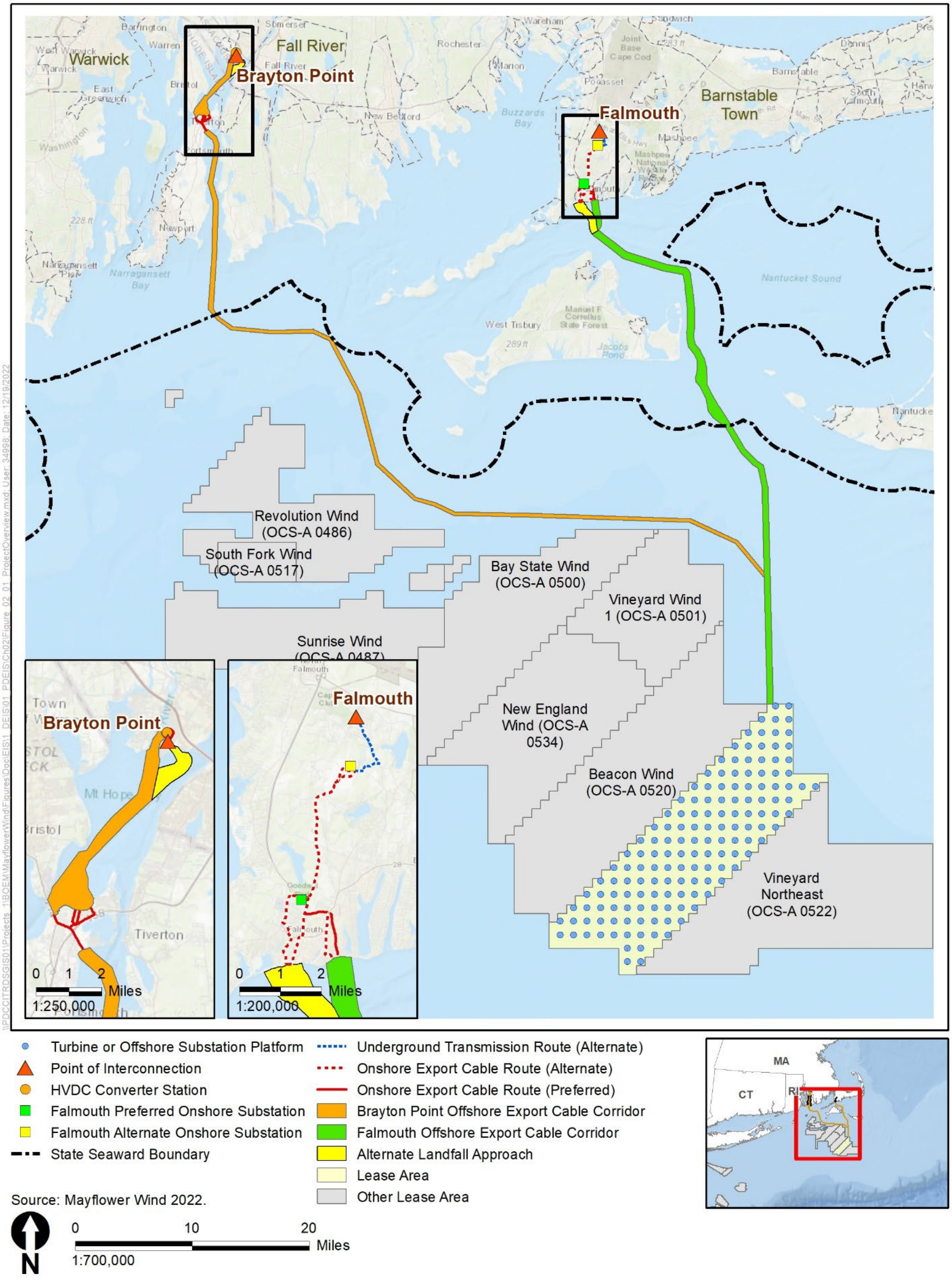


Figure 2-1. Mayflower Wind Project area

The landfall at Aquidneck Island would require HDDs at two locations: one entering and one exiting the island. For the Falmouth offshore export cable and the Brayton Point offshore export cable, it is anticipated that the cables would be unbundled at landfall. Each individual power cable would require a separate HDD with an individual bore and conduit for each power cable. If a dedicated communications cable is used, it may be installed within the same bore as a power cable but would likely require a separate conduit.

Once the offshore export cables make landfall, depending on the landfall location, the cables would either connect to the new onshore substation or converter station via the onshore cable route corridors shown on Figure 2-2 and Figure 2-3. One of the three Falmouth onshore export cable routes and one of the two Brayton Point onshore export cable routes would be used based on the landfall site selected. The Brayton Point onshore export cable would be no longer than 0.6 mile (1.0 kilometer) because of the proximity of the landfall site to the location of the new HVDC converter station. Depending on the landfall site selected and the onshore substation chosen, the Falmouth onshore export cable would be between 1.9 miles (3.0 kilometers) and 6.4 miles (10.3 kilometers).

Mayflower Wind would commission the development of a new onshore substation to transform the underground export cable for interconnection with the Falmouth POI. There are two onshore substation locations under consideration. Onshore Substation Option A (Mayflower Wind's preferred location) at the Lawrence Lynch site would be located west of Gifford Street and north of Jones Road in Falmouth, Massachusetts, on approximately 27.3 acres (11.05 hectares) of previously disturbed land. Onshore Substation Option B would be on the 33.6-acre (13.6-hectare) Cape Cod Aggregate site at the north end of Blacksmith Shop Road in Falmouth, Massachusetts. Mayflower Wind would commission the development of a new HVDC converter station to convert the Projects' HVDC power to 345-kilovolt (kV) HVAC for interconnection with the Brayton Point POI. The converter station would be located on the northern portion of the former Brayton Point Power Station site, a former coal-fired plant that was decommissioned in 2017. The maximum footprint of the converter station site would be up to 7.5 acres (3 hectares).

At Brayton Point, an underground transmission route would connect the converter station to the POI. If significant underground infrastructure from the decommissioned cooling towers prevents a suitable buried path, an overhead line to the POI may be required. In Falmouth, overhead transmission lines would connect the onshore substation to the POI. An alternate underground transmission route is also under consideration in the event overhead transmission lines are not feasible.

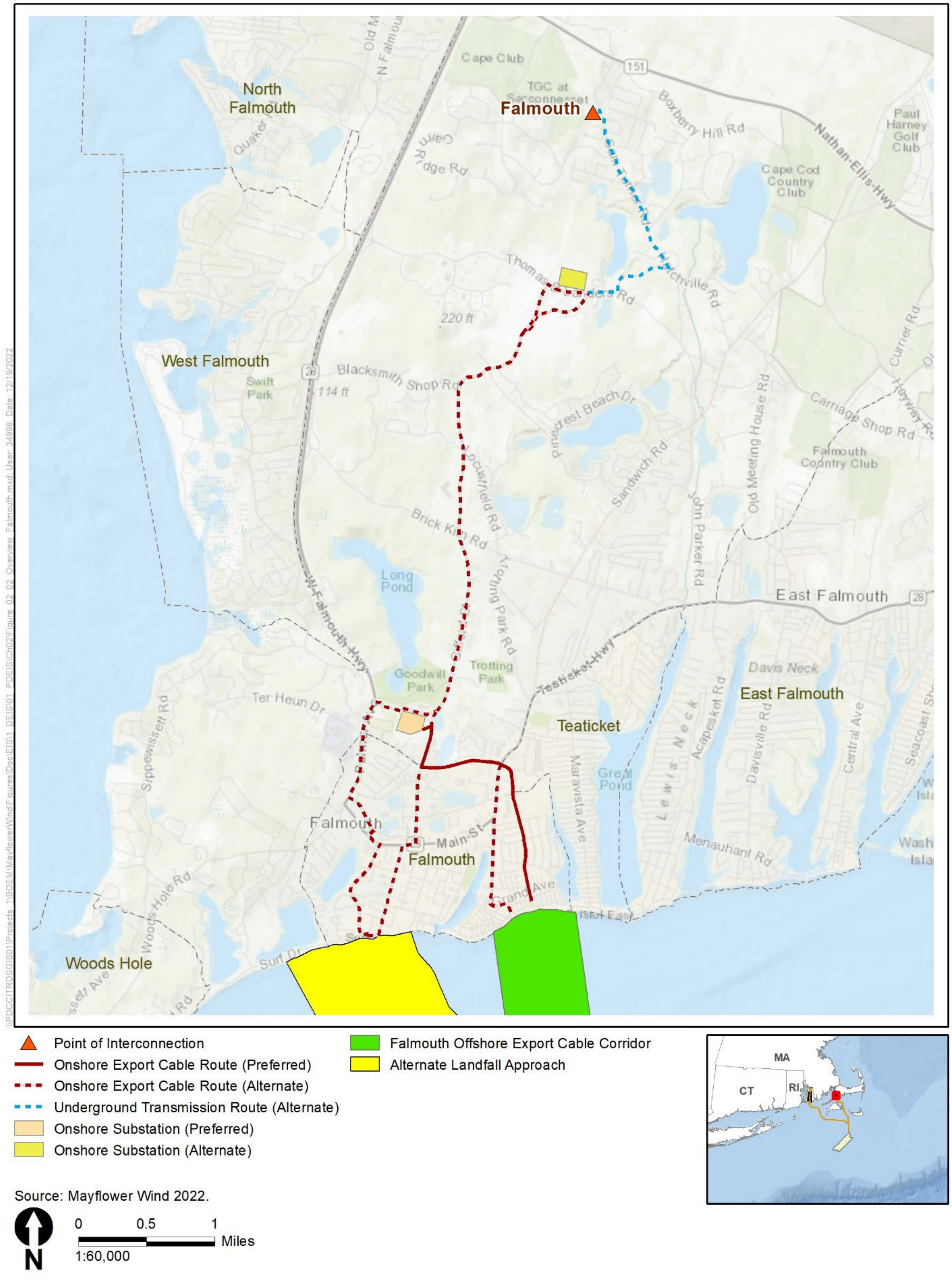


Figure 2-2. Onshore facilities for the proposed Project—Falmouth

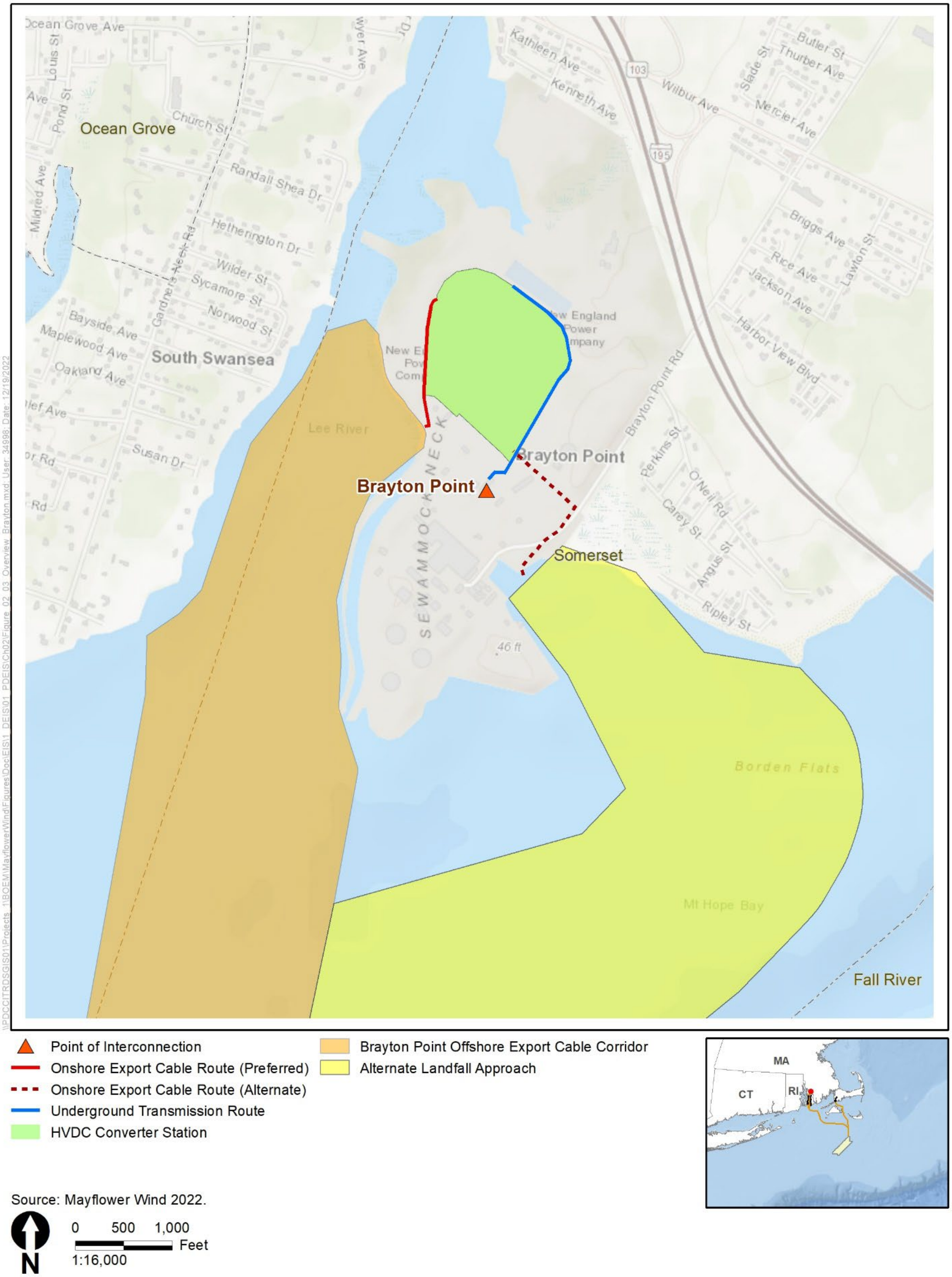
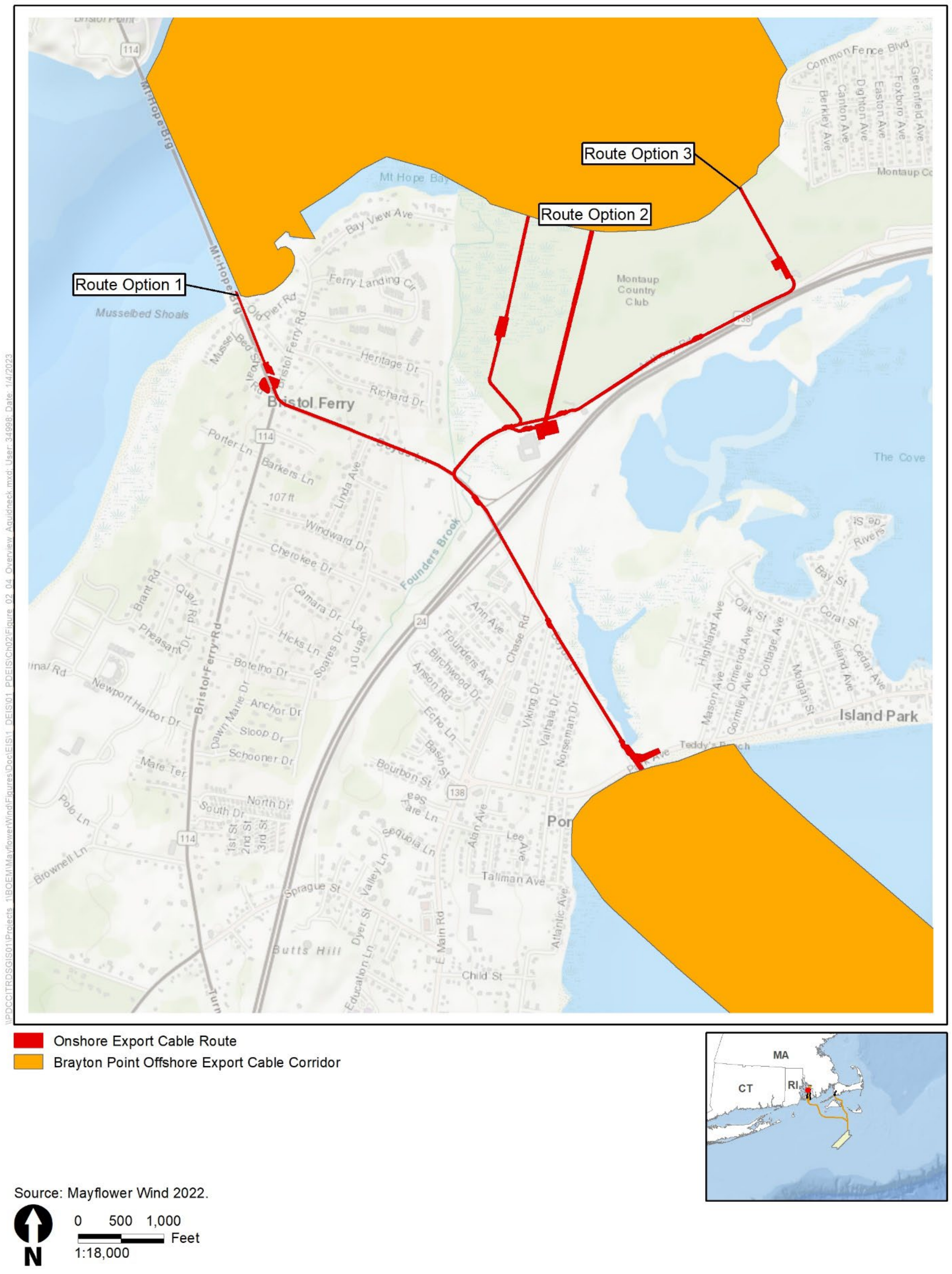


Figure 2-3. Onshore facilities for the proposed Project—Brayton Point



Source: Mayflower Wind 2022.

Figure 2-4. Onshore facilities for the proposed Project—Aquidneck Island

Offshore Activities and Facilities

The proposed offshore project components that collectively compose the Offshore Project area include WTGs, OSPs, substructures, scour protection, inter-array cables, and offshore export cables. The proposed offshore Project elements are on the OCS as defined in OCSLA, with the exception that offshore export cables within 3 nm of the shore would be in state waters (Figure 2-1). Appendix C describes the PDE for offshore activities and facilities, and the Mayflower COP Volume 1, Section 3.3 provides additional details on construction and installation methods (Mayflower Wind 2022).

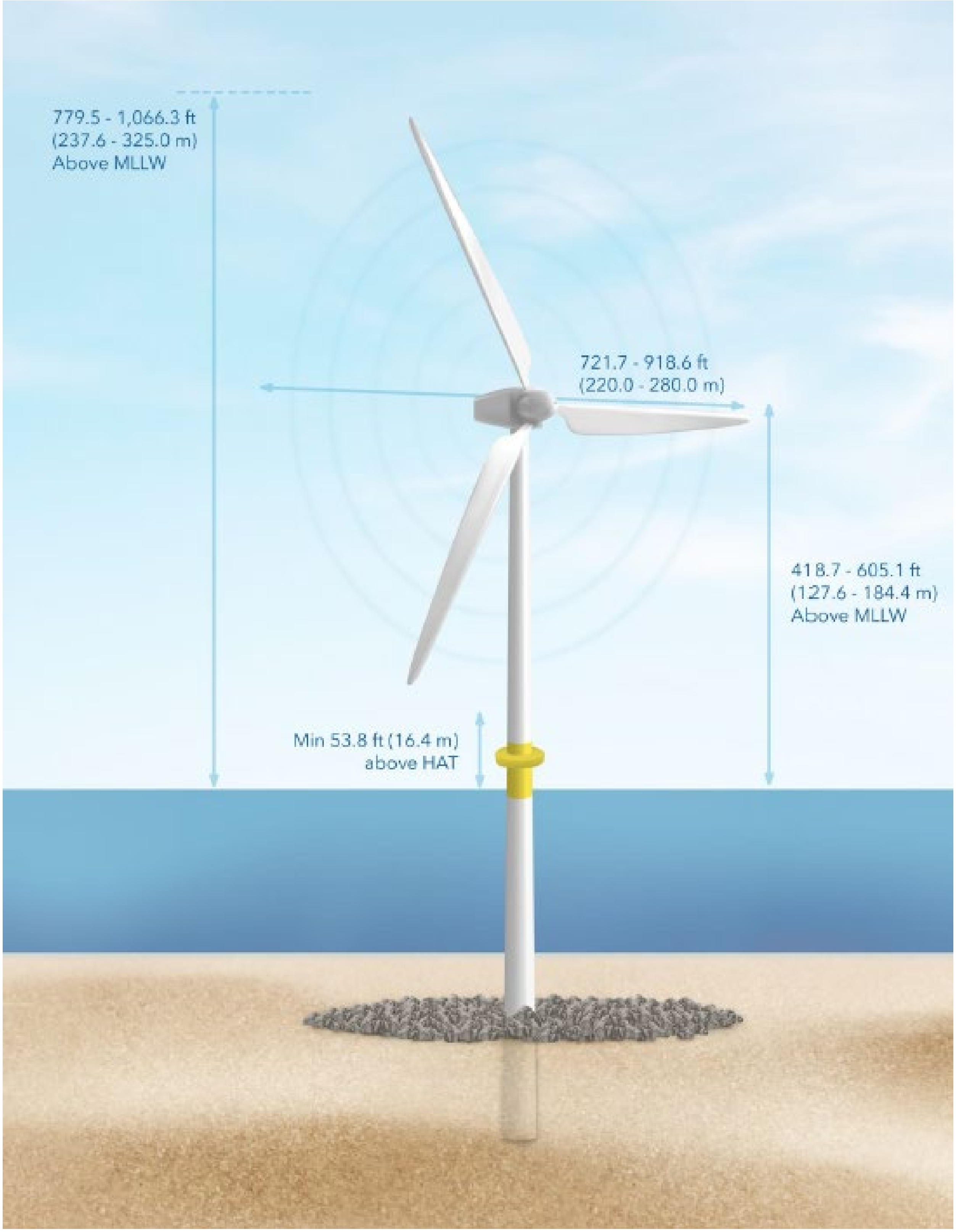
Within the 127,388-acre (51,552-hectare) Wind Farm Area, Mayflower Wind would construct up to 149 substructures that support a combination of WTGs and OSPs in a 1-by-1-nm-grid layout with east–west and north–south orientation. Mayflower Wind is considering four types of substructures: monopile, piled jacket, suction-bucket jacket, and gravity-based structure (GBS). Of these four types of substructures considered, up to two would be selected for WTGs and a third type may be selected for OSPs. Monopile foundations typically consist of a single steel cylindrical pile that is embedded into the seabed and is made up of sections of rolled steel plate welded together. A transition piece is fitted over the monopile and secured via bolts or grout. Monopiles can be used to support both the WTGs and the Option A – Modular OSP. Piled jacket structures are large lattice structures fabricated of steel tubes welded together and consist of three- or four-legged structures to support WTGs and four- to nine-legged structures to support OSPs. Suction-bucket jackets have a similar steel lattice design as the piled jacket structures, but these substructures use suction-bucket jackets instead of piles to secure the structure to the seabed. GBS foundations are typically constructed of steel, concrete, or a combination of both. Because these structures have sufficient mass and diameter, they sit on top of the sea floor and are not pile driven. The GBS foundation could be used to support WTGs or the largest OSP platforms, Option C – Direct Current (DC) Converter. Renderings of the substructure types are included in the Mayflower COP Volume 1, Section 3.3.1 (Mayflower Wind 2022).

For all substructure and foundation types, the seabed may be leveled in preparation for installation. Mayflower Wind proposes to install substructures using jack-up, dynamic positioning, or semi-submersible vessels. For monopile and piled-jacket substructures, the foundations would be driven to the target seabed penetration depths using a hydraulic impact hammer, vibratory hammer, water jetting, or combinations of all three. Pile installation procedures would use a soft-start method with a gradual increase in hammering energy levels to warn marine and avian animals, allowing them to distance themselves from the construction activity. During the installation of suction-bucket jacket substructures, the open bottom of the bucket would settle on the seabed, then water and air would be pumped out of the bucket to create a negative pressure, which embeds the foundation bucket into the seabed. Site preparation is a critical element of the overall installation of GBS and may include dredging to remove soft seabed surface layers. GBS substructures would be lowered into position through water ballasting and adding a solid ballast if required. For all substructure types, scour protection, consisting of rock, concrete mattresses, sandbags, artificial seaweed/reefs/frond mats, or self-deploying umbrella systems (typically used for suction-bucket jackets), may be applied around foundations before or after installation, if required.

Up to 147 of the 149 substructure positions in the Wind Farm Area would support WTGs. WTGs would extend up to 1,066.3 feet (325.0 meters) at the highest blade tip height with a minimum tip clearance above highest astronomical tide of 53.8 feet (16.4 meters)

The proposed Project would include up to five OSPs to collect the energy generated by the WTGs and would be located on the same 1-by-1-nm grid layout as the WTGs. OSPs help stabilize and maximize the voltage of power generated offshore, reduce potential electrical losses, and transmit energy to shore. Three OSP designs are under consideration: Option A – Modular, Option B – Integrated, Option C – HVDC Converter. Each OSP design would include a topside that houses electrical equipment and a foundation substructure to support the topside. The smallest topside structure would be Option A – Modular and would likely hold a single alternating current (AC) transformer with a single export cable. It would sit on any type of substructure design considered for the WTGs. Option B – Integrated is also an AC solution but is designed to support a high number of inter-array cable connections, as well as multiple export cable connections and would contain multiple transformers in a single topside structure. Depending on the weight of the topside structure and soil conditions, the jacket substructure may be four- or six-legged and require one to three piles per leg. Because of its larger size, if Option B is selected, a smaller number of OSPs would be required to support the proposed Project. Option C – HVDC Converter would convert electric power from HVAC to HVDC for transmission to the onshore grid system and would serve as a gathering platform for inter-array cables or be connected to one or more HVAC gathering units, which would be similar to the Modular and Integrated OSP designs. The northernmost HVDC Converter OSP will be located outside of a 6-mile (10-kilometer) buffer from the 98-foot (30-meter) isobath from Nantucket Shoals. Due to its size, the HVDC Converter OSP would be installed on either a piled jacket or GBS substructure. Inter-array cables would transfer electrical energy generated by the WTGs to the OSPs.

The WTGs and OSPs would be lit and marked in accordance with Federal Aviation Administration (FAA) and U.S. Coast Guard (USCG) lighting standards and consistent with BOEM best practices. Mayflower Wind would implement an Aircraft Detection Lighting System (ADLS) to automatically activate lights when aircraft approach. Lighting would be placed on all structures and would be visible throughout a 360-degree arc from the surface of the water. Tower marking would include unique rows and columns of letters and numbers to maximize charting effectiveness. Reflective paint and lettering materials would be used to provide visibility at night.



Source: Mayflower Wind 2022

Figure 2-5. Indicative wind turbine generator diagram

Two offshore ECCs are proposed by Mayflower Wind in the COP and presented on Figure 2-1: the Falmouth ECC and the Brayton Point ECC (Mayflower Wind 2022). The Falmouth ECC would begin from the OSPs in the Lease Area and extend northward through the Muskeget Channel, then turn northwest to the landfall site in Falmouth, Massachusetts. The Brayton Point ECC would start from the OSPs within the Lease Area and extend northwest through the Rhode Island Sound to the Sakonnet River. It would then extend northward until making intermediate landfall on Aquidneck Island in Portsmouth, Rhode Island, for a brief underground onshore export cable route section before entering into Mount Hope Bay and finally to the landfall at Brayton Point. The Falmouth ECC would use either HVAC or HVDC transmission technology and would have transmission export circuits that would consist of up to four power cable circuits and up to one associated communications cable. The Brayton Point ECC would use HVDC transmission technology and would use six single-core power cables with a voltage of up to ±320 kV and up to two associated communications cables. For HVAC transmission, one end of the transmission system would be the OSPs in the Lease Area that would step up the power from the WTG array to a voltage appropriate for long distance transmission. An HVDC system requires converters at each end of the transmission circuit, with one located on the OSPs in the Lease Area and the other converter station located at Brayton Point in Somerset, Massachusetts.

Inter-array cables and the export cables would be installed similarly. Prior to installation, the area would be surveyed, and the seafloor would be prepared by removing boulders and buried hazards if applicable. Depending on the survey findings and seabed conditions, several preparation and installation methods and equipment may be used including a vertical injector, a jetting sled, jetting remotely operated vessel (ROV), pre-cut plow, mechanical plowing, mechanical cutting ROV system and anchoring. More information on cable installation methods can be found in the Mayflower COP Volume 1, Section 3.3.5.4 (Mayflower Wind 2022). Cable protection would be required at any cable crossing locations and for areas where cable burial depth cannot be achieved. Cable protection methods such as the creation of a rock berm, concrete mattress placement, rock placement, and fronded mattresses may be used.

2.1.2.2 Operations and Maintenance

The proposed Project is anticipated to have a commercial lifespan of 35 years.[1] The location of the O&M facility has not been finalized; however, Mayflower Wind is considering facilities at one of the Massachusetts-based marshalling ports used during construction and installation. The O&M facility would have trained staff, office space, and a warehouse for spare parts.

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[1] Mayflower Wind's lease with BOEM (Lease OCS-A 0521) has an operational term of 33 years that commences on the date of COP approval. (https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/MA/Lease-OCS-A-0521.pdf; see also 30 CFR 585.235(a)(3).) Mayflower Wind would need to request an extension of its operational term from BOEM in order to operate the proposed Projects for 35 years. For the purposes of maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, the Draft EIS analyzes a 35-year operational term.

The proposed Project would include a comprehensive maintenance program, including preventative maintenance based on statutory requirements, original equipment manufacturers' guidelines, and industry best practices. Mayflower Wind would inspect WTGs, OSPs, foundations, interarray cables, submarine and onshore export cables, and other parts of the proposed Projects using methods appropriate for the location and element. Additionally, Mayflower Wind would maintain an Oil Spill Response Plan (OSRP), an Incident Management Plan, and a Safety Management System. These plans would be in place before construction and installation activities begin and would be reviewed and approved by BOEM and the Bureau of Safety and Environmental Enforcement (BSEE).

Onshore Activities and Facilities

The onshore substation and converter station would be designed to serve as unmanned stations and would not have an operator onsite during typical operation. However, the substation and converter station would be inspected regularly and may require routine maintenance activities such as replacing or updating electrical components or equipment. The onshore export cables and the underground transmission cables would require periodic testing but should not require maintenance unless there is a failure.

Offshore Activities and Facilities

Routine maintenance is expected for WTGs, OSPs, and substructures. Mayflower Wind would conduct annual maintenance of WTGs, including safety surveys and inspections for signs of wear on WTG components (Mayflower COP Volume 1, Table 3-9; Mayflower Wind 2022). Routine inspections and maintenance of switchgear and other equipment would occur annually at OSPs. Substructures would be inspected every 2 years for damage to the substructure, cracks at welds, excessive marine growth, signs of corrosion, and seabed scour. The offshore export cables would not be expected to require regular maintenance, except for manufacturer-recommended cable testing.

Mayflower Wind would use vessels, remote-sensing equipment, vehicles, and aircraft during the O&M activities described above. The Project would use a variety of vessels to support O&M including crew-transfer vessels, service operation vessels, anchor-handling tugs, and jack-up vessels. In a year, the Proposed Action would generate a maximum of 100 crew-transfer vessel trips, 1 jack-up vessel trip, and 24 supply vessel trips; and a maximum of 250 helicopter trips (Mayflower COP Volume 1, Section 3.3.14.2, Table 3-23; Mayflower Wind 2022). Additional vessels/vehicles may be used as needed (e.g., ROV for inspections/repairs).

2.1.2.3 Decommissioning

Under 30 CFR 585 and commercial Renewable Energy Lease OCS-A 0521, Mayflower Wind would be required to remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seabed of all obstructions created by the proposed Project. All foundations would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)). Absent permission from BOEM, Mayflower Wind would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed. Mayflower Wind has submitted a conceptual decommissioning plan as part of the COP, and the final decommissioning application would outline Mayflower Wind's process for managing waste and recycling proposed Project components (Mayflower COP Volume 1, Section 3.3.19; Mayflower Wind 2022). Although the proposed Project is anticipated to have an operational life of 35 years, it is possible that some installations and components may remain fit for continued service after this time. Mayflower Wind would have to apply for and be granted an extension if it wanted to operate the proposed Project for more than the 33-year operations term stated in its lease.

BOEM would require Mayflower Wind to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease, 90 days after completion of the commercial activities on the commercial lease, or 90 days after cancellation, relinquishment, or other termination of the lease (30 CFR 585.905). Upon completion of the technical and environmental reviews, BOEM may approve, approve with conditions, or disapprove the lessee's decommissioning application. This process would include an opportunity for public comment and consultation with municipal, state, and federal management agencies. Mayflower Wind would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed Project. Approval of such activities would require compliance under NEPA and other federal statutes and implementing regulations.

If the COP is approved or approved with modifications, Mayflower Wind would have to submit a bond (or another form of financial assurance) prior to installation that would be held by the U.S. government to cover the cost of decommissioning the entire facility in the event that Mayflower Wind would not be able to decommission the facility.

Onshore Activities and Facilities

At the time of decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. Onshore export and transmission cables would likely be retired in place; however, if removal would be required, the cables would be pulled out of the transition vault and duct banks and sent to repurposing or recycling facilities. Depending on the needs at the time, the onshore facilities would be left in place for possible future use or demolished and materials recycled.

Offshore Activities and Facilities

For both WTGs and OSPs, decommissioning is anticipated to be the reverse of construction and installation, with turbine components or the OSP topside structure removed prior to foundation removal. Foundations that penetrate the seabed would be cut 15.0 feet (4.6 meters) below the mudline in accordance with 30 CFR 595.910 or may be removed completely. Mayflower Wind would assess the removal of scour protection and select a strategy that minimizes environmental impacts. Decommissioning of the topside structures for WTGs and offshore substations would include removal of all WTG components including removal of the rotor, nacelle, blades and tower and removal of the OSPs' topside structures. Materials would be brought onshore for recycling and disposal. Inter-array cables and offshore export cables may be retired in place or extracted from the seabed via dredging vessels.

2.1.3 Alternative C – Fisheries Habitat Impact Minimization

Alternative C was developed through the scoping process for the Draft EIS in response to comments received from NMFS and other agencies expressing concern with the potential impact of the offshore export cable on fisheries, Essential Fish Habitat (EFH), and Habitat Areas of Particular Concern (HAPC) in the Sakonnet River. The Sakonnet River supports EFH for 16 fish species and has HAPCs for Summer flounder and Atlantic Cod. To address this concern, BOEM developed onshore cable route options that would avoid placing the Offshore Export Cable in the Sakonnet River. Under this alternative, the construction, O&M, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, subject to applicable mitigation measures. BOEM worked with Mayflower Wind to identify feasible onshore cable routes to avoid the Sakonnet River and identified two onshore route alternatives as described below and shown on Figure 2-6. Appendix B contains detailed maps of the Alternative C onshore cable routes.

Alternative C-1: Aquidneck Island, Rhode Island Route (Figure 2-6). The onshore export cables would generally be located within existing public road ROW along the following described routes. Cable would primarily be placed in road shoulders and medians but may also include off-road areas such as private property and transmission line ROWs, and could involve crossings of streams, wetlands, and other sensitive areas. Alternative C-1 runs the length of Aquidneck Island with two variations, but ultimately traveling along Route 138. Alternative C-1 would make landfall at the Second Beach parking lot in Middletown, Rhode Island, via HDD under the municipal public beach from Sachuest Bay. From the landfall, Alternative C-1 would proceed inland through Middletown via a western variation or eastern variation before reaching Route 138. From landfall, the western variation would proceed along Hanging Rock Road, Paradise Avenue, Berkley Avenue, Wyatt Road, Turner Road and Route 138 (to Mitchell's Lane) (4.1 mile total distance). The eastern variation would proceed along Hanging Rock Road, Third Beach Avenue, and Mitchell's Lane before reaching Route 138 (4 mile total distance). Both segments pass by wetlands, parks, and reserves, and both segments pass through natural heritage areas. The eastern variation abuts more reserves and natural heritage areas than the western variation. The roadways along the variants are predominately local, two-lane roads without paved shoulders. The roads are frequently abutted by old stone walls, large trees with canopies overhanging the road, and overhead utility poles. The western variation has slightly wider road widths and more developed surroundings.

The western and eastern variations rejoin at the intersection of Route 138 and Mitchell's Lane, continuing north on Route 138 into Portsmouth (4.5 miles). Route 138 is a four-lane road without paved shoulders, abutted by commercial properties and residences. When the route reaches Boyd's Lane, it follows the same route as the Proposed Action to Brayton Point (Figure 2-4). Alternative C-1 would reduce the total offshore export cable route by 9 miles (14 kilometers) and increase the total onshore export cable route by 9 miles (14 kilometers).

Alternative C-2: Little Compton/Tiverton, Rhode Island Route (Figure 2-6). Alternative C-2 would make landfall on the ocean facing side of Breakwater Point, in the parking lot across from the Sakonnet Harbor. The area is constrained, with the parking lot separated from water by only a narrow strip of riprap coast. The surface grades may not allow for sufficient HDD burial depth in the approach to the onshore entry pit. From Breakwater Point the route follows Route 77 through Little Compton and into Tiverton; once in Tiverton, the route turns east onto Route 177 to Fish Road (12.9 miles total). From this point, Alternative C-2 would follow Fish Road (north) to Souza Road (west), which turns into Schooner Drive (2.9 miles total). Both Route 77 and Route 177 are two-lane roads with minimal paved shoulders. Fish Road and Souza Road are both narrow two-laned roads without paved shoulders. Schooner Drive is the access road to the residential Village at Mount Hope Bay and Boat House Waterfront Dining restaurant. Schooner Drive ends at the bottom of a hill, where there is an open area with a cul-de-sac that could serve as the onshore HDD installation area for cable entrance into Mount Hope Bay. Schooner Drive also includes a bridge over an abandoned railroad right-of-way, which would require a trenchless installation method. Alternative C-2 would reduce the total offshore export cable route by 12 miles (19 kilometers) and increase the total onshore export cable route by 13 miles (21 kilometers). Similar to Alternative C-1, Alternative C-2 would be located mostly in road ROWs but may also cross private property and transmission and railroad ROWs.

2.1.4 Alternative D – Nantucket Shoals

Alternative D was developed through the scoping process for the Draft EIS to address potential impacts on protected species in the northeastern portion of the Lease Area. Following installation of foundations, a commenter speculated that the presence of WTGs in the northeastern portion of the Lease Area may alter the foraging habitat associated with the physical hydrodynamic features along the western edge of Nantucket Shoals. However, modeling of the full build out of the entire southern New England lease areas indicates that minor, local changes to the physical hydrodynamic features may occur on the western side of Nantucket Shoals adjacent to the BOEM lease areas (Johnson et al. 2021). Based on best available science, BOEM believes there is a lack of conclusive evidence that the removal of proposed turbine locations in the northeastern portion of the Lease Area would measurably lessen these minor impacts on the hydrodynamic features. If the potential hydrodynamic effects are consistent with the modeling of the southern New England lease areas and other hydrodynamic studies of wind facilities in the North Sea, the effects would be local to the immediate vicinity of the turbine array and not extend to Nantucket Shoals. If the potential hydrodynamic effects are as extensive as potential wind wakes that could extend tens of kilometers under stable conditions, which has not been demonstrated, then the removal of turbines would not remove this potential range of effects from extending far enough from the turbine array to overlap with Nantucket Shoals. Nonetheless, Nantucket Shoals is an area of high productivity with higher abundances of amphipods, chlorophyll, birds, and North Atlantic right whale (NARW) (Figure 2-7). Nantucket Shoals has high foraging value for several species, including NARW at different times of the year as well as seabirds and seaducks. Consequently, BOEM has developed this alternative to address the environmental concern that wildlife may be subject to increased impacts in this area. Under Alternative D, up to six WTGs (AZ-47, BA-47, BB-47, BC-47, BC-48, and BF-49) in the northeastern portion of the Lease Area would be eliminated to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals (Figure 2-7).

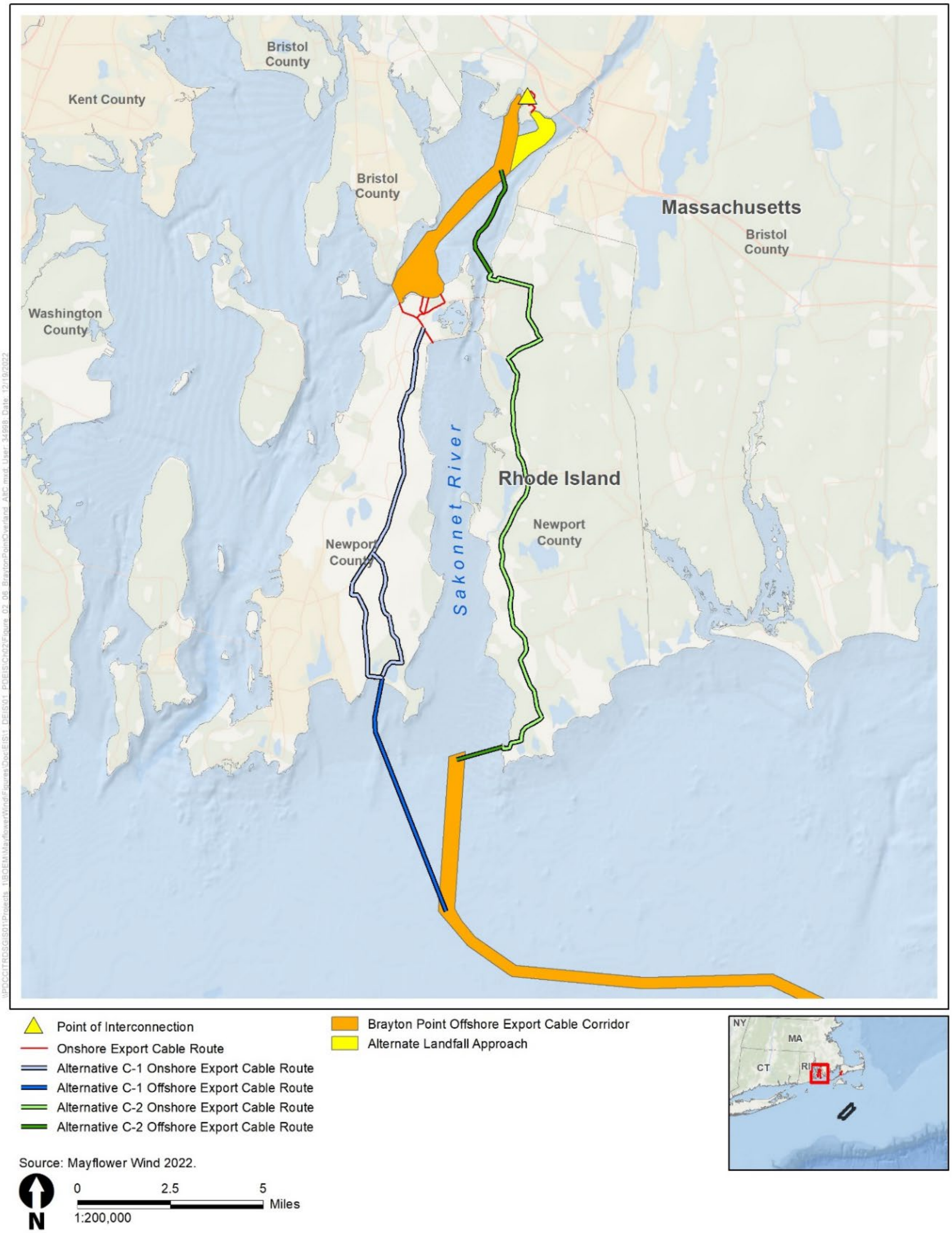


Figure 2-6. Alternative C fisheries habitat impact minimization

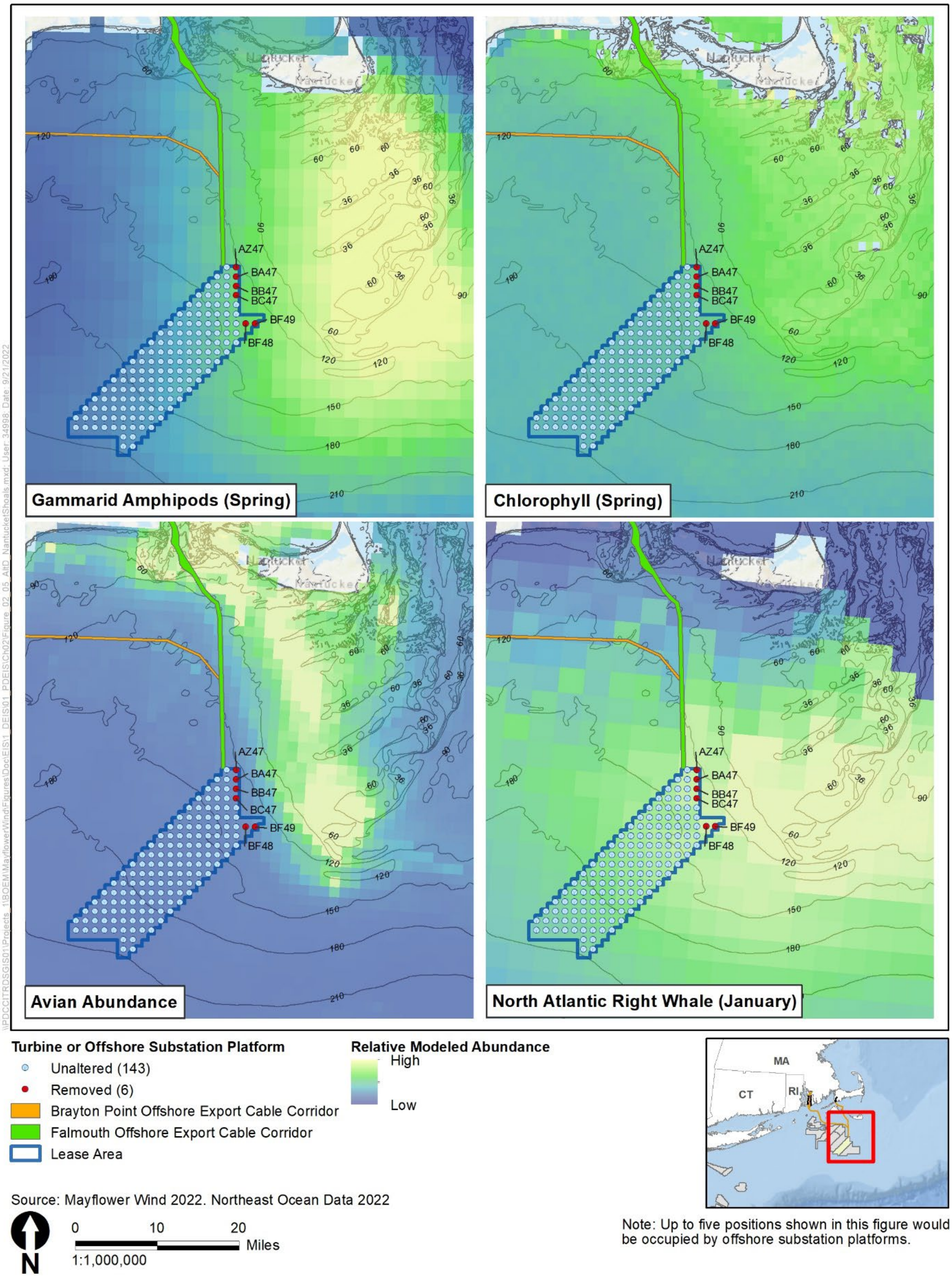


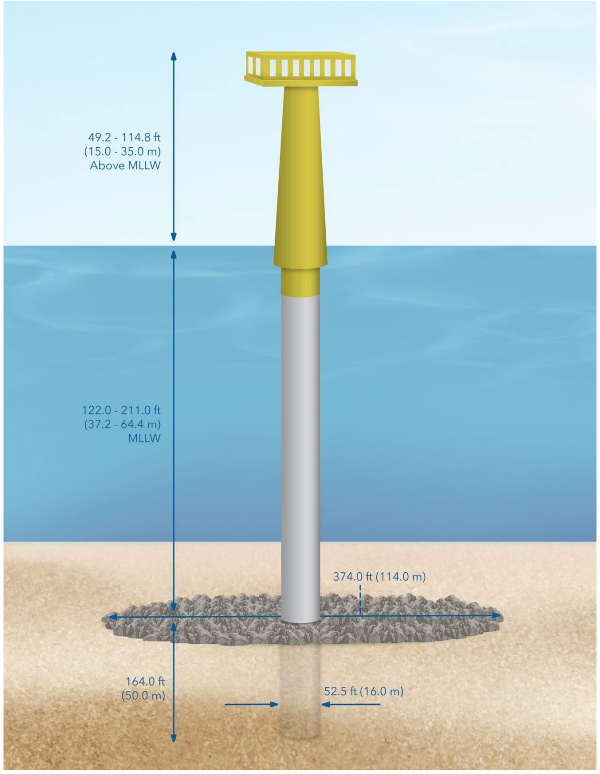
Figure 2-7. Alternative D Nantucket Shoals—elimination of six WTGs

2.1.5 Alternative E – Foundation Structures

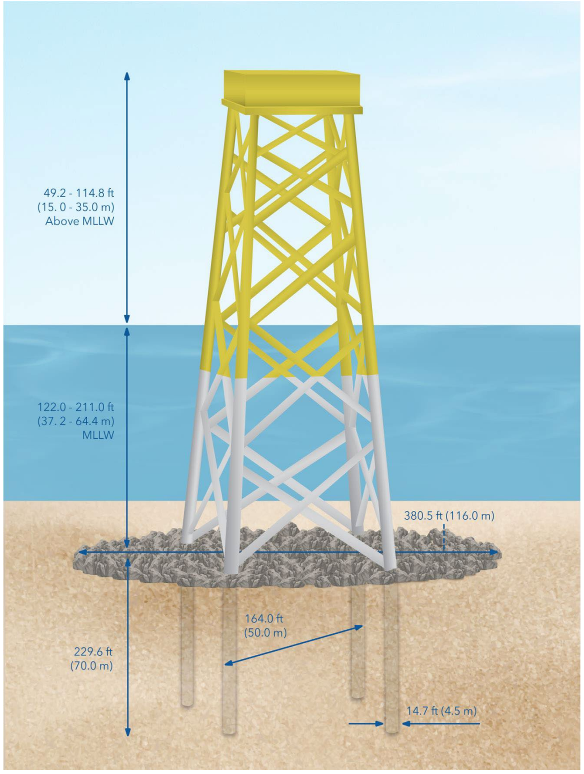
Alternative E was developed through the scoping process for the Draft EIS to address options posed in the Mayflower Wind COP and in response to comments received from multiple commenters on construction noise related to foundation installation. Alternative E addresses the possibility for one or more foundation types to be utilized for WTGs and OSPs and includes three sub-alternatives which detail the different foundation structures. This EIS analyzes the maximum potential impacts on each environmental resource from each type of foundation: piled (monopile and piled jacket), suction bucket, and GBS foundations. A representation of the impacts that could occur given the choice of foundation type per project can be found in Table 2-2. The table looks at the maximum extent of how each foundation type could affect a resource.

2.1.5.1 Alternative E1 – Piled Foundations

Under this alternative, the use of 149 monopile and/or piled jacket foundation structures (Figure 2-8) to support up to 147 turbines and up to 5 OSPs would be analyzed for the extent of impacts.



Monopile Foundation



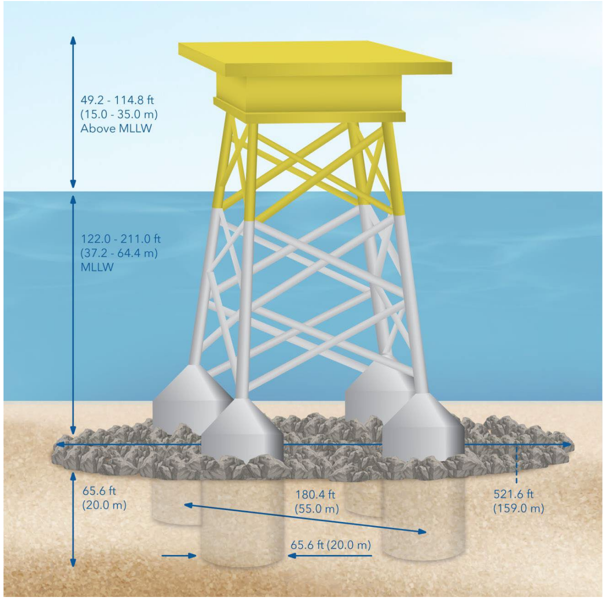
Piled Jacket Foundation

Source: Mayflower Wind 2022

Figure 2-8. Piled foundations

2.1.5.2 Alternative E2 – Suction Bucket Foundations

Under this alternative, the use of 149 suction bucket foundation structures (Figure 2-9) to support up to 147 turbines and up to five OSPs would be analyzed for the extent of impacts.

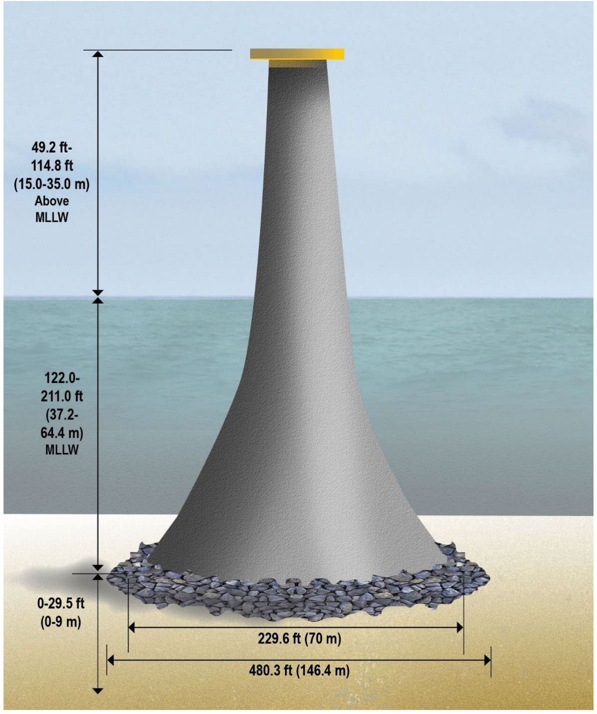


Source: Mayflower Wind 2022

Figure 2-9. Suction bucket foundations

2.1.5.3 Alternative E3 – Gravity-Based Structure Foundations

Under this alternative, the use of 149 GBS foundations (Figure 2-10) to support up to 147 turbines and up to five OSPs would be analyzed for the extent of impacts.



Source: Mayflower Wind 2022

Note: Indicative diagram of single-footed GBS Substructure

Figure 2-10. Gravity-based structure foundations

Table 2-2. Resource effects by foundation type

Resource Effect	Foundation Types		
	Monopile and Piled Jacket	Suction Bucket Jackets	Gravity-based Structures
Structures	149 structures (up to 147 WTGs and 5 OSPs)	149 structures (up to 147 WTGs and 5 OSPs)	149 structures (up to 147 WTGs and 5 OSPs)
Habitat Loss: • Species displacement and/or mortality • Soft bottom habitat loss	Foundations will be positioned to avoid areas of sensitive seafloor and benthic habitat to the extent practicable. However, habitat conversion would occur due to the number of foundations and scour protection. Maximum permanent footprint area (foundation and scour protection) per WTG of 2.61 acres and per OSP of 9.79 acres.	Soft bottoms may be removed during seabed preparation. Maximum permanent footprint area (foundation and scour protection) per WTG or OSP of 4.9 acres.	Greatest area of habitat conversion. Maximum permanent footprint area (foundation and scour protection) per WTG of 11.55 acres and per OSP of 10.9 acres.
Artificial Reefs: • Introduction of organisms that grow on the surfaces of foundations • Increased food source and source of prey	Increased aggregation of fish near structures; more opportunities around piled jackets than monopiles. The amount of scour protection present may also increase aggregation.	Similar to the piled jacket, the suction bucket jacket provides an increased area for aggregation.	Similar to the piled jacket, GBS would provide an increased opportunity for aggregation.
Invasive Species Spread Effects Introduction of invasive species	Impacts may be widespread and permanent where the species are able to establish populations. Colonization would be limited to the surface area of the foundation and scour protection.	Similar risk to the monopile and piled jacket but with increased surface area associated with foundation legs and area of scour protection.	Larger risk given the increased surface area of the foundations and sour protection.

Resource Effect	Foundation Types		
	Monopile and Piled Jacket	Suction Bucket Jackets	Gravity-based Structures
Wake and Scour: • Increased concentration and/or availability of prey in wakes • Altered conditions can affect recruitment of larvae of benthic species, suspended sediment concentration, availability of food, oxygen, and waste removal.	Maximum permanent footprint area (foundation and scour protection) per WTG of 2.61 acres and per OSP of 9.79 acres.	Maximum permanent footprint area (foundation and scour protection) per WTG or OSP of 4.9 acres.	Maximum permanent footprint area (foundation and scour protection) per WTG of 11.55 acres and per OSP of 10.9 acres.
Release of Suspended Sediment and Sediment Deposition: • Decreased water quality due to increased suspended sediment • Smothering of species and habitats by deposited sediment • Avoidance of area by species due to increase sediments • Changes in organic matter content in sediments associated with sediment particle size • Exposure to toxic contaminants within sediment	Some seabed preparation may be required especially if seabed is not sufficiently level. In addition to permanent foundation and scour protection, an additional 0.5 acre of temporary seabed disturbance per foundation.	Some seabed preparation may be required especially if seabed is not sufficiently level. In addition to permanent foundation and scour protection, an additional 0.6 acre of temporary seabed disturbance per foundation.	Seabed preparation is required and may include rock layer/scour protection and dredging. In addition to permanent foundation and scour protection, an additional 1.0 acre of temporary seabed disturbance per WTG foundation and 1.5 acre per OSP foundation.
Attraction: • Refuge/resting areas for sheltering from currents and/or predation • Increased prey availability due to artificial reef effect and wake effect • Increased predation rates due to higher predator abundance	Much like the effect of artificial reefs, foundation structures could have a beneficial effect on local bird populations due to consequent increases in fish aggregations near structures	Similar to the effect of artificial reefs.	Similar to the effect of artificial reefs.

Resource Effect	Foundation Types		
	Monopile and Piled Jacket	**Suction Bucket Jackets**	**Gravity-based Structures**
Avoidance Effects: • Displacement of species from the Wind Farm Area • Disruption of migration routes	During installation, there may be temporary displacement of species in the area. See *Acoustic* below for installation timeframes.	Similar to the monopile and piled jacket, but the temporary displacement may be more related to the scour protection installation	Similar to the monopile and piled jacket, but the temporary displacement may be more related to the scour protection installation
Acoustic: • Mortality or physical injury from noise • Behavioral alterations like startling, fleeing, or hiding • Masking of biologically significant sounds	During the installation, activities that create noise and vibrations may harm or displace marine animals, birds, benthic invertebrates, and finfish. Impact pile driving for piled jacket foundations would occur for 2 hours per foundation with a maximum of 8 piles installed per day. Impact pile driving for monopile would occur for 4 hours per foundation with a maximum of 2 piles installed per day.	Sounds related to the construction, O&M, and decommissioning of the Project are expected to be much less than impulsive pile driving	Sounds related to the construction, O&M, and decommissioning of the Project are expected to be much less than impulsive pile driving.

2.1.6 Alternative F – Muskeget Channel Cable Modification

Alternative F was developed to minimize impacts on complex habitats and reduce seabed disturbance in the Muskeget Channel east of Martha's Vineyard in response to concerns from NMFS. Under Alternative F, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the Mayflower Wind COP, subject to applicable mitigation measures. However, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use ±525kV HVDC cables connected to one HVDC converter OSP, instead of HVAC cables connected to one or more HVAC OSPs as proposed under the Proposed Action. The OSP design for the offshore export cables connecting to Brayton Point would remain unchanged from the Proposed Action. As a result, there would be two HVDC converter OSPs under Alternative F – one HVDC converter OSP for Brayton Point and one HVDC converter OSP for Falmouth. In addition, Alternative F would use up to three offshore export cables to Falmouth, instead of up to five offshore export cables under the Proposed Action.

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 DOI has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action" (43 CFR 46.420(b). There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental effects of the project (43 CFR 46.415(b)). Therefore, alternatives that could not be implemented if they were chosen (for legal, economic, or technical reasons), or do not resolve the need for action and fulfill the stated purpose in taking action to a large degree, are not considered reasonable.

BOEM considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies and through public comment received during the public scoping period for the EIS. BOEM evaluated the alternatives described in Table 2-3 and excluded them from further consideration because they did not meet the purpose and need or did not meet the screening criteria (listed below). 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), DOI regulations at 43 CFR 46.420(b)-(c), and BOEM's process for identifying alternatives for environmental reviews of offshore wind COPs pursuant to NEPA.[2]

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[2] See BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act,* published June 22, 2022, and available at: https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEM%20COP%20EIS%20Alternatives-2022-06-22.pdf.

An alternative would be considered but not analyzed in detail if it meets any of the following criteria.

- It does not respond to BOEM's purpose and need.
    - It results in activities that are prohibited under the lease (e.g., requiring locating part, or all, of the wind energy facility outside of the Lease Area, or constructing and operating a facility for another form of energy).
    - It is inconsistent with the federal and state policy goals below:
        - The United States' policy under the OCSLA to make OCS energy resources available for the expeditious and orderly development, subject to environmental safeguards.
        - Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, issued on January 27, 2021.
        - The shared goal of the Departments of Interior, Energy, and Commerce to deploy 30 GW of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use.
        - The goals of affected states, including state laws that establish renewable energy goals and mandates, where applicable.
    - It is inconsistent with existing law, regulation, or policy; a state or federal agency would be prohibited from permitting activities required by the alternative.
- It does not meet most of the goals of the applicant.[3]
    - It proposes relocating a majority of the Project outside of the area proposed by the applicant.
    - It results in the development of a project that would not allow the developer to satisfy contractual offtake obligations.
- There is no scientific evidence that the alternative would avoid or substantially lessen one or more significant socioeconomic or environmental effects of the Project.
- It is technically infeasible or impractical, meaning implementation of the alternative is unlikely given past and current practice, technology, and/or site conditions as determined by BOEM's technical experts.
- It is economically infeasible or impractical, meaning implementation of the alternative is unlikely due to unreasonable costs as determined by BOEM's technical and economic experts.
- It is environmentally infeasible, meaning implementation of the alternative would not be allowed by another agency from which a permit or approval is required, or implementation results in an obvious and substantial increase in impacts on the human environment that outweighs potential benefits.

[3] For a project without an existing offtake agreement, BOEM should determine whether the project is currently being reviewed as part of a competitive offtake award, or whether it plans to compete for an award during the EIS development, and identify the minimum nameplate capacity required to remain eligible for these awards. This minimum nameplate capacity may be used as an applicant's primary goal.

- The implementation of the alternative is remote or speculative, or it is too conceptual in that it lacks sufficient detail to meaningfully analyze impacts; or there is insufficient available information to determine whether the alternative is technically feasible.
- It has a substantially similar design to another alternative that is being analyzed in detail.
- It would have a substantially similar effect as an alternative that is analyzed in detail.

Table 2-3. Alternatives considered but not analyzed in detail

Alternative Dismissed	Justification for Dismissal
Generating Capacity	
WTG generation capacities that analyze different deployment ranges of WTG MW generation capacities	One commenter requested that BOEM analyze different deployment ranges of WTG MW generation capacities to potentially reduce project impacts. This alternative is not practicable or economically feasible. Selection of WTG design(s) with specific nameplate capacities cannot be deferred until the ROD under the current market conditions. Specifically, waiting until the ROD is issued for the government to decide whether to select a turbine capacity for Phase 1 of the Project would delay final Phase 1 project design and engineering by at least a year.[1] This delay would put the commercial viability of the entire Project at significant risk by restricting Mayflower Wind'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. Moreover, the generation capacities of the selected WTGs must also be able to meet Mayflower Wind's 1,275 MW in existing offtake agreements for Phase 1 by the deadlines incorporated into those agreements. In order to meet its Massachusetts PPA obligations to deliver power in Quarter 3 of 2027, Mayflower Wind is currently engaged with original equipment manufacturers to select WTG models that can be manufactured and installed on this timeline. In sum, Mayflower Wind cannot delay the selection of a WTG for Phase 1 until after the ROD because it would render their entire proposal economically infeasible. Notably, BOEM's analysis of the Project includes a review of the PDE included in the Mayflower Wind COP, which describes a range of potential design options for WTGs. The EIS assesses the impacts of the reasonable range of designs described using a "maximum-case scenario" that considers the PDE parameters (or combination of parameters) that represent the greatest effect for an individual impact for each environmental resource.
Wind Turbine Array Layout	
Transit lanes through Lease Area for safe and efficient access through the Massachusetts and Rhode Island Wind Energy Areas, including from Long Island ports to fishing grounds	BOEM's navigation subject matter expert considered proposed transit lane alternatives proposed by the New York Department of State and the Responsible Offshore Development Alliance (RODA) and found that transit lanes would cause funneling of vessel traffic and create choke points and intersections, leading to denser traffic with no associated vessel transit or navigational safety benefit. Furthermore, BOEM determined that the presence of these lanes would likely create a conflicting use scenario, regardless of corridor width and layout. Therefore, BOEM did not identify any other alternatives to the proposed lanes proposed by the commenters that would meet the navigational needs identified by the commenters. Additionally, the 1-by-1-nm grid layout included in the Mayflower Wind COP is consistent with the findings in the USCG *The Areas Offshore of Massachusetts and*

Alternative Dismissed	Justification for Dismissal
	Rhode Island Port Access Route Study (MARIPARS) and is intended to maximize safety and navigation consistency (USCG 2020). The MARIPARS concluded that “a standard and uniform grid pattern with at least three lines of orientation and standard spacing to accommodate vessel transits, traditional fishing operations, and search and rescue (SAR) operations, throughout the Massachusetts and Rhode Island Wind Energy Areas would allow for safe navigation and continuity of USCG missions through seven adjacent wind farm areas.” Finally, transit corridors analyzed as alternatives in the Vineyard Wind 1 and South Fork EISs were not found to measurably increase navigation safety and were ultimately not selected.
Preclude the development of WTGs within a 20-kilometer buffer of the Nantucket Shoals 30-meter isobath	NMFS requested that BOEM consider an alternative that would prohibit installation of WTGs within a 20-kilometer buffer of the Nantucket Shoals 30-meter isobath to reduce potential impacts on this important foraging area for aquatic species, such as the NARW and sea ducks. Under this alternative, a total of 53 WTGs would be eliminated, leaving 94 WTG and 2 OSP positions remaining; 85 WTGs and 1 OSP, out of the remaining 96 positions would be needed for Phase 1, assuming the use of a 15 MW WTG model. BOEM determined the use of a 15 MW WTG for Phase 1 is a reasonable assumption based on the PDE in the COP and RFI responses from Mayflower Wind. Mayflower Wind needs the 85 WTGs for Phase 1 to achieve the 1,275 MW in existing offtake agreements that Mayflower Wind has. Under this alternative, for Phase 2 Mayflower would only have 9 WTGs and 1 OSP left with a total nameplate capacity of 162 MW, assuming 18 MW WTGs were used.[a] BOEM determined the use of an 18 MW WTG for Phase 2 is a reasonable assumption based on the PDE in the COP and RFI responses from Mayflower Wind. This alternative is not reasonable under NEPA because it is not consistent with the purpose and need, nor Mayflower Wind’s primary goals, and is not economically feasible or practicable and would, therefore, be equivalent to the No Action Alternative. First, Mayflower Wind has collected and analyzed full geotechnical data on about two-thirds of their WTG positions, all within the shallower northeast portion of the Lease Area, to support the design and engineering of foundations and other components of their Phase I Project while meeting the schedule for power delivery under their PPAs with Massachusetts. If one-third of their WTG positions were not available for timely development, and 53 out of approximately 100 WTG positions were eliminated by the alternative, far fewer (around 50) WTG positions than the 85 WTG positions needed to produce 1,200 MW would remain for the timely execution of the Massachusetts PPAs. While Mayflower Wind is currently finishing collecting the remaining geotechnical data for the other positions in the lease, Mayflower Wind is not able to analyze and design foundations in time to meet the deadlines in their Massachusetts PPAs. Thus, this alternative is unreasonable because it would be incompatible with the Massachusetts offtake awards which are integral to both the purpose and need for the Project and Mayflower Wind’s primary goals. Second, Mayflower Wind’s primary goals also include interconnecting at two POIs, for which they have queue positions and interconnection agreements, each with a maximum capacity of 1,200 MW. For the Phase 2 POI, 162 MW accounts for only 13% of the POI capacity which would result in extremely high costs per MW for the required upgrades (which cost hundreds of millions of dollars total) under Mayflower Wind’s interconnection agreement, rendering Phase 2 economically infeasible, and severely increasing the unit cost of constructing and operating

Alternative Dismissed	Justification for Dismissal
	Phase 1, which may also render it infeasible. Moreover, the 162 MW could not be added to the POI for Phase 1 because it is already maxed out at 1,275 MW. Third, Mayflower Wind is planning to compete for one or more future solicitations competed by New York State, Massachusetts and Rhode Island which require between 400 MW-1,000 MW of offtake per award. If this alternative was analyzed in detail, it would preclude Mayflower Wind from competing in any of these upcoming solicitations because it would invalidate any bids over 162 MW. BOEM's *Screening Criteria for Alternatives to be Analyzed in Detail in Environmental Impact Statements for Construction and Operations Plans* further support these determinations. Notably, other reasonable and feasible alternatives and mitigation measures to reduce potential impacts on NARWs and sea ducks are analyzed in detail. For example, Alternative D would remove up to six WTGs from development that are in areas with the greatest presence of protected species and highly productive habitats for foraging. In addition, BOEM is proposing additional mitigation measures to reduce potential impacts on protected species, most notably NARW, and their food sources (refer to Appendix G, *Mitigation and Monitoring*, Table G-2). Therefore, restricting WTG development within 20-kilometer of the Nantucket Shoals 30-meter isobath was not carried forward.
Eliminate up to 17 WTGs in the northeastern portion of the Lease Area	After determining that the alternative proposed by NMFS to "preclude the development of WTGs within a 20-km buffer of the Nantucket Shoals 30-meter isobath" was infeasible, BOEM reviewed the available information under the COP and designed a potentially feasible alternative that addressed many of the concerns raised by NMFS. This alternative would eliminate up to 17 WTGs in the northeastern portion of the Lease Area to reduce potential impacts on this important foraging area for protected species, such as the NARW and sea ducks. However, after obtaining additional information through RFIs, BOEM has also determined that this alternative is unreasonable and should not be analyzed in detail because it is inconsistent with Mayflower Wind's primary goals, and the alternative is not economically feasible or practicable and would be equivalent to the No Action Alternative. Based on information obtained through RFIs, BOEM established that Mayflower Wind plans to use an area within the lease ("Phase 2"), and its associated WTG and OSP positions to support competitive bids for up to 1,200 MW in offtake in upcoming Rhode Island and/or Massachusetts and/or New York State (through NYSERDA) solicitations which require between 400 MW-1,000 MW of offtake per award. Given that larger capacity bids allow for cheaper power pricing and therefore enhanced competition for a solicitation award, BOEM determined that any alternative that was incompatible with the 1,000 MW minimum award size for New York was unreasonable under BOEM's *Screening Criteria for Alternatives to be Analyzed in Detail in Environmental Impact Statements for Construction and Operations Plans*. (While NYSERDA has an exception to the 1,000 MW minimum for a bid, if the remainder of a lease is bid in, it is unlikely bids less than 1,000 MW will be competitive given the quantity of potential applicants, a half dozen or more, currently in the market that will be able to enter bids of 1,000 MW+). Notably, 1,000 MW of capacity for Phase 2 would also allow Mayflower Wind to compete for 400 MW in Massachusetts and 600 MW in Rhode Island simultaneously, or sequentially. Under the assumptions that Mayflower Wind's Phase 1 would use 15 MW WTGs and Phase 2 would use 18 MW WTGs, 57 positions for 56 WTGs and one OSP would be needed to support the minimum of

Alternative Dismissed	Justification for Dismissal
	1,000 MW of capacity for Phase 2. The elimination of 17 WTGs under this alternative would only leave 46 positions for 45 WTGs and 1 OSP and consequently prevent Mayflower from being able to bid more 804 MW into any solicitations, well below the 1,000 MW minimum bid for NYSERDA, and/or a pair of bids into Massachusetts and Rhode Island. The ability to compete for and enter into one or more offtake agreements for Phase 2 of the Mayflower Wind project is fundamental to its economic feasibility. Offshore wind projects will not obtain financing for the capital investment needed for construction without an offtake agreement. Mayflower Wind proposed the entirety of the lease (Phase 1 and Phase 2) in their COP because their financing strategy depends on using economies of scale for major supplies and services, and a continuous build-out construction campaign that limits de-mobilizations and re-mobilizations. Moreover, the price of power underlying Mayflower Wind's existing awards with Massachusetts is comparatively low for current PPAs for offshore wind, which lowers the tolerance of the Project to accept losses in profit margins that would occur from a Phase 2 that is less than 1,000 MW, particularly in light of their POI upgrade obligations and the need to use HVDC technology. BOEM's *Screening Criteria for Alternatives to be Analyzed in Detail in Environmental Impact Statements for Construction and Operations Plans* further support these determinations. Notably, other reasonable and feasible alternatives, and mitigation measures, to reduce potential impacts on NARWs and sea ducks have been considered in detail. For example, Alternative D would remove up to six WTGs from development that are in areas with the greatest presence of protected species and highly productive habitats for foraging. In addition, BOEM is proposing additional mitigation measures to reduce potential impacts on protected species, primarily NARW, and their food sources (refer to Appendix G, Table G-2). Therefore, an alternative eliminating up to 17 WTGs in the northeastern portion of the Lease Area was not carried forward.
Technology Alternatives	
Closed-loop cooling at the offshore HVDC converter station	Commenters recommended that BOEM consider an alternative that would include a closed-loop cooling system at the offshore HVDC converter station to minimize impacts on aquatic habitat and species. Based on BOEM's independent market research, a closed-loop cooling system for an offshore wind HVDC converter station has not been implemented in any operational projects to date. There is some interest in the industry and conceptual designs for a closed system exist; however, it is not a proven, commercially available system, and its reliability, operations and maintenance needs and cost effectiveness are currently unknown. Using proven and reliable technology is particularly important for the HVDC converter station because it is a single point of failure for the transport of the entire Project's power to shore. Given the lack of commercial availability, it is not reasonable or technically practical for BOEM to require the selection of a closed-loop system for an HVDC converter station at this time.
Alternative offshore renewable energy technologies, including offshore solar, hydrokinetic	One commenter requested that BOEM consider renewable offshore energy alternatives to the Project, including offshore floating solar, hydrokinetic energy, and offshore floating wind. However, none of these would meet the purpose and need for the Proposed Action. Furthermore, the lease allows only the submission of a COP for offshore wind energy development. Development of offshore solar or marine hydrokinetics is not permitted under this lease. The development of

Alternative Dismissed	Justification for Dismissal
energy, and floating offshore wind technologies	floating offshore wind is unlikely to be commercially viable within the time frame of this Project. Additionally, the majority of the Mayflower Wind Lease Area is in relatively shallow water depths not suitable for floating technology, which could cause challenges with mooring and dynamic cabling.
Export Cables	
Common cable corridor that would use a predetermined corridor, for projects adjacent to each other, in which to run cables, as well as a shared landing point	Commenters requested that BOEM consider an alternative that would use common cable corridors for adjacent projects. One commenter requested that BOEM also consider an alternative where the shared cable corridor would lead to a common landing point at Brayton Point. BOEM cannot dictate that the lessee use a shared cable corridor. 30 CFR § 585.200(b) states, "a lease issued under this part confers on the lessee the rights to one or more project easements without further competition for the purpose of installing gathering, transmission, and distribution cables; pipelines; and appurtenances on the OCS as necessary for the full enjoyment of the lease." While BOEM could require a lessee to use a previously existing shared cable corridor established by a ROW grant (30 CFR § 585.112) when the use of the shared cable corridor is a technically and economically practical and feasible alternative for the proposed Project, BOEM cannot limit a lessee's right to a project easement when such a cable corridor does not exist and there is no way of determining if the use of a future shared cable corridor would be a technically and economically practical and feasible alternative for the proposed Project. Therefore, BOEM cannot require the applicant to use a non-existent shared cable corridor for this proposed Project. Moreover, it would be impractical for Mayflower Wind's export cables to share a corridor with the known corridors of other nearby projects because they would connect to the power grid via different onshore interconnection points. These include Vineyard Wind (Barnstable, Massachusetts), South Fork Wind (Suffolk County, New York), New England Wind (Barnstable, Massachusetts), Revolution Wind (North Kingstown, Rhode Island), or Sunrise Wind (Brookhaven, New York). In addition, a shared cable corridor may not be technically feasible as cable collocation may conflict with industry standards. In addition, neither the Falmouth Tap nor the Brayton Point POIs have the capacity, even after planned upgrades, to receive all power generated from the Project at a single POI.
Offshore cable corridor to avoid the Sakonnet River by following a western passage around Aquidneck Island	A commenter requested that BOEM consider an in-water routing that follows a western passage to Brayton Point to the west of Aquidneck Island to avoid or minimize impacts on complex benthic habitats in the Sakonnet River. Offshore export cable routes to the west of Aquidneck Island in Narragansett Bay were considered by Mayflower Wind as part of its route selection process, which included a route west of Conanicut Island (west passage) and a route east of Conanicut Island (east passage). The Rhode Island CRMC expressed concerns with fisheries activities in both the west and east passages, as well as conflicts with U.S. Navy restricted areas in the east passage per 33 CFR 334.80, 334.81, 334.82). In addition, Mayflower Wind consulted with the Rhode Island CMRC and was advised that an ECC traversing the western passage to Brayton Point would be unfavorable from a regulatory and stakeholder standpoint. Further, BOEM considered an alternative that would approve only the Falmouth POI and remove the Brayton Point POI. However, given the amount of electricity to be generated, neither the Falmouth nor the Brayton Point POI has the capacity to receive all power generated from the proposed Project. At Falmouth

Alternative Dismissed	Justification for Dismissal
	specifically, the ISO-NE rules and reliability and planning requirements, in effect, limit a single point of interconnection to no more than 1,200 MW. In response to this limitation, Mayflower Wind secured additional interconnection rights at Brayton Point to deliver the additional 1,200 MW of energy the Project would generate.
Onshore cable corridor options to avoid the Sakonnet River and Mount Hope Bay by following a primarily overland route to Brayton Point	Commenters requested that BOEM consider an alternative export cable route that would follow an overland route to Brayton Point to avoid the Sakonnet River and Mount Hope Bay. BOEM requested Mayflower Wind assess the feasibility of an onshore route that would avoid these waterbodies. Mayflower Wind identified two feasible overland routes that would avoid the Sakonnet River, and BOEM is carrying these routes forward for detailed analysis as Alternatives C-1 and C-2. BOEM and Mayflower Wind determined there was not a feasible onshore route to avoid Mount Hope Bay. Based on the Massachusetts Department of Transportation (MassDOT) Utility Accommodation Policy on State Highway Right of Way (page 76, Section 12; Mass DOT 2013), a high voltage electric power transmission line (greater than 35kV) on bridge structures is generally not permitted except under extraordinary circumstances, and then only after a detailed analysis of all other construction methods or alternatives are determined not to be practicable. MassDOT reviewed a proposed alternative to hang high-voltage power cables from the Braga and Veterans Memorial bridges across the Taunton River and determined it was not feasible (MassDOT 2022). The Braga and Veterans Memorial bridges are considered critical infrastructure, and MassDOT considers it in its best interest to limit outside parties from accessing the bridge structures based on security considerations. Furthermore, the presence of a high-voltage power cable on the bridges may preclude MassDOT from performing required maintenance activities on both bridges. In addition, Mayflower Wind has coordinated with the Rhode Island Department of Transportation about bridge use, and it was determined that using a bridge to hang an electrical cable was unfeasible due to various factors including liability, responsibility, and technical challenges. Therefore, placing transmission lines on bridges to avoid Mount Hope Bay was determined not be feasible and was eliminated from further consideration. In addition, a non-bridge option to avoid Mount Hope Bay was evaluated using Taunton River and Westport River submarine/HDD crossings to establish a route passing north of the bay. However, this option was also deemed infeasible due to the lack of a feasible landfall near Westport Harbor and Westport Point. Therefore, a primarily overland crossing option north of Mount Hope Bay across the Taunton River was determined to not be feasible and was eliminated from further consideration.
Offshore cable route between Martha's Vineyard and Nomans Land that would result in an ECC to Brayton Point that is approximately 10 miles shorter than the proposed route	A commenter requested that BOEM consider alternative ECC routes from the lease area to Brayton Point that would result in an overall shorter cable and suggested that a route cutting between Martha's Vineyard and Nomans Land before connecting with the planned Brayton Point ECC route off the Elizabeth Islands would be a more direct and shorter cable route. The proposed Mayflower Wind ECC to Brayton Point was determined to be the shortest feasible route from the Lease Area to Brayton Point identified through Mayflower Wind's corridor selection process. An alternative route that cuts between Martha's Vineyard and Nomans Land Island was not considered to be feasible due to several technical challenges and risk factors, including shallow seabed bathymetry, high seabed mobility, seabed properties that are expected to

Alternative Dismissed	Justification for Dismissal
	be rocky with significant boulders, and the risk of encountering unexploded ordnance. In addition, routing the ECC between Martha's Vineyard and Nomans Island would create impacts on submerged ancient landforms within the Vineyard Sound and Moshup's Bridge Traditional Cultural Property.
Falmouth offshore cable route and landfall to avoid eelgrass	NMFS requested that BOEM consider an alternative that would avoid potential eelgrass meadows mapped along the shoreline at the Falmouth landfalls (refer to COP Appendix K, Attachment 1; Mayflower Wind 2022). BOEM reviewed potential route options that would avoid eelgrass and also requested Mayflower Wind explore feasible alternate route options. BOEM identified one landing location that avoided eelgrass and that was in reasonable proximity to the Project's onshore facilities (Figure 2-11). This landfall option was identified at the Menauhant Town Beach parking lot in East Falmouth, approximately 2 miles east of the Proposed Action landfall sites. After landfall, this route would follow Menauhant Road west, then north along Davisville Road to Massachusetts State Highway 28, where it would turn west along the highway until connecting back to the Proposed Action's route at Worcester Court. BOEM received input from MassDOT about the placement of the cable along roads in this area and they stated that a large portion is currently under moratorium and final roadway restoration may be extensive, there could be conflict with the Town of Falmouth projects, and there could be conflicts with new gas and sewer lines. BOEM also contacted the Town of Falmouth for input, and they were concerned about the cable landing at Menauhant Road and routing through dense neighborhoods, stating they were not interested in reviewing the alternative route because of these concerns. Furthermore, Mayflower Wind is proposing HDD at the Falmouth landfall sites under the Proposed Action, which would generally avoid eelgrass because the cable would be bored underneath the eelgrass and the HDD punchout location offshore is deeper than the deepest eelgrass extent. The punchout locations are anticipated to be in water depths of 16.4 feet to 26.3 feet. For these reasons, BOEM eliminated this alternative from further consideration.

[a] To distinguish between the portions of the Project interconnecting at the two POIs, which would have different offtake agreements and associated timelines, BOEM is using the terms Phase 1 and Phase 2. Phase 1 refers to development of the offshore portion of the Project connecting to the Falmouth POI. Phase 2 refers to development of the offshore portion of the Project connecting to the Brayton Point POI.

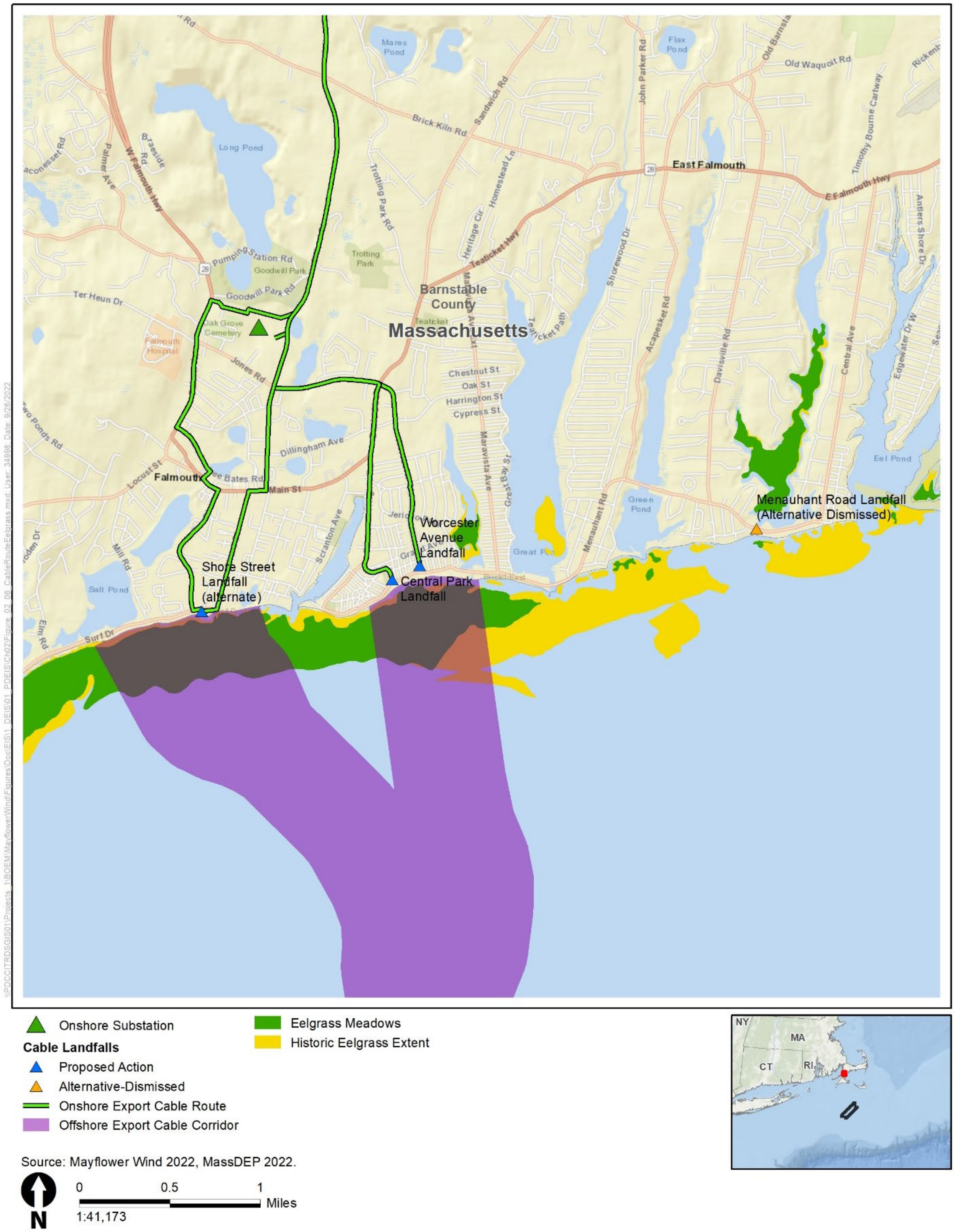

Figure 2-11. Alternative Falmouth Landfall Dismissed – Eelgrass Avoidance

2.3 Non-Routine Activities and Low-Probability Events

Non-routine activities and low-probability events associated with the proposed Project could occur during construction and installation, O&M, or decommissioning. Examples of such activities or events could include corrective maintenance activities; collisions involving vessels or vessels and marine life; allisions (a vessel striking a stationary object) involving vessels and WTGs or OSPs; cable displacement or damage by anchors or fishing gear; chemical spills or releases; severe weather and other natural events; and terrorist attacks. These activities or events are impossible to predict with certainty. This section provides a brief assessment of each of these potential events or activities.

- **Corrective maintenance activities:** These activities could be required as a result of other low-probability events, or as a result of unanticipated equipment wear or malfunctions. Mayflower Wind would stock spare parts and have sufficient workforce available to conduct corrective maintenance activities, if required.
- **Collisions and allisions:** These could result in spills (described below) or injuries or fatalities to wildlife (addressed in Chapter 3, Affected Environment and Environmental Consequences). Collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Project: USCG requirements for lighting on vessels; NOAA vessel speed restrictions; the proposed spacing of WTGs and OSPs; and the inclusion of proposed Project components on navigation charts.
- **Cable displacement or damage by vessel anchors or fishing gear:** This could result in safety concerns and economic damage to vessel operators and may require corrective action by Mayflower Wind such as the need for one or more cable splices to an export or interarray cable(s). However, such incidents are unlikely to occur because the proposed Project's features would be indicated on navigational charts, and the cable would be buried at least 3.2 feet (1 meter) deep or protected with rock berms, concrete mattresses, rock placement fronded mattresses, or half shells.
- **Chemical spills or releases:** For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills as a result of a catastrophic event. In the event of a spill, Mayflower Wind and its contractors would follow the procedures outlined in the Project OSRP, which defines spill prevention measures, as well as provisions for communication, coordination, containment, removal, and mitigation of a spill. For onshore activities, these may include inadvertent releases from debris, spills from refueling, accidental release from construction equipment, and releases associated with horizontal directional drilling. All onshore waste likely to cause environmental harm would be stored in designated, secure, and bermed locations away from depressions and drainage lines that carry surface water until collected by the selected waste contractor. To minimize and control spills, spill kits would be provided at all locations where hazardous materials are stored.
- **Severe weather and natural events:** Extratropical storms, including northeasters, are common in the Lease Area from October to April. These storms bring high winds and heavy precipitation, which can lead to severe flooding and storm surges. Hurricanes that travel along the coastline of the eastern U.S. have the potential to affect the Lease Area with high winds and severe flooding. Between 1982 and 2017, 20 historical storms identified as hurricanes crossed the Lease Area (COP

Volume 2, Table 4-10; Mayflower Wind 2022). The return rate of hurricanes may become more frequent than the historical record, and the future probability of a major hurricane will likely be higher than the historical record of these events due to climate change. The engineering specifications of the WTGs and their ability to sufficiently withstand weather events is independently evaluated by a certified verification agent when reviewing the Facility Design Report and Fabrication and Installation Report according to international standards, which include withstanding hurricane-level events. One of these standards calls for the structure to be able to withstand a 50-years return interval event. An additional standard includes withstanding 3-second gusts of a 500-years return interval event, which would correspond to Category 5 hurricane windspeeds. If severe weather caused a spill or release, the actions outlined above would help reduce potential impacts. Severe flooding or coastal erosion could require repairs, with impacts associated with repairs being similar to those outlined in Chapter 3 for construction activities. While highly unlikely, structural failure of a WTG (i.e., loss of a blade or tower collapse) would result in temporary hazards to navigation for all vessels, similar to the construction and installation impacts described in Chapter 3.

- **Seismic activity:** The Lease Area is located in an area with low historical seismicity, and mapped faults in the area are considered to be inactive. Fault rupture hazard is not anticipated to be a hazard, and seismic hazards (e.g., liquefaction, strong ground shaking, lateral spreading, etc.) are not deemed to present a hazard to cables in the export cable corridor (COP Section 3.4.8; Mayflower Wind 2022).
- **Terrorist attacks:** BOEM considers these unlikely, but impacts could vary depending on the magnitude and extent of any such attacks. The actual impacts of this type of activity would be the same as the outcomes listed above for sever weather and natural events. Therefore, terrorist attacks are not analyzed further.

2.4 Summary and Comparison of Impacts by Alternative

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

Table 2-4. Summary and comparison of impacts among alternatives with no mitigation measures

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
3.4.1 Air Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on air quality. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **moderate** adverse impacts due to emissions of criteria pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases, mostly released during construction and decommissioning, and **minor** to **moderate beneficial** impacts on regional air quality after offshore wind projects are operational.	*Proposed Action:* The Proposed Action would have **minor** adverse impacts attributable to air pollutant, GHG emissions and accidental releases. The Project may lead to reduced emissions from fossil-fueled power-generating facilities and consequently **minor beneficial** impacts on air quality and climate. *Cumulative Impacts of the Proposed Action:* Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would result in **moderate** adverse impacts and **moderate beneficial** impacts.	*Alternative C:* Increased length of the onshore export cable routes would increase localized air quality impacts compared to the Proposed Action, with Alternative C-2 having the greatest potential for onshore air quality impacts followed by Alternative C-1. However, the overall impact level would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Alternative D could have slightly lower emissions from offshore construction and operation compared to the Proposed Action due to the installation of up to six fewer WTGs. Impact magnitude would remain **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* Emissions from construction of different foundation types would not differ substantially among Alternatives E-1, E-2, and E-3 and would be similar to the Proposed Action. Impact magnitude would remain **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* Restricting the number of Falmouth offshore export cables to three may slightly reduce emissions associated with cable-laying activity, but the emissions would not differ substantively from the Proposed Action and would not change the impact magnitude. Impact magnitude would remain **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.4.2 Water Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on water quality. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts because any potential detectable impacts are not anticipated to exceed water quality standards.	*Proposed Action:* The Proposed Action would result in **minor** impacts on water quality primarily due to sediment resuspension, discharges, and accidental releases. The impacts are likely to be temporary or small in proportion to the geographic analysis area and the resource would recover completely after decommissioning. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **minor** primarily due to short-term, localized effects from increased turbidity and sedimentation.	*Alternative C:* Alternatives C-1 and C-2 would slightly reduce the potential for offshore water quality impacts but would slightly increase the potential for onshore water quality impacts from re-routing the Brayton Point export cable onshore. Because the cables would be installed largely within existing road rights-of-way, Alternative C would have the same **minor** impacts as the Proposed Action. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* The reduced number of structures under Alternative D may slightly reduce localized water quality impacts during construction and operations, but the difference in impacts compared to the Proposed Action would not be materially different and would result in **minor** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* The GBS foundations proposed under Alternative E-3 would require larger disturbance footprints than the piled foundations and suction bucket foundations under Alternatives E-1 and E-2, but the total difference is small and there would be no meaningful change in impacts on water quality and would result in **minor** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* The reduced number of Falmouth offshore export cables may slightly reduce localized water quality impacts during construction. The additional HVDC converter OSP would increase the discharge of warm water, but the difference in impacts compared to the Proposed Action would not be materially different and would result in **minor** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.5.1 Bats	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on bats. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities	*Proposed Action:* The Proposed Action would result in **minor** impacts on bats. Primary risks would be from potential onshore removal of habitat and operation of the offshore WTGs. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the	*Alternative C:* Alternative C would have the same **minor** impacts as the Proposed Action. While the longer onshore cable routes would result in more habitat disturbance, the overall affected area would still be small. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when	*Alternative D:* Alternative D would reduce the number of WTGs and noise impacts compared to the Proposed Action in the northern Lease Area but would have similar overall **minor** impacts on bats. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when	*Alternative E:* The different foundation types under Alternative E are not expected to change the impacts on bats compared to the Proposed Action; the same **minor** impacts would occur. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when	*Alternative F:* Alternative F would result in the same **minor** impacts on bats as the Proposed Action. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
	(including other offshore wind activities) would result in **minor** impacts on bats because bats infrequently occur offshore where offshore wind infrastructure would be installed.	impacts from ongoing and planned activities including other offshore wind activities would be **minor** primarily through the permanent onshore habitat loss.	combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	offshore wind activities would be the same as the Proposed Action.
3.5.2 Benthic Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on benthic resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts from habitat degradation and conversion and **moderate beneficial** impacts from offshore wind structures that provide new habitat for benthic species.	*Proposed Action:* The Proposed Action would result in **negligible** to **moderate** impacts from habitat disturbance; permanent habitat conversion; and behavioral changes, injury, and mortality of benthic fauna. **Moderate beneficial** impacts would result from new hard surfaces that could provide new benthic habitat. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **moderate** and **moderate beneficial**.	*Alternative C:* Alternative C would reduce the length of the Brayton Point offshore export cable route, thereby reducing total seabed disturbance and associated benthic habitat disturbance, with Alternative C-2 having the greatest reduction followed by Alternative C-1. Impacts would remain **negligible** to **moderate** and **moderate beneficial**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Alternative D would install up to six fewer WTGs than the Proposed Action, which would reduce total long-term seabed disturbance and benthic habitat impacts. Impacts would remain **negligible** to **moderate** and **moderate beneficial**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* Alternative E-1 would result in similar impacts as the Proposed Action from installing only piled foundations. Alternatives E-2 and E-3 would avoid pile-driving noise impacts from installing GBS and suction-bucket foundations but would result in increased habitat conversion from larger foundations. Impacts would remain **negligible** to **moderate** and **moderate beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* Alternative F, which would reduce the number of Falmouth offshore export cables from five to three, would reduce seafloor and benthic habitat disturbance compared to the Proposed Action. The additional HVDC converter OSP would result in increased potential for entrainment of eggs and larval life stages, as well as increased thermal impacts due to heated discharge effluent; however, as a whole the difference in impacts compared to the Proposed Action would not be materially different and would remain **negligible** to **moderate** and **moderate beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.5.3 Birds	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on birds. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts due to increased collision risk from offshore structures and **moderate beneficial** impacts from increased foraging opportunities.	*Proposed Action:* The Proposed Action would result in **minor** impacts on birds associated with habitat loss and collision-induced mortality from rotating WTGs. **Minor beneficial** impacts would occur from increased foraging opportunities for marine birds. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **moderate** and **moderate beneficial**.	*Alternative C:* Alternative C would have the same **minor** and **minor beneficial** impacts as the Proposed Action. While the longer onshore cable routes would result in more habitat disturbance, the overall affected area would still be small. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Alternative D would remove up to six WTGs nearest to Nantucket Shoals, which may lessen impacts on collision- and displacement-sensitive avian species that frequent this area. The same **minor** and **minor beneficial** impacts on birds are anticipated. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* Larger foundations may increase foraging opportunities and foundations that require no pile driving would reduce underwater noise, but these differences would be small and the same **minor** and **minor beneficial** impacts on birds are anticipated. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* Alternative F would reduce cable-laying activity, which could slightly lessen impacts on birds, but the same **minor** and **minor beneficial** impacts on birds would occur. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.5.4 Coastal Habitat and Fauna	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on coastal habitat and fauna.	*Proposed Action:* The Proposed Action would result in **minor** impacts because most potential effects associated with habitat disturbance would be localized, short-term, and can be	*Alternative C:* Alternative C would result in slightly greater impacts on coastal habitats than the Proposed Action from longer onshore cable routes, with Alternative C-2 having the	*Alternative D:* Because Alternative D would involve modifications only to offshore components, impacts on coastal habitat and fauna would be	*Alternative E:* Because Alternative E would involve modifications only to offshore components, impacts on coastal habitat and fauna would be	*Alternative F:* Because Alternative F would involve modifications only to offshore components, impacts on coastal habitat and fauna would be

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
	Cumulative Impacts of the No Action Alternative: The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts due to onshore coastal construction and climate change.	minimized with best management practices. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **moderate**.	greatest impact followed by Alternative C-1. The overall impact level would be the same as the Proposed Action: **minor**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	the same as the Proposed Action: **minor**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	the same as the Proposed Action: **minor**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	the same as the Proposed Action: **minor**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.5.5 Finfish, Invertebrates, and Essential Fish Habitat	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** impacts on finfish, invertebrates, and EFH. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts primarily through cable emplacement and maintenance, noise, presence of structures, regulated fishing efforts, and climate change.	*Proposed Action:* The Proposed Action would result in **negligible** to **moderate** impacts on finfish primarily associated with construction noise; **negligible** to **moderate** impacts on EFH primarily associated with habitat disturbance; and **negligible** to **moderate** impacts on invertebrates from displacement, habitat conversion, and injury/mortality. The presence of structures may have a **minor beneficial** effect on invertebrates through an artificial reef effect. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **negligible** to **moderate**.	*Alternative C:* Avoiding cable installation in the Sakonnet River would reduce impacts on EFH and HAPC for juvenile Atlantic cod from cable laying activity and long-term O&M impacts from presence of cable protection. While impacts would be reduced in the Sakonnet River, overall impact levels would be the same as the Proposed Action: **negligible** to **moderate** and **minor beneficial.** *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Removal of up to six WTGs may slightly reduce impacts but would not likely result in a meaningful change in impacts associated with construction (primarily pile-driving noise) or the presence of structures. Impact levels would be the same as the Proposed Action: **negligible** to **moderate** and **minor beneficial**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* Alternative E-1 would result in similar impacts as the Proposed Action from all piled foundations. Alternatives E-2 and E-3 would avoid underwater noise impacts. Larger foundations under Alternatives E-2 and E-3 would cause more habitat conversion but also greater beneficial artificial reef effects. Overall impacts would be the same as the Proposed Action: **negligible** to **moderate** and **minor beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* The reduced number of Falmouth offshore export cables would reduce seafloor and benthic habitat disturbance and EMF effects compared to the Proposed Action. Because cable installation would still occur in the same corridor, the same overall impacts are expected. The additional HVDC converter OSP would increase the potential for entrainment of fish larvae at cooling water intakes and thermal plume discharge impacts. Overall impacts would remain **negligible** to **moderate** and **minor beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.5.6 Marine Mammals	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on marine mammals. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts on mysticetes, odontocetes, and pinnipeds, with the exception of the NARW, on which impacts could be **major**. Impacts would primarily result from underwater noise, vessel collisions, entanglement, and seabed disturbance associated with offshore	*Proposed Action:* The Proposed Action would result in **negligible** to **major** adverse impacts on marine mammals and could include potentially **beneficial** impacts. Adverse impacts are expected to result mainly from underwater noise (e.g., UXO detonations and impact pile-driving) and potential for vessel strikes. Beneficial impacts are expected to result from the presence of structures. *Cumulative Impacts of the Proposed Action:* The Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **negligible** to **major**	*Alternative C:* Routing the Brayton Point export cable onshore may slightly reduce impacts on marine mammals occurring in the Sakonnet River. However, because the presence of most marine mammals in the Sakonnet River is uncommon, and cable installation impacts outside of the river would still occur, BOEM anticipates impacts would not be meaningfully different from the Proposed Action and the same **negligible** to **major** and potentially **beneficial** impacts would result. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing	*Alternative D:* The removal of up to six WTGs may lessen the impacts on marine mammals by providing more area of open ocean nearest to Nantucket Shoals, which provides important foraging habitat for marine mammals. Impacts from noise, EMF, and vessel traffic would also be reduced. However, because Alternative D only represents a reduction of up to six WTGs, impact levels would be the same as the Proposed Action: **negligible** to **major** and potentially **beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing	*Alternative E:* Alternative E-1 would result in similar impacts as the Proposed Action from all piled foundations. Alternatives E-2 and E-3 would avoid piled foundations, reducing underwater noise impacts and resulting in greater artificial reef effects from larger foundations. The overall impact level would be the same as the Proposed Action: **negligible** to **major** and potentially **beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other	*Alternative F:* The reduced number of Falmouth offshore export cables would reduce seafloor disturbance, vessel activity, and EMF effects compared to the Proposed Action. Because cable installation would still occur, the same **negligible** to **major** adverse with potentially **beneficial** impacts are expected. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
	wind activities and could include **minor** beneficial impacts.	and could include **minor beneficial** impacts.	and planned activities including other offshore wind activities would be the same as the Proposed Action.	and planned activities including other offshore wind activities would be the same as the Proposed Action.	offshore wind activities would be the same as the Proposed Action.	
3.5.7 Sea Turtles	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on sea turtles. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts primarily related to the presence of structures and pile-driving noise.	*Proposed Action:* The Proposed Action would result in **negligible** to **minor** impacts on sea turtles from habitat disturbance, noise impacts, water quality degradation, vessel strikes, and potential discharges/spills and trash. **Minor beneficial** impacts would result from the reef effect created by the presence of structures. *Cumulative Impacts of the Proposed Action:* The Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **minor**.	*Alternative C:* Alternative C would lessen impacts on sea turtles in the Sakonnet River by routing the cable onshore. However, sea turtle presence in the Sakonnet River is uncommon and cable emplacement impacts along the rest of the Brayton Point corridor would still occur. Impacts would remain **negligible** to **minor** adverse with **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Installation of up to six fewer WTGs would reduce impacts from noise, vessel traffic, and anchoring when compared to the Proposed Action. However, since the number of WTGs to be removed would be small relative to the total number of WTGs, the same **negligible** to **minor** adverse with **minor beneficial** impacts are expected. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* Alternative E-1 would result in similar impacts as the Proposed Action from all piled foundations. Alternatives E-2 and E-3 would avoid piled foundations, reducing underwater noise impacts and resulting in greater artificial reef effects from larger foundations. The overall impact level would be the same as the Proposed Action: **negligible** to **minor** adverse with **minor beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* The reduced number of Falmouth offshore export cables would reduce seafloor disturbance and EMF effects compared to the Proposed Action. Because cable installation would still occur in the same corridor, the same **negligible** to **minor** adverse with **minor beneficial** impacts are expected. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.5.8 Wetlands	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on wetlands. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts on wetlands, primarily because of land disturbance and in consideration of regulatory requirements for avoiding, minimizing, and mitigating impacts on wetlands.	*Proposed Action:* The Proposed Action would result in **minor** impacts on wetlands through short-term or permanent disturbance from activities within or adjacent to these resources and in consideration of avoidance, minimization, and mitigation measures for wetlands required under federal and state statutes. *Cumulative Impacts of the Proposed Action:* The Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **moderate**.	*Alternative C:* Alternative C would result in slightly greater impacts on wetlands than the Proposed Action from longer onshore cable routes, with Alternative C-2 having the greatest impacts followed by Alternative C-1. The overall impact level would be the same as for the Proposed Action: **minor**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* The impacts associated with the Proposed Action would not change under Alternative D because the alternative only differs in offshore components, and offshore components would not contribute to impacts on wetlands; the same **minor** impacts on wetlands are anticipated. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* The impacts associated with the Proposed Action would not change under Alternative E because the alternative only differs in offshore components, and offshore components would not contribute to impacts on wetlands; the same **minor** impacts on wetlands are anticipated. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* The impacts associated with the Proposed Action would not change under Alternative F because the alternative only differs in offshore components, and offshore components would not contribute to impacts on wetlands; the same **minor** impacts on wetlands are anticipated. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.6.1 Commercial Fisheries and For-Hire Recreational Fishing	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** to **major** impacts on commercial fisheries and for-hire recreational fishing. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind	*Proposed Action:* The Proposed Action would have **minor** to **major** impacts depending on the fishery and fishing operation. Some fishing operations could experience long-term, major disruptions. However, it is estimated that most vessels would only have to adjust somewhat to account for disruptions due to impacts. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed	*Alternative C:* Routing the Brayton Point offshore export cable onshore to avoid the Sakonnet River could result in slight reductions in impacts on fishers that use the Sakonnet River but the difference in impact would be slight and the same overall **minor** to **major** impacts would result. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing	*Alternative D:* By removing up to six WTGs, Alternative D would provide more area in the northern portion of the Lease Area for commercial fishing vessels to operate without potential impacts from structures, slightly reducing the potential for gear entanglement and allisions. The same **minor** to **major** impacts would result. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when	*Alternative E:* Alternative E-1 would have similar impacts as the Proposed Action. The larger foundations under Alternatives E-2 and E-3 would increase the potential for gear entanglement and loss. Conversely, the larger foundations would increase beneficial artificial reef effects. The same **minor** to **major** impacts would result.	*Alternative F:* Installation of fewer cables would require less hard cable protection, reducing the potential for gear entanglement and loss but any difference in impacts would be small. The same **minor** to **major** impacts would result. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
	activities) would result in **moderate** to **major** impacts because some commercial fisheries would experience substantial long-term disruptions. Presence of structures would cause **minor** to **moderate** impacts on for-hire recreational fishing, and could include **moderate** beneficial impacts.	Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **major**.	and planned activities including other offshore wind activities would be the same as the Proposed Action.	combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	offshore wind activities would be the same as the Proposed Action.
3.6.2 Cultural Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on cultural resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **major** impacts on cultural resources due to disturbance, damage, disruption, and destruction of individual cultural resources.	*Proposed Action:* The Proposed Action would have **major** impacts on cultural resources. BOEM anticipates that NHPA requirements to identify historic properties and resolve adverse effects would reduce the significance of potential impacts on some historic properties but mitigation of both physical and visual adverse effects on historic properties would still be needed under the Proposed Action. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **minor** to **major**.	*Alternative C:* Alternative C-1 or C-2 cable routes could introduce adverse impacts on a larger number of individual cultural resources as compared to the Proposed Action. However, Alternatives C-1 and C-2 routes are predominantly along public road ROWs and may not contribute additional impacts in these previously disturbed areas. The same **major** impacts would result. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**.	*Alternative D:* Eliminating up to six WTGs is not anticipated to result in a reduction of impacts on marine cultural resources and would only slightly reduce the visibility of the Project on historic aboveground resources. The same **major** impacts would result. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**.	*Alternative E:* Alternative E-3 would result in the greatest potential for impacts on marine cultural resources because of the larger foundation size, followed by Alternatives E-2 and E-1. Overall, the anticipated range of impact severity on individual marine cultural resources under Alternatives E-1, E-2, and E-3 would be the same as the Proposed Action and the overall impact would remain **major**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**.	*Alternative F:* Reducing the number of installed cables would reduce the overall area subject to seabed disturbance, thereby reducing adverse impacts on marine cultural resources including the Nantucket Sound TCP. However, most cultural resources are located in other areas unaffected by this alternative; therefore, the same **major** impacts would result. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**.
3.6.3 Demographics, Employment, and Economics	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts, primarily associated with impacts on commercial fishing and other marine businesses from offshore wind development. **Minor beneficial** impacts would result from increased jobs, tax revenues, improved ports, and marine industry diversification.	*Proposed Action:* The Proposed Action would have **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. Adverse impacts include temporary and permanent disruptions to commercial fishing and recreational business operations. Beneficial impacts include job creation, workforce development, and income and tax revenue. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **minor** adverse and **moderate beneficial** impacts.	*Alternative C:* Installation of longer onshore cable routes under Alternative C would result in increased traffic delays, disruptions to business and residential access, and related construction impacts. Alternative C-2 would result in the greatest impact followed by Alternative C-1; however, the overall impact magnitude would be the same: **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Alternative D would install up to six fewer WTGs, which would result in a shorter duration of noise impacts and less vessel traffic. However, the Project would generate less energy and would result in slightly lower beneficial impacts associated with delivering a reliable supply of energy. The overall impact levels would be the same as for the proposed action**: minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* Alternative E, which would involve installing a range of foundation types, would not have measurable impacts on demographics, employment, and economics that are materially different from the impacts of the Proposed Action. The overall impact levels would be the same as for the Proposed Action**: minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* Alternative F, which would involve reducing the number of Falmouth offshore export cables from five to three, would not have measurable impacts on demographics, employment, and economics that are materially different from the impacts of the Proposed Action. The overall impact levels would be the same as for the Proposed Action**: minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.6.4 Environmental Justice	*No Action Alternative:* Continuation of existing environmental trends and	*Proposed Action:* The Proposed Action would have **negligible** to **minor**	*Alternative C:* Increased length of the Brayton Point onshore export cable	*Alternative D:* Alternative D would install up to six fewer WTGs than the	*Alternative E:* Under Alternative E-1, use of all piled foundations would	*Alternative F:* Reducing the number of Falmouth offshore export cables from

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
	activities under the No Action Alternative would result in **minor** impacts on environmental justice. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts due to gentrification and potential loss of income for low-income and minority workers; and **minor beneficial** impacts related to employment in the offshore wind industry and displaced fossil fuel emissions after offshore wind projects are operational.	adverse impacts attributable to air emissions, noise at ports, onshore construction, and impacts on marine businesses. The Proposed Action may have **major** disproportionally high and adverse impacts on Tribal Nations due to potential impacts on ancient submerged landforms. The Proposed Action would also have **minor beneficial** impacts from displacement of fossil fuel energy generation and employment opportunities. *Cumulative Impacts of the Proposed Action:* Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **moderate**.	route would result in construction-related increases in air emissions, traffic, and noise. However, the location of the Alternative C onshore cables would not occur in areas with environmental justice populations. Impacts from Alternative C would be the same as the Proposed Action: **negligible** to **major** adverse and **minor beneficial**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	Proposed Action, which would slightly reduce the impacts of vessel activity in ports and offshore structures on fishing. The impact magnitude of Alternative D would remain **negligible** to **major** adverse and **minor beneficial**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	result in similar impacts as the Proposed Action. Under Alternatives E-2 and E-3, use of foundations that avoid pile driving would slightly reduce impacts on businesses in environmental justice communities that rely on fishing or tourism by reducing noise associated with foundation installation. Impact magnitude would remain **negligible** to **major** adverse and **minor beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	five to three would not meaningfully change the impacts on environmental justice from the Proposed Action. Impact magnitude would remain **negligible to major** adverse and **minor beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.6.5 Land Use and Coastal Infrastructure	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** and **minor beneficial** impacts on land use and coastal infrastructure. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts from land disturbance and accidental releases during onshore construction, as well as from the views of offshore structures that could affect the use and value of onshore properties; **minor beneficial** impacts would result from productive use of ports and related infrastructure for offshore wind activity.	*Proposed Action:* The Proposed Action would have **negligible** to **minor** impacts resulting from port utilization, accidental spills, and land disturbance and construction impacts, and **moderate** impacts associated with the need for zoning relief for the Falmouth landfalls and substation sites. The Proposed Action would also have **minor beneficial** impacts by supporting designated uses and infrastructure improvements at ports. *Cumulative Impacts of the Proposed Action:* Overall, impacts from ongoing and planned activities including other offshore wind activities would result in **moderate** adverse impacts and **minor beneficial** impacts.	*Alternative C:* Alternative C would increase the length of the Brayton Point onshore cable route, resulting in increased impacts from land disturbance, traffic, and noise compared to the Proposed Action, with Alternative C-2 resulting in the most impacts. The overall impact magnitudes would be the same as the Proposed Action: **moderate** and **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* The impacts associated with the Proposed Action would not change under Alternative D because the alternative only differs in offshore components, and the offshore components would not substantively contribute to impacts on land use and coastal infrastructure; the same **moderate** adverse and **minor beneficial** impacts are anticipated. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* The impacts associated with the Proposed Action would not change under Alternative E because the alternative only differs in offshore components, and the offshore components would not substantively contribute to impacts on land use and coastal infrastructure; the same **moderate** adverse and **minor beneficial** impacts are anticipated. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* The impacts associated with the Proposed Action would not change under Alternative F because the alternative only differs in offshore components, and the offshore components would not substantively contribute to impacts on land use and coastal infrastructure; the same **moderate** adverse and **minor beneficial** impacts are anticipated. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.6.6 Navigation and Vessel Traffic	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on navigation and vessel traffic. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative	*Proposed Action:* The Proposed Action would result in **negligible** to **moderate** impacts associated with changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions. Some commercial fishing, recreational,	*Alternative C:* Routing the Brayton Point offshore export cable onshore would slightly reduce the impacts on navigation and vessel traffic from fewer miles of offshore cable installation in the Sakonnet River, which would reduce the potential for collisions with slow-moving cable-	*Alternative D:* Installation of up to six fewer WTGs under Alternative D would incrementally decrease impacts on vessel traffic compared to the Proposed Action by providing additional space closer to Nantucket Shoals and coastal areas, which are more frequently used by fishing and	*Alternative E:* Alternative E, which would involve installing a range of foundation types, may slightly change the duration of foundation construction and the number of vessels, but any differences would be small and last only for the duration of construction. The overall impact levels	*Alternative F:* Reducing the number of Falmouth offshore export cables from five to three would result in a slight reduction in cable-laying vessel construction activity but overall impacts would be similar to those of the Proposed Action and the same

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
	combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** impacts primarily due to the presence of offshore wind structures, which would increase the risk of collisions, allisions, and accidental releases.	and other vessels would avoid the Wind Farm Area altogether. *Cumulative Impacts of the Proposed Action:* Overall, impacts from ongoing and planned activities including other offshore wind activities would result in **negligible** to **moderate** impacts.	laying vessels. Alternative C-2 would cross the Fall River Harbor Federal Navigation Channel three times, contributing to an increased potential for short- and long-term impacts. However, overall impact levels under Alternative C-1 and C-2 would be the same as the Proposed Action: **negligible** to **moderate**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	recreational vessels, but would not change the overall impact magnitude of **negligible** to **moderate**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	would be the same as for the Proposed Action**: negligible** to **moderate**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	**negligible** to **moderate** impact level would result. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems, and **major** for scientific research and surveys. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** impacts for marine mineral extraction; **minor** impacts for aviation and air traffic, and cables and pipelines; **moderate** for radar systems due to WTG interference; **minor** for most military and national security uses, except for USCG SAR operations, which would have **moderate** adverse impacts; and **major** for scientific research and surveys.	*Proposed Action:* The Proposed Action would result in **negligible** impacts for marine mineral extraction and cables and pipelines; **minor** impacts for aviation and air traffic, radar systems, and most military and national security uses except for USCG SAR operations, which would have **moderate** adverse impacts; and **major** impacts for scientific research and surveys. *Cumulative Impacts of the Proposed Action:* The Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind activities would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems and USCG SAR operations; and **major** for NOAA's scientific research and surveys.	*Alternative C:* Alternative C rerouting of export cables onshore would reduce localized impacts on cables and pipelines; however, overall impacts would remain the same as described under the Proposed Action: **negligible** impacts for marine mineral extraction and cables and pipelines; **minor** impacts for aviation and air traffic, radar systems, and most military and national security uses except for USCG SAR operations, which would have **moderate** adverse impacts; and **major** impacts for scientific research and surveys. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Alternative D could decrease impacts on radar systems on Nantucket Island by removing up to six WTGs closest to shore. While this would reduce line-of-sight impacts of the three radar systems on Nantucket Island, localized, long-term impacts on the other radar systems in the geographic analysis area are still anticipated, and overall impacts would remain the same as described under the Proposed Action: **negligible** impacts for marine mineral extraction and cables and pipelines; **minor** impacts for aviation and air traffic, radar systems, and most military and national security uses except for USCG SAR operations, which would have **moderate** adverse impacts; and **major** impacts for scientific research and surveys. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* The suction bucket and GBS foundations proposed under Alternatives E-2 and E-3 would have a larger seabed footprint and would exclude more area from future submarine and cable pipeline placement as compared to the piled foundations proposed under Alternative E-1. However, because future cables and pipelines would have the option to route around the foundations, impacts on cables and pipelines would remain the same as described under the Proposed Action: **negligible** impacts for marine mineral extraction and cables and pipelines; **minor** impacts for aviation and air traffic, radar systems, and most military and national security uses except for USCG SAR operations, which would have **moderate** adverse impacts; and **major** impacts for scientific research and surveys. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* Reducing the number of Falmouth offshore export cables to three would not meaningfully change the impacts on cables and pipelines because crossings would still be required at this, and other locations within the geographic analysis area. Impacts would remain the same as described under the Proposed Action: **negligible** impacts for marine mineral extraction and cables and pipelines; **minor** impacts for aviation and air traffic, radar systems, and most military and national security uses except for USCG SAR operations, which would have **moderate** adverse impacts; and **major** impacts for scientific research and surveys. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Fisheries Habitat Impact Minimization	Alternative D Nantucket Shoals	Alternative E Foundation Structures	Alternative F Muskeget Channel Cable Modification
3.6.8 Recreation and Tourism	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on recreation and tourism. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** adverse impacts from increased noise, vessel traffic, and offshore structures. **Minor beneficial** impacts would result from offshore structures that provide opportunities for sightseeing and fishing.	*Proposed Action:* The Proposed Action would result in **minor** impacts associated with noise, anchored vessels, hindrances on recreational vessel navigation, and visual impacts from the presence of offshore wind structures. **Minor beneficial** impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures. *Cumulative Impacts of the Proposed Action:* Overall, impacts from ongoing and planned activities including other offshore wind activities would result in **moderate** adverse and **minor beneficial**.	*Alternative C:* Alternative C would increase the length of the Brayton Point onshore cable route, resulting in increased impacts from traffic, noise, and temporary emissions that degrade the recreational experience, with Alternative C-2 resulting in the most impacts. The overall impact magnitudes would be the same as the Proposed Action: **minor** and **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative D:* Installation of up to six fewer WTGs under Alternative D would result in a negligible reduction of impacts on visual resources. Gear entanglements and loss, as well as allisions, and recreational fishing may slightly decrease due to fewer structures but the overall impact magnitude is the same as the Proposed Action: **minor** and **minor beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative E:* Alternative E, which would involve installing a range of foundation types, would not have measurable impacts on recreation and tourism that are materially different from the impacts of the Proposed Action. Impacts would be **minor** and **minor beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.	*Alternative F:* Alternative F, which would reduce the maximum number of Falmouth offshore export cables from five to three, would not have measurable impacts on recreation and tourism that are materially different from the impacts of the Proposed Action. Impacts would be **minor** and **minor beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be the same as the Proposed Action.
3.6.9 Scenic and Visual Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **major** impacts on recreation and tourism. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** to **major** impacts on seascape and landscape resources and **major** impacts on open ocean due to addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.	*Proposed Action:* Effects of offshore Project elements on high- and moderate-sensitivity seascape character units, open ocean character units, and landscape character units would be **minor** to **major**. Onshore facilities would result in **negligible** to **minor** impacts on scenic and visual resources. *Cumulative Impacts of the Proposed Action:* Overall, impacts from ongoing and planned activities including other offshore wind activities would result in **negligible** to **major** impacts.	*Alternative C:* Installation of longer onshore export cables and infrastructure would result in slightly greater localized, temporary visual impacts near construction sites than the Proposed Action. However, the overall impact on visual and scenic resources would be approximately the same as the Proposed Action: **minor** to **major**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**	*Alternative D:* Eliminating up to six WTGs may result in a slight reduction in visual impacts, but the number of structures removed would be small and it is unlikely these changes would be noticeable to the casual viewer. Therefore, impacts from Alternative D are anticipated to be approximately the same as the Proposed Action: **minor** to **major**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**.	*Alternative E:* Installation of different foundation types under Alternatives E-1, E-2, and E-3 would not change the most prominent visible aspects of WTGs and OSPs and, therefore, would have no meaningful difference in impacts on seascape, open ocean, and landscape character units and viewer experience compared to the Proposed Action and would result in **minor** to **major** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**.	*Alternative F:* The reduction in the number of cables installed along the Falmouth offshore export cable route under Alternative F may reduce the number of vessel trips required to install the cables, but this slight reduction in vessel activity would have no meaningful difference in impacts compared to the Proposed Action and would result in **minor** to **major** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities including other offshore wind activities would be **major**.

Chapter 3

Affected Environment and Environmental Consequences

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

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, BOEM identified information that was incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter. The identification and assessment of incomplete or unavailable information is presented in Appendix E, *Analysis of Incomplete and Unavailable Information*.

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

3.1 Impact-Producing Factors

BOEM completed a study on the North Atlantic OCS of impact-producing factors (IPFs) to consider in an offshore wind development planned activities scenario (2019). This document incorporates that study by reference. The study provides the following information.

- Identifies cause-and-effect relationships between renewable energy projects and the human environment (includes but is not limited to physical and biological resources, socioeconomic conditions, scenic and visual resources, and cultural 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 for consideration in a cumulative impacts analysis.
- Identifies actions and activities that may affect the same resources as renewable energy projects and states that such actions and activities may produce the same IPFs.

The study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS. As also discussed in the study, reasonably foreseeable actions other than offshore wind projects may also affect the same resources as the proposed offshore wind Project or other offshore wind projects, possibly via the same or additional IPFs. BOEM determined the relevance of each IPF to each resource analyzed in this Draft EIS. If BOEM found an IPF not associated with the proposed Project, it did not include it in the analysis.

Table 3.1-1 provides brief descriptions of the primary IPFs involved in this analysis, including examples of sources or activities that result in each IPF. The IPFs cover all phases of the Project, including construction, O&M, and decommissioning.

Table 3.1-1. Primary IPFs addressed in this analysis

IPF	Sources and Activities	Description
Accidental releases	• Mobile sources (e.g., vessels) • Installation, operation, and maintenance of onshore or offshore stationary sources (e.g., wind turbine generators, offshore substations, transmission lines, and interarray cables)	Refers to unanticipated releases or spills into receiving waters of a fluid or other substance, such as fuel, hazardous materials, suspended sediment, invasive species, trash, or debris. Accidental releases are distinct from routine discharges, consisting of authorized operational effluents, and they are restricted via treatment and monitoring systems and permit limitations.
Air emissions	• Combustion related stationary or mobile emission sources (e.g., generators [both on- and offshore], or support vessels, vehicles, and aircraft) • Non-combustion related sources, such as leaks from tanks and switchgears	Refers to emission sources that emit regulated air pollutants (gaseous or particulate matter) into the atmosphere. Releases can occur on- and offshore.
Anchoring	• Anchoring of vessels Attachment of a structure to the sea bottom by use of an anchor, mooring, or gravity-based weighted structure (i.e., bottom-founded structure)	Refers to seafloor disturbance (anything below Mean Higher High Water [MHHW]) related to any offshore construction or maintenance activities. Refers to an activity or action that disturbs or attaches objects to the seafloor.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Cable protection of concrete mattress and rock placement	Refers to seafloor disturbances (anything below MHHW) related to the installation and maintenance of new offshore submarine cables. Cable placement methods include trenchless installation (such as HDD, direct pipe, and auger bore), jetting, vertical injection, control flow excavation, trenching, and plowing.

IPF	Sources and Activities	Description
Discharges/intakes	• Vessels • Structures • Onshore point and non-point sources • Dredged material • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure • High-voltage direct current (HVDC) converter cooling system	Refers to routine permitted operational effluent discharges of pollutants to receiving waters. Types of discharges may include bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, seawater cooling system intake and effluent, and HDD fluid. Water pollutants include produced water, manufactured or processed hydrocarbons, chemicals, sanitary waste, and deck drainage. Rainwater, freshwater, or seawater mixed with any of these constituents is also considered a pollutant. These discharges are restricted to uncontaminated or properly treated effluents that require best management practice and/or numeric pollutant concentration limitations as required through USEPA National Pollutant Discharge Elimination System permits or USCG regulations. Refers to the discharge of solid materials, such as the deposition of sediment at approved offshore disposal or nourishment sites and cable protection. Discharge of dredged and/or fill material may be regulated through the Clean Water Act. Refers to entrainment/impingement as a result of intakes used by cable laying equipment and in HVDC converter cooling systems.
Electric and magnetic fields (EMFs) and cable heat	• Substations • Power transmission cables • Interarray cables • Electricity generation	Power generation facilities and cables produce electric fields (proportional to the voltage) and magnetic fields (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of the magnetic and induced electric fields from offshore wind energy projects: (1) the amount of electrical current being generated or carried by the cable, (2) the design of the generator or cable, and (3) the distance of organisms from the generator or cable. Refers to thermal effects of the transmission of electrical power, dependent on cable design and burial depth.
Gear utilization	• Monitoring surveys	Refers to entanglement and bycatch during monitoring surveys.

IPF	Sources and Activities	Description
Land disturbance	• Vegetation clearance • Excavation • Grading • Placement of fill material	Refers to land disturbances during 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 that may produce light above the water onshore and offshore, as well as underwater. Refers to lighting associated with onshore Project infrastructure during construction and O&M, such as permanent lighting at O&M facilities.
Noise	• Aircraft • Vessels • Turbines • Geophysical (HRG surveys) and geotechnical surveys (drilling) • Construction equipment • Operations and maintenance • Onshore and offshore construction and installation • Vibratory and impact pile driving • Dredging and trenching • Unexploded ordnances (UXO) detonations	Refers to noise from various sources. Commonly associated with construction activities, geophysical and geotechnical surveys, and vessel traffic. May be impulsive (e.g., pile driving) or broad spectrum and continuous (e.g., from Project-associated marine transportation vessels and onshore substations). 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 occur only as a result of the Project from increased economic activity. Includes activities related to port expansion and construction such as placement of dredged materials, dredging to deepen channels for larger vessels, and maintenance dredging.
Presence of structures	• Onshore structures including towers and transmission cable infrastructure • Offshore structures including WTGs, OSPs, and scour/cable protection	Refers to the post-construction, long-term presence of onshore or offshore structures.
Traffic	• Aircraft • Vessels (construction, operation and maintenance, surveys) • Vehicles • Towed arrays/equipment	Refers to marine and onshore vessel and vehicle use, including use in support of surveys such as geophysical and geotechnical, fisheries monitoring, and biological monitoring surveys.

3.2 Mitigation Identified for Analysis in the Environmental Impact Statement

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

3.3 Definition of Impact Levels

In accordance with the most recent CEQ NEPA regulations (40 CFR 1501.3), federal agencies are required to evaluate the potentially affected environment and degree of the effects of the action when considering if effects are significant.

This Draft EIS uses a four-level classification scheme to characterize the potential adverse and beneficial impacts of the Proposed Action and alternatives. Impact levels described in BOEM's 2007 *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* were used as the initial basis for establishing adverse impacts specific to each resource. These resource-specific impact-level definitions were then further refined based on prior NEPA analyses, scientific literature, and best professional judgment and are presented in each resource section. The impact classification used in the analyses is considered an adverse impact unless specified with a bolded "beneficial."

Overall determinations consider the context, intensity, directionality (adverse or beneficial), and duration of the effects and provide the basis for the impact-level determination by resource. When considering the magnitude of impacts, the analysis should identify if the impacts are geographically local, regional, or widespread. With regard to temporal extent, the Draft EIS assumes that potential construction effects generally diminish once construction ends; however, ongoing O&M activities could result in additional impacts during the 35-year life of the Project. Following O&M, Mayflower Wind would complete decommissioning activities. Therefore, the Draft EIS considers the time frame beginning with construction and installation and ending when the Project's conceptual decommissioning is complete, unless otherwise noted.

When considering duration of impacts under NEPA, this Draft EIS uses the following terms.

- Short-term effects: Effects that may extend up to 3 years. An example would be clearing of onshore shrubland vegetation for a construction staging area; the area would be revegetated when the construction is complete, and, after revegetation is successful, this effect would end.
- Long-term effects: Effects lasting longer than 3 years and may extend for the life of the Project (35 years). An example would be the loss of habitat where a foundation has been installed.
- Permanent effects: Effects that extend beyond the life of the Project. An example would be the conversion of land to support new onshore facilities.

Some impacts of the Proposed Action may not be measurable at the project level, such as the beneficial impacts on benthic resources due to artificial habitat or climate change due to a reduction in greenhouse gas emissions.

3.4 Physical Resources

3.4.1 Air Quality

This section discusses potential impacts on air quality from the proposed Project, alternatives, and ongoing and planned activities in the air quality geographic analysis area. The air quality geographic analysis area, as shown on Figure 3.4.1-1, includes the airshed within 25 miles (40 kilometers) of the Lease Area and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and ports that may be used for the Project. The geographic analysis area encompasses the geographic region subject to USEPA review as part of an OCS permit for the Project under the Clean Air Act (CAA) (42 USC 7409). The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the marshalling port(s) outside of the OCS permit area. Given the generally low emissions of the sea vessels and equipment that would be used during proposed construction activities, any potential air quality impacts would likely be within a few miles of the source. BOEM selected the 15.5-mile (25-kilometer) distance to provide a reasonable buffer.

3.4.1.1 Description of the Affected Environment and Future Baseline Conditions

The geographic analysis area for air quality covers most of Rhode Island, southeastern Massachusetts eastward across Cape Cod, southward across Martha's Vineyard, and over the open ocean south and west of Martha's Vineyard. This includes the air above the Wind Farm Area and adjacent OCS area, the offshore export cable routes and onshore cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports used to support proposed Project activities. COP Volume 2, Table A-1 (Mayflower Wind 2022a), provides further description of the air quality geographic analysis area. Appendix B, *Supplemental Information and Additional Figures and Tables*, provides information on climate and meteorological conditions in the Project area and vicinity.

Air quality within a region is measured in comparison to the National Ambient Air Quality Standards (NAAQS), which are standards established by USEPA pursuant to the CAA for several common pollutants, known as criteria pollutants, to protect human health and welfare. The criteria pollutants are carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone, particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). Massachusetts has established ambient air quality standards (AAQS) that are similar to the NAAQS. Table 3.4.1-1 shows the NAAQS. Emissions of lead from Project-associated sources would be negligible because lead is not a component of liquid or gaseous fuels; accordingly, lead is not analyzed in this EIS. Ozone is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily nitrogen oxides (NO_X) and volatile organic compounds (VOCs), in the presence of sunlight. Potential impacts of a project on ozone levels are evaluated in terms of NO_X and VOC emissions.

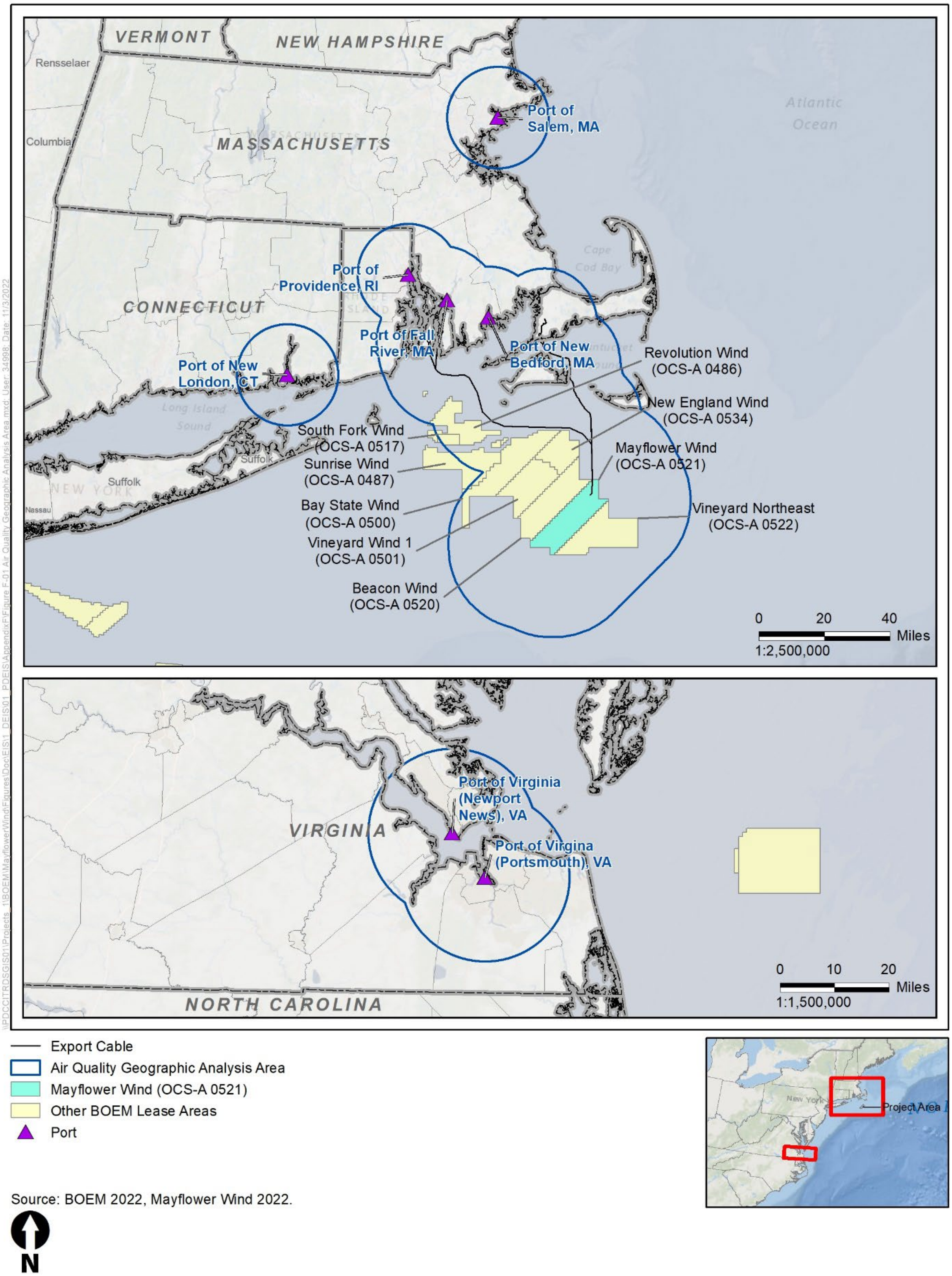

Figure 3.4.1-1. Air quality geographic analysis area

Table 3.4.1-1. National Ambient Air Quality Standards

Criteria Pollutant		Primary/ Secondary	Averaging Time	Level	Form of Standard
Carbon Monoxide (CO)		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		Primary and secondary	Rolling 3-month average	0.15 μg/m^3 [a]	Not to be exceeded
Nitrogen Dioxide (NO_2)		Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and secondary	1 year	53 ppb [b]	Annual mean
Ozone (O_3)		Primary and secondary	8 hours	0.070 ppm [c]	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	Primary	1 year	12.0 μg/m^3	Annual mean, averaged over 3 years
		Secondary	1 year	15.0 μg/m^3	Annual mean, averaged over 3 years
		Primary and secondary	24 hours	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		Primary	1 hour	75 ppb [d]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Source: 40 CFR 50.
μg/m^3 = micrograms of pollutant per cubic meter of air; ppb = parts per billion;
ppm = parts per million.

[a] In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 μg/m^3 as a calendar quarter average) also remain in effect.

[b] The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

[c] Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards are not revoked and remain in effect for designated areas. Additionally, some areas may have certain continuing implementation obligations under the prior revoked 1-hour (1979) and 8-hour (1997) O_3 standards.

[d] The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards (40 CFR 50.4(3)). A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

USEPA designates all areas of the country as being in attainment or nonattainment, or as unclassified for each criteria pollutant. An attainment area is an area where all criteria pollutant concentrations are within all NAAQS. A nonattainment area does not meet the NAAQS for one or more pollutants. Unclassified areas are those where attainment status cannot be determined based on available information and are regulated as attainment areas. An area can be in attainment for some pollutants and nonattainment for others. If an area was in nonattainment at any point in the last 20 years but is currently in attainment or is unclassified, then the area is designated a maintenance area. Nonattainment and maintenance areas are required to prepare a State Implementation Plan, which describes the region's program to attain and maintain compliance with the NAAQS. The attainment status of an area can be found at 40 CFR 81 and in the USEPA Green Book, which the agency revises from time to time (USEPA 2021a). Attainment status is determined through evaluation of air quality data from a network of monitors.

All of southeastern Massachusetts is currently designated as unclassifiable or in attainment for all criteria pollutants, except for Dukes County on Martha's Vineyard, which is designated as marginally in nonattainment for the 2008 ozone NAAQS of 75 parts per billion (ppb). Though the 2008 NAAQS are still technically in effect, Dukes County was designated in attainment in August 2018 against the current, more stringent 2015 ozone NAAQS of 70 ppb. Thus, though the 2008 designation has not yet been changed, monitored values in Dukes County have significantly improved since 2011. Dukes County is in attainment with the 2015 ozone NAAQS standard; however, its official designation is as a "marginal nonattainment area" based on the 2008 ozone standard. Administratively, USEPA must change this designation to attainment, but has not yet done so. The entire state of Rhode Island is currently in attainment for all criteria pollutants.

Mayflower Wind is considering a number of ports for project construction, the nearest being the Port of New Bedford, Massachusetts and the Port of Providence, Rhode Island, and additional locations in New England. Mayflower Wind is considering the ports of New Bedford and Fall River, Massachusetts for project operations and maintenance. More distant ports that could be used include Port of Virginia, Virginia. The attainment status of these ports varies. The potential ports in the New England region are in attainment areas except for the Port of New London, Connecticut, which is in a nonattainment area for the ozone NAAQS. The Port of Virginia, Virginia is in an attainment area. Figure 3.4.1-1 shows the locations of all these ports.

The CAA prohibits federal agencies from approving any activity that does not conform to a State Implementation Plan. This prohibition applies only with respect to nonattainment or maintenance areas (i.e., areas that were previously in nonattainment and for which a maintenance plan is required). Conformity to a State Implementation Plan means conformity to a State Implementation Plan's purpose of reducing the severity and number of violations of the NAAQS to achieve attainment of such standards. The activities for which BOEM has authority are outside of any nonattainment or maintenance area and, therefore, not subject to the requirement to show conformity.

The CAA defines Class I areas as certain national parks and wilderness areas where very little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres and wilderness areas larger than 5,000 acres that were in existence before August 1977. Projects subject to federal permits are required to notify the federal land manager responsible for designated Class I areas within 62 miles (100 kilometers) of a Project[1] (USEPA 1992). The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of the Project on air quality–related values. Air quality–related values identified by the federal land manager for a particular Class I area may include criteria pollutants, visibility, and acidic deposition. The nearest Class I area is the Lye Brook Wilderness, Vermont, which is approximately 130 miles (210 kilometers) from the nearest Project component (the Brayton Point HVDC Converter Station). This distance is greater than the 100-kilometer distance within which USEPA recommends that the federal land manager of the Class I area be notified about a project that requires a federal air quality permit.

The CAA amendments directed USEPA to establish requirements to control air pollution from OCS oil- and gas-related activities along the Pacific, Arctic, and Atlantic Coasts and along the U.S. Gulf Coast off of Florida, east of 87° 30′ west longitude. The OCS Air Regulations (40 CFR 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for facilities subject to the CAA. These regulations apply to OCS sources that are beyond state seaward boundaries. Projects within 25 nautical miles of a state seaward boundary are required to comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements.

3.4.1.2 Impact Level Definitions for Air Quality

Definitions of potential impact levels are provided in Table 3.4.1-2. Impact levels are intended to serve NEPA purposes only, and they are not intended to establish thresholds or other requirements with respect to permitting under the CAA.

Table 3.4.1-2. Impact level definitions for air quality

Impact Level	Type of Impact	Definition
Negligible	Adverse	Increases in ambient pollutant concentrations due to Project emissions would not be detectable.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would not be detectable.
Minor to Moderate	Adverse	Increases in ambient pollutant concentrations due to Project emissions would be detectable but would not lead to violation of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be detectable.
Major	Adverse	Increases in ambient pollutant concentrations due to Project emissions could cause or contribute to violation of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be larger than for minor to moderate impacts.

[1] The 100-kilometer distance applies to notification and is not a threshold for use in evaluating impacts. Impacts at Class I areas at distances greater than 100 kilometers may need to be considered for larger emission sources if there is reason to believe that such sources could affect the air quality in the Class I area (USEPA 1992).

3.4.1.3 Impacts of Alternative A – No Action on Air Quality

When analyzing the impacts of the No Action Alternative on air quality, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for air quality. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for air quality described in Section 3.4.1.1, *Description of the Affected Environment and Future Baseline Conditions* 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 air quality are generally associated with onshore impacts, including residential, commercial, industrial, and transportation activities as well as construction. These activities and associated impacts are expected to continue at current trends and have the potential to affect air quality through their emissions. Impacts associated with climate change could affect ambient air quality through increased formation of ozone and particulate matter associated with increasing air temperatures.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on air quality include ongoing construction of the Vineyard Wind 1 project (62 WTGs and 1 OSP) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSP) in OCS-A 0517. Ongoing construction of the Vineyard Wind 1 and South Fork projects would have the same type of impacts on air quality that are described in *Cumulative Impacts of the No Action Alternative* for all ongoing and planned offshore wind activities in the geographic analysis area, but would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). The Massachusetts Global Warming Solutions Act of 2008 sets out a series of requirements for how the state is to achieve greenhouse gas (GHG) emissions reductions by mid-century. One of the requirements is for the state to set an emissions limit for 2030 and develop an implementation plan to achieve that limit. Massachusetts has set its GHG emissions reduction target for the next decade at a 45 percent reduction below the 1990 level in 2030. The Massachusetts Clean Energy and Climate Plan for 2025 and 2030 establishes a blueprint for achieving this limit equitably and affordably, with major new initiatives advancing decarbonization of the Commonwealth's buildings, transportation, and electricity sectors (EEA 2022). Similarly, Rhode Island Executive Order 20-01 of 2020 set a goal to meet 100 percent of Rhode Island's electricity demand with renewable energy by 2030. The Rhode Island State Energy Plan demonstrates that Rhode Island can increase sector fuel diversity, produce net economic benefits, and reduce GHG emissions by 45 percent by the year 2035. The plan proposes advanced policies and strategies to achieve those goals (OER 2015).

Impacts from fossil-fueled power facilities are expected to be mitigated partially by implementation of other offshore wind projects near the geographic analysis area, including in the regions off New England, New York, New Jersey, Delaware, Maryland, and Virginia to the extent that these wind projects would result in a reduction in emissions from fossil-fueled power facilities. Other planned activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; oil and gas activities; and onshore development activities (see Appendix D, Section D.2 for a complete description of planned activities).

The sections below summarize the potential impacts of ongoing and planned offshore wind activities (other than the Proposed Action) on air quality during construction, O&M, and decommissioning of the projects. The air quality geographic analysis area overlaps with most, but not all, of the offshore wind lease areas in the Massachusetts and Rhode Island region (Figure 3.4.1-1). BOEM conservatively assumed in its analysis of air quality impacts that all 901 WTGs estimated for the Massachusetts/Rhode Island region (except for the Proposed Action) associated with OCS-A-0486, OCS-A-0487, OCS-A-0500, OCS-A 0501, OCS-A 0517, OCS-A-0520, OCS-A 0522, OCS-A 0534 would be sited within the air quality geographic analysis area (Appendix D, Table D2-1).

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

Air emissions: Most air pollutant emissions and air quality impacts from offshore wind projects would occur during construction, potentially from multiple projects occurring simultaneously. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. All projects would be required to comply with the CAA. Primary emissions sources would include increased public and commercial vehicular traffic, air traffic, combustion emissions from construction equipment, and fugitive emissions from construction-generated dust. During operations, emissions from future offshore wind projects in the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would result largely from commercial vessel traffic and emergency diesel generators. The aggregate operational emissions for all projects in the air quality geographic analysis area would vary by year as successive projects begin operation. As wind energy projects come online, power-generation emissions overall could decrease and the region as a whole could realize a net benefit to air quality.

The offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts in the air quality geographic analysis area include projects within all or portions of the following lease areas: OCS-A-0486, OCS-A-0487, OCS-A-0500, OCS-A 0501, OCS-A 0517, OCS-A-0520, OCS-A 0522, OCS-A 0534 (Appendix D, Table D2-4). If fully developed, projects proposed in these lease areas would produce 14 GW of renewable power from the installation of 901 WTGs (Appendix D, Table

D2-1). Based on the assumed offshore construction schedule in Table D2-1, the projects in the geographic analysis area would be in construction between 2023 and 2030.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Mayflower Wind proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 34,496 tons of CO, 165,807 tons of NO_X, 8,808 tons of PM_{10}, 5,589 tons of $PM_{2.5}$, 4,441 tons of SO_2, 5,732 tons of VOCs, and 11,228,498 tons of carbon dioxide (CO_2) (Appendix D, Table D2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would be minor, shifting spatially and temporally across the geographic analysis area.

During operations, emissions from offshore wind projects in the geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. The aggregate operational emissions for all projects in the analysis area would vary by year as successive projects begin operation. Estimated operational emissions would be 1,297 tons per year of CO, 5,073 tons per year of NO_X, 152 tons per year of PM_{10}, 137 tons per year of $PM_{2.5}$, 75 tons per year of SO_2, 100 tons per year of VOCs, and 412,263 tons per year of CO_2 (Appendix D, Table D2-4). Operational emissions would result in negligible air quality impacts because emissions would be intermittent, localized, and dispersed throughout the combined lease areas and vessel routes from the onshore O&M facility.

Offshore wind energy development could help displace emissions from fossil fuels, potentially improving regional air quality and reducing GHG emissions. An analysis by Katzenstein and Apt (2009), for example, estimates that CO_2 emissions can be reduced by up to 80 percent and NO_X emissions can be reduced up to 50 percent by implementing wind energy projects.[2] An analysis by Barthelmie and Pryor (2021) calculated that, depending on global trends in GHG emissions and the amount of wind energy expansion, development of wind energy could reduce predicted increases in global surface temperature by 0.3 to 0.8 degrees Celsius (°C) (0.5–1.4 degrees Fahrenheit [°F]) by 2100.

Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about the air pollutant emissions contributions of the existing and projected mixes of power generation sources, and generally estimate the annual health

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[2] Katzenstein and Apt (2009) modeled a system of two types of natural gas generators, four wind farms, and one solar farm. The power output of wind and solar facilities can vary relatively rapidly as meteorological conditions change, and the natural gas generators vary their power output accordingly to meet electrical demand. When gas generators change their power output their emissions rates may increase above their steady-state levels. As a result, the net emissions reductions realized from gas generators reducing their output in response to wind and solar power can be less than the reduction that would be expected based solely on the amount of wind and solar power. The study found that reductions in CO_2 emissions would be about 80 percent, and in NO_X emissions about 30 to 50 percent, of the emissions reductions expected if the power fluctuations caused no additional emissions.

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

The potential health benefits of avoided emissions can be evaluated using USEPA's CO-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool (USEPA 2020a). COBRA is a tool that estimates the health and economic benefits of clean energy policies. COBRA was used to analyze the avoided emissions that were calculated for development of 36 GW of reasonably foreseeable wind power on the OCS from ongoing and planned offshore wind projects (Appendix D, Table D2-1). Table 3.4.1-3 presents the estimated monetized health benefits and avoided mortality for this scenario.

Table 3.4.1-3. COBRA estimate of annual avoided health effects with 36 GW reasonably foreseeable offshore wind power

Discount Rate[a] (2023)	Monetized Total Health Benefits (million U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[b]	High Estimate[b]	Low Estimate[b]	High Estimate[b]
3%	$232	$523	21	47
7%	$203	$460	21	47

Source: USEPA 2020a.
[a] The discount rate is used to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the "time value of money" preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2020b).
[b] The low and high estimates are derived using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2020b).

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

Accidental releases: Offshore wind activities could release VOCs and HAPs because of accidental chemical spills in the geographic analysis area. Section 3.4.2, *Water Quality*, discusses the nature of releases anticipated. Based on Appendix D, Table D2-3, up to about 1,833,481 gallons (6.9 million liters) of coolants, 6,835,448 gallons (25.9 million liters) of oils and lubricants, and 1,729,064 gallons (6.5 million liters) of diesel fuel would be contained in the 920 wind turbine and substation structures for the wind energy projects in the geographic analysis area. If accidental releases occur, they would be most likely during construction but could occur during operation and decommissioning of offshore wind facilities. These may lead to short-term periods (hours to days)[3] of HAP emissions through surface evaporation. HAP emissions would consist of VOCs, which may be important for ozone formation. By

[3] For example, small diesel fuel spills (500–5,000 gallons) usually will evaporate and disperse within a day or less (NOAA 2006).

comparison, the smallest tanker vessel operating in these waters (a general-purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million and 30.3 million liters). Tankers are relatively common in these waters, and the total WTG chemical storage capacity in the geographic analysis area is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). BOEM expects air quality impacts from accidental releases would be negligible because impacts would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 30-year period with a higher probability of spills during future project construction, but they would not be expected to contribute appreciably to overall impacts on air quality.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, air quality would continue to reflect current regional trends and respond to IPFs introduced by other ongoing activities. Additional, higher-emitting, fossil-fueled power facilities could be built, or could be kept in service, to meet future power demand, fired by natural gas, oil, or coal. These impacts would be partially mitigated once the approved Vineyard Wind 1 and South Fork offshore wind projects are operational. BOEM expects ongoing non-offshore wind activities and offshore wind activities to have continuing regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change. BOEM anticipates that the impacts of ongoing activities, such as air pollutant emissions and GHGs, would be **moderate**.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue to affect air quality in the geographic analysis area. Planned non-offshore wind activities would contribute to impacts on air quality because air pollutant and GHG emissions would increase through construction and operation of new energy generation facilities to meet future power demands. Although there are no such energy generation facilities planned to occur in the geographic analysis area, continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts in Massachusetts and the other New England states.

Planned and ongoing offshore wind activities would contribute to air quality impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Impacts would be minor because these emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or Massachusetts AAQS. Pollutant emissions during operations would be generally lower and more transient. Most air pollutant emissions and air quality impacts would occur during multiple overlapping project construction phases from 2023 through 2030. Once operational, offshore wind projects likely would lead to beneficial impacts on air quality through reduced emissions from fossil-fueled power facilities.

Overall, BOEM anticipates the cumulative impacts of the No Action Alternative on air quality from ongoing and planned activities would be **moderate**, largely driven by emissions from fossil-fueled power facilities, other ongoing and planned non-offshore wind emissions, and emissions from construction and decommissioning of offshore wind projects. Because offshore wind projects likely would lead to reduced emissions from fossil-fueled power facilities, BOEM also anticipates the cumulative impacts of the No Action Alternative would result in **minor** to **moderate beneficial** impacts on regional air quality.

Construction and operation of offshore wind projects would produce GHG emissions that would contribute incrementally to climate change. CO_2 is relatively stable in the atmosphere and, for the most part, mixed uniformly throughout the troposphere and stratosphere. As such, the impact of GHG emissions does not depend on the source location. Increasing energy production from offshore wind projects would likely reduce regional GHG emissions by displacing energy from fossil fuels. This reduction would more than offset the relatively small GHG emissions from offshore wind projects. Regional reductions in GHG emissions would support states in meeting their renewable energy and emissions goals and would reinforce ongoing trends toward electrifying transportation and heating, as the climate benefits of electrification of these sectors depend on renewable electricity as a lower-emissions source of energy than fossil fuels. In all, the reduction in regional GHG emissions would be noticeable in the regional context, would contribute incrementally to reducing climate change, and would represent a moderate beneficial impact in the regional context but a negligible beneficial impact in the global context.

3.4.1.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the following sections. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on air quality.

- Emissions ratings of construction equipment and vehicle engines.
- Location of construction laydown areas.
- Choice of cable-laying locations and pathways.
- Choice of marine traffic routes to and from the Wind Farm Area and offshore export cable routes.
- Soil characteristics at excavation areas, which may affect fugitive emissions.
- Emissions control strategy for fugitive emissions due to excavation and hauling operations.

Changes to the design capacity of the WTGs would not alter the maximum potential air quality impacts for the proposed Project and alternatives because the maximum-case scenario involves the maximum number of WTGs (147) allowed in the PDE.

Mayflower Wind has committed to measures to minimize impacts on air quality. Low sulfur fuels would be used to the extent practicable. Low-NO_X engines designed to reduce air pollution would be used when practicable. Mayflower Wind would implement an onshore construction schedule to minimize effects on neighboring land uses to the extent feasible. Best management practices would be implemented throughout the Project phases to reduce potential air quality effects. Impacts from accidental releases would be reduced through implementation of a Stormwater Pollution Prevention

Plan (SWPPP) and a Spill Prevention, Control, and Countermeasure Plan. The SWPPP also would include measures to control fugitive dust that may be generated as a result of soil disturbance and construction vehicle traffic (COP Volume 2, Table 16-1; Mayflower Wind 2022a).

3.4.1.5 Impacts of Alternative B - Proposed Action on Air Quality

The Proposed Action may generate emissions and affect air quality in the Massachusetts region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur in the onshore export cable corridors and at points of interconnection, potentially including the Falmouth Tap substation in Falmouth, Massachusetts, and the National Grid substation at Brayton Point in Somerset, Massachusetts. Offshore emissions would be within the OCS, including state offshore waters. Offshore emissions would occur in the Lease Area and the offshore export cable corridors. COP Volume 1, Section 3.3 (Mayflower Wind 2022a) provides additional information on land use and proposed ports.

Air quality in the geographic analysis area may be affected by emissions of criteria pollutants from sources involved in the construction or maintenance of the Proposed Action and, potentially, during operations. These impacts, while generally localized to the areas near the emissions sources, may occur at any location associated with the Proposed Action, be it offshore in the Wind Farm Area or at any of the onshore construction or support sites. Ozone levels in the region also could be affected.

The Proposed Action's WTGs, substations, and offshore and onshore cable corridors would not themselves generate air pollutant emissions during normal operations. However, air pollutant emissions from equipment used in the construction, O&M, and decommissioning phases could affect air quality in the geographic analysis area and nearby coastal waters and shore areas. Most emissions would occur temporarily during construction, offshore in the Wind Farm Area, onshore at the landfall sites, along the offshore and onshore export cable routes, at the onshore substation and converter station sites, and at the construction staging areas. Additional emissions related to the Proposed Action could also occur at the ports used to transport material and personnel to and from the Project area. However, the Proposed Action would provide beneficial impacts on air quality in the vicinity of the Project and the surrounding region to the extent that energy produced by the Proposed Action would displace energy produced by fossil-fueled power facilities.

The majority of air pollutant and GHG emissions from the Proposed Action alone would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities. Fugitive dust emissions would occur as a result of excavation and hauling of soil during onshore construction activities. Emissions from the OCS source, as defined in the CAA, would be permitted as part of Mayflower Wind's OCS permit.

Air Emissions – Construction

Fuel combustion, earthmoving, and solvent use would cause construction-related emissions. The air pollutants would include criteria pollutants, VOCs, HAPs, and GHGs. During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality. Construction equipment would comply with all applicable fuel-efficiency, fuel sulfur content, and emissions standards to minimize combustion emissions and associated air quality impacts. The total estimated construction emissions of each pollutant are summarized in Table 3.4.1-4. BOEM anticipates that air quality impacts from construction of the Proposed Action would be minor.

Table 3.4.1-4. Mayflower Wind total construction emissions (criteria pollutants and VOCs in U.S. tons; GHGs in metric tons)

Year[a]	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
2023	497	2,352	469	244	91	104	144,568	0.7	5.0	145,905
2024	2,542	12,819	818	446	498	545	756,599	3.7	27	763,972
2025	3,872	18,728	1,016	560	730	733	1,102,116	5.6	42	206,235
2026	1,373	6,066	594	316	237	208	361,760	2.0	15	365,681
Total	8,284	39,964	2,897	1,566	1,556	1,1,589	2,365,042	12	89	2,388,972

Source: COP, Appendix G, Table 5-1; Mayflower Wind 2022a.
Sum of individual values may not equal total due to rounding.
[a] Mayflower Wind has revised its construction schedule to 7 years from 4 years; however, Mayflower Wind COP Appendix G (the source for the emissions data in Table 3.4.1-4) reflects 4 years of construction emissions. BOEM expects that total construction emissions over a 7-year period would be similar to the totals shown in the table, but that maximum annual emissions would be less than in the table because construction would be spread out over 7 years instead of 4.

Offshore Construction

Emissions from potential construction activities would vary throughout the construction and installation of offshore components. Emissions from offshore activities would occur during pile driving and scour-protection installation, offshore cable laying, turbine installation, and substation installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and substations so that workers could operate lights, controls, and other equipment before cabling is in place. There also would be emissions from engines used to power pile-driving hammers and air compressors used to supply compressed air to noise-mitigation devices during pile driving (if used). Emissions from vessels used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. The Proposed Action may need emergency generators at times, potentially resulting in increased emissions for limited periods. Mayflower Wind has proposed measures to reduce emissions including compliance with applicable fuel-efficiency, fuel sulfur content, and emissions standards (COP Volume 2, Table 16-1; Mayflower Wind 2022a).

The majority of air pollutant and GHG emissions from the Proposed Action alone would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities. Fugitive dust emissions would occur as a result of excavation and hauling of soil during onshore construction activities. Emissions from the OCS source, as defined in the CAA, would be permitted as part of the OCS permit for which Mayflower Wind is currently in the application process. The Project must demonstrate compliance with the NAAQS. The OCS air permitting process includes air dispersion modeling of emissions to demonstrate compliance with the NAAQS. The CAA also provides protection of air quality in Class I wilderness areas by means of the NAAQS and the Prevention of Significant Deterioration (PSD) program and gives federal land managers a responsibility to protect the air quality–related values of Class I areas from the adverse impacts of air pollution. If emissions from the Project would cause or contribute to adverse impacts on the air quality–related values of a Class I area, the permitting authority (i.e., USEPA) can deny the permit. As part of the air quality–related values analysis, the Project must demonstrate that significant visibility degradation would not occur.

NAAQS and PSD Dispersion Modeling

As part of the *Mayflower Wind Outer Continental Shelf Air Permit Application* (OCS Application) (Mayflower Wind 2022b), Mayflower Wind conducted dispersion modeling to demonstrate that construction of the Proposed Action will show modeled compliance with the NAAQS and PSD increments. Construction activities were divided among 11 scenarios (e.g., Seabed Prep/Scour Protection), which were selected based on consideration of the locations in which they are expected to occur as well as the likelihood that activities could take place simultaneously. The OCS Application, *Appendix C – OCS Permit Air Quality Modeling Report*, Section 4.4, *Modeling Scenarios* (Mayflower Wind 2022b), provides further description of the air quality modeling scenarios.

For the purposes of modeling, it was assumed that the worst-case year (resulting in the highest air emissions) will include up to 85 potential WTGs constructed and 1 OSP constructed within that year. Short-term construction modeling assumed all construction scenarios except OSP installation occurring simultaneously during a single day in the Lease Area but at separate/adjacent WTG locations. The overlap of impacts from an adjacent WTG location was accounted for by adding a representative concentration from another scenario (Mayflower Wind 2022b: Appendix C, Section 4.0).

Dispersion modeling was conducted in accordance with USEPA's *Guideline on Air Quality Models*, which is contained in 40 CFR Part 51, Appendix W, *Guidance for Ozone and Fine Particulate Matter Permit Modeling*, and MassDEP's *Modeling Guidance for Significant Stationary Sources of Air Pollution* (Mayflower Wind 2022b: Appendix C, Section 4.0). The USEPA's AERMOD-AERCOARE model was used to estimate criteria pollutant concentrations for comparison to the NAAQS and PSD increments (Mayflower Wind 2022b: Appendix C, Section 4.2). Three years (2018–2020) of Weather Research and Forecasting prognostic model data obtained from USEPA were selected for use in developing the overwater data required by AERCOARE. The Mesoscale Model Interface Program (MMIF–Version 4.0) was used to extract the meteorological data from a grid point located nearest to the Lease Area centroid (Mayflower Wind 2022b: Appendix C, Section 4.3). Emissions of secondary pollutants (particulate matter and ozone formed in the atmosphere from reactions of precursor chemicals) were estimated using USEPA's *Guidance on the Development of Modeled Emission Rates for Precursors as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program* (Mayflower Wind 2022b: Appendix C, Section 4.10).

Table 3.4.1-5 and Table 3.4.1-6 present a summary of model results for comparison to the NAAQS and PSD increments, respectively. The maximum modeled impact includes the contribution from nearby simultaneous-emissions scenarios where applicable. As shown in the tables, all pollutants and averaging periods are less than the NAAQS and PSD increments.

Table 3.4.1-5. Estimated pollutant concentrations during construction compared to NAAQS

Pollutant	Averaging Period	Rank [a]	Modeled Design Concentration [b] (μg/m³)	Background Concentration (μg/m³)	Total Conc. (μg/m³)	NAAQS (μg/m³)	% of NAAQS
CO	1-hour	H2H	2,430	1,803	4,233	40,000	11%
CO	8-hour	H2H	1,016	1,146	2,162	10,000	22%
NO_2	1-hour	98^{th}%ile	173.76	Included [c]	173.76	188	92%
NO_2	Annual	Max	11.47	12.38	23.85	100	24%
PM_{10}	24-hour	H2H	10.23	26	36.23	150	24%
$PM_{2.5}$	24-hour	98^{th} %ile	4.76 [d]	16.2	20.96	35	60%
$PM_{2.5}$	Annual	Max	0.58 [d]	6.61	7.19	12	60%
SO_2	1-hour	99^{th} %ile	50.93	7.86	58.8	196	30%

Source: Mayflower Wind 2022b, Appendix C – OCS Permit Air Quality Modeling Report, Table 5-3.
μg/m³ = micrograms of pollutant per cubic meter of air
[a] H2H = highest second-highest, 98th %ile = 98th percentile, 99th %ile = 99th percentile, Max = Maximum annual concentration.
[b] Maximum modeled design concentration over all construction scenarios. Contributions from nearby simultaneous scenarios are included, where applicable.
[c] Seasonal and hourly varying background concentrations were included directly in AERMOD.
[d] Includes $PM_{2.5}$ secondary concentration.

Table 3.4.1-6. Estimated pollutant concentrations during construction compared to Prevention of Significant Deterioration increments

Pollutant	Averaging Period	Rank [a]	Modeled Design Concentration [b] (μg/m³)	PSD Increment (μg/m³)	% of PSD Increment
NO_2	Annual	Max	11.5	25	46%
PM_{10}	24-hour	H2H	10.2	30	34%
PM_{10}	Annual	Max	0.6	17	3%
$PM_{2.5}$	24-hour	H2H	8.7 [c]	9	96%
$PM_{2.5}$	Annual	Max	0.58 [c]	4	15%
SO_2	3-hour	H2H	59.3	512	12%
SO_2	24-hour	H2H	22.1	91	24%
SO_2	1-hour	Max	0.7	20	4%

Source: Mayflower Wind 2022b, Appendix C – OCS Permit Air Quality Modeling Report, Table 5-5.
μg/m³ = micrograms of pollutant per cubic meter of air.
[a] H2H = highest second-highest, Max = Maximum annual concentration.
[b] Maximum modeled design concentration over all construction scenarios. Contributions from nearby simultaneous scenarios are included, where applicable.
[c] Includes $PM_{2.5}$ secondary concentration.

Class 1 Wilderness Area Dispersion Modeling

Potential Mayflower Wind Project impacts at Lye Brook Wilderness (Class 1 area) were estimated by scaling impacts at the same location presented by the nearby Vineyard Wind 1 project as a supplemental analysis to their OCS air permit application. Impacts for 24-hour PM_{10}, 24-hour $PM_{2.5}$, and annual NO_2 reported by Vineyard Wind 1 were scaled proportionally according to the ratio of Mayflower Wind emissions to Vineyard Wind 1 emissions (and PSD increments) (Mayflower Wind 2022b: Appendix C, Section 5.4.1). As shown in Table 3.4.1-7, the estimated impacts due to the Mayflower Wind Project are less than the USEPA Class I significant impact levels (SILs). USEPA considers that no further analysis is necessary for impacts that are less than the SILs.

Table 3.4.1-7. Estimated impacts due to the Project at Lye Brook Wilderness (Class 1 Area)

Pollutant	Averaging Period	Mayflower Wind Conc. (µg/m^3) [a]	Class 1 SIL (µg/m^3)
NO_2	Annual	0.012	0.1
PM_{10}	24-hour	0.056	0.3
$PM_{2.5}$	24-hour	0.269	0.27

Source: Mayflower Wind 2022b, Appendix C – OCS Permit Air Quality Modeling Report, Table 5-7.
µg/m^3 = micrograms of pollutant per cubic meter of air
[a] Scaled proportionally according to the ratio of Mayflower Wind emissions to Vineyard Wind 1 emissions.

Soil, Vegetation, and Growth Analysis

Based on the modeled concentrations in the OCS Application (Mayflower Wind 2022b: Appendix C, Section 5.4.3), it was determined that impacts on soils and vegetation would be lower than applicable thresholds. The Proposed Action would have an overall positive effect on employment and the economy of the region, while few effects on population and housing are expected. Mayflower Wind will implement certain measures to further reduce the likelihood of any negative effects and promote potential positive effects on regional demographics, employment, and economics (Mayflower Wind 2022b: Appendix C, Section 5.4.4). For further discussion of economic impacts see Section 3.6.3, *Demographics, Employment, and Economics*.

Visibility Analysis

The visibility analysis is an estimate of the impacts due to Project emissions on the visual quality in the area. The USEPA's VISCREEN screening model was used to assess visibility impairment at Class II vistas at Nantucket. As explained in the OCS Application (Mayflower Wind 2022b: Appendix C, Section 5.4.3), the VISCREEN user's guide (USEPA 1992) indicates the maximum short-term emission rates expected during the course of a year should be input to the model. The maximum short-term emission rates during construction would be less than for O&M, as the maximum emissions rates associated with O&M were used. The total emissions from both the daily O&M scenario as well as the major repair scenario were used. The modeling results in the OCS Application indicate that plume blight and contrast are less than Class I criteria for all viewing angles. Values less than the criteria indicate that the visual impact is not considered adverse and no further visibility analysis is required. Note that the analysis conservatively used Class I criteria because there are no criteria established for Class II areas (Mayflower Wind 2022b:

Appendix C, Section 5.4.2.). Table 3.4.1-8 summarizes the visibility assessment results. Because short-term emission rates during construction would be less than during O&M, visibility impacts during construction would be less than shown in Table 3.4.1-8 and would be less than the Class I impact criteria. USEPA considers that no further analysis is necessary for impacts that are less than the impact criteria.

Table 3.4.1-8. Estimated visibility impacts due to the Project

Light Scattering Angle (degrees)	Perceptibility (ΔE)		Contrast (C_{plume})	
	Modeled Value	Class I Criterion	Modeled Value	Class I Criterion
10	1.808	2	-0.006	±0.05
140	0.656	2	-0.007	±0.05

Source: Mayflower Wind 2022b: Appendix C, Table 5-9.
ΔE = Color difference parameter used to characterize the perceptibility of the difference between two colors. It is used to characterize the perceptibility of a plume on the basis of the color difference between the plume and a viewing background such as the sky, a cloud, or a terrain feature.
C_{plume} = Contrast of a plume against a viewing background such as the sky or a terrain feature.

Onshore Construction

Onshore activities of the Proposed Action would consist primarily of HDD, duct-bank construction, cable-pulling operations, and substation construction. Emissions would be primarily from operation of diesel-powered equipment and vehicle activity, such as bulldozers, excavators, and diesel trucks, and fugitive particulate emissions from excavation and hauling of soil. Mayflower Wind has proposed measures to reduce emissions including compliance with applicable fuel-efficiency, fuel sulfur content, and emissions standards (COP Volume 2, Table 16-1; Mayflower Wind 2022a).

These emissions would be highly variable and limited in spatial extent at any given period and would result in minor impacts because they would be temporary in nature. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air Emissions – Operations and Maintenance

Offshore O&M

During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. The WTGs operating under the Proposed Action would have no pollutant emissions. Emergency generators on the WTGs and the substations would operate only during emergencies or testing, so emissions from these sources would be small and transient. Pollutant emissions from O&M would be mostly the result of operations of ocean vessels and helicopters used for maintenance activities. Crew transfer vessels and helicopters would transport crews to the Wind Farm Area for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the Wind Farm Area for significant maintenance and repairs. The Proposed Action's contribution would be additive with the impact(s) of any and all other operational activities, including offshore wind activities, that occur in the geographic analysis area. COP Volume 2, Section 3.5 (Mayflower Wind 2022a), provides a more detailed description of offshore and onshore O&M activities, and COP Appendix G, Section 5 (Mayflower Wind 2022) summarizes emissions during O&M. The annual estimated emissions for O&M are summarized in Table 3.4.1-9.

Table 3.4.1-9. Mayflower Wind operations and maintenance emissions (criteria pollutants and VOCs in U.S. tons; GHGs in metric tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
Annual	180	729	24	19	28	13	42,569	0.3	2.0	44,359
Lifetime (35 years)	5,940	24,057	792	627	924	429	1,404,805	9	64	1,463,856

Source: COP Appendix G, Table 5-2 (Mayflower Wind 2022a).

BOEM anticipates that air quality impacts from O&M of the Proposed Action would be minor, occurring for short periods of time several times per year during the proposed 35 years.

NAAQS and PSD Dispersion Modeling

As part of the OCS Application (Mayflower Wind 2022b), Mayflower Wind conducted dispersion modeling to demonstrate that O&M of the Proposed Action will show modeled compliance with the NAAQS and PSD increments. O&M activities were categorized as either O&M Daily Inspection/Routine Maintenance or WTG and OSP Major Repair. The analysis conservatively assumed worst-case short-term and annual operating conditions and accounted for activities that can occur simultaneously in the Lease Area, but at separate/adjacent WTG locations (Mayflower Wind 2022b: Appendix C, Section 4.0). Dispersion modeling was conducted using the models and guidance summarized above for *Offshore Construction*.

Table 3.4.1-10 and Table 3.4.1-11 present the summary of model results for comparison to the NAAQS and PSD increments, respectively. The maximum modeled impact includes the contribution from nearby simultaneous-emissions scenarios where applicable. As shown in the tables, results for all pollutants and averaging periods are less than the NAAQS and PSD increments.

Table 3.4.1-10. Estimated pollutant concentrations during O&M compared to NAAQS

Pollutant[a]	Averaging Period	Rank[b]	Modeled Design Concentration[c] (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	% of NAAQS
PM_{10}	24-hour	H2H	10.15	26	36.15	150	24%
$PM_{2.5}$	24-hour	98th %ile	6.05[d]	16.2	22.25	35	64%
SO_2	1-hour	99th %ile	163.05	7.86	170.91	196	87%
SO_2	3-hour	H2H	133.36	8.65	142.01	1,300	11%

Source: Mayflower Wind 2022b, Appendix C – OCS Permit Air Quality Modeling Report, Table 5-4.
µg/m³ = micrograms of pollutant per cubic meter of air.

[a] Modeling performed as part of the OCS Application indicates that only 24-hour $PM_{2.5}$ and 1-hour and 24-hour SO_2 are greater than their respective SILs (Mayflower Wind 2022b: Appendix C, Section 5.1.2). Therefore, these are the only pollutants and averaging periods that required additional analysis to demonstrate compliance with the NAAQS. All other pollutants and averaging periods are excluded from the table.
[b] H2H = highest second-highest, 98th %ile = 98th percentile, 99th %ile = 99th percentile
[c] Maximum modeled design concentration over both O&M scenarios. Contributions from nearby simultaneous-emissions scenarios are included.
[d] Includes $PM_{2.5}$ secondary concentration.

Table 3.4.1-11. Estimated pollutant concentrations during O&M compared to Prevention of Significant Deterioration increments

Pollutant[a]	Averaging Period	Rank[b]	Modeled Design Concentration[c] (μg/m^3)	PSD Increment (μg/m^3)	% of PSD Increment
PM10	24-hour	H2H	10.15	30	34%
PM2.5	24-hour	H2H	8.8[d]	9	98%
SO_2	3-hour	H2H	133.4	512	26%
SO_2	24-hour	H2H	60.8	91	67%

Source: Mayflower Wind 2022b, Appendix C – OCS Permit Air Quality Modeling Report, Table 5-6.
μg/m^3 = micrograms of pollutant per cubic meter of air.
[a] Modeling performed as part of the OCS Application indicates that only 24-hour $PM_{2.5}$ and 1-hour and 24-hour SO_2 are greater than their respective SILs (Mayflower Wind 2022b: Appendix C, Section 5.1.2). Therefore, these are the only pollutants and averaging periods that required additional analysis to demonstrate compliance with PSD increments. All other pollutants and averaging periods are excluded from the table.
[b] H2H = highest second-highest
[c] Maximum modeled design concentration over both O&M scenarios. Contributions from nearby simultaneous scenarios are included.
[d] Includes $PM_{2.5}$ secondary concentration.

Class 1 Wilderness Area Dispersion Modeling

Potential Project construction impacts at Lye Brook Wilderness (Class 1 area) were estimated by scaling impacts at the same location presented by the Vineyard Wind 1 project as a supplemental analysis to their OCS air permit application. The results of the analysis are summarized in Table 3.4.1-7. Because emissions during O&M would be much less than during construction, impacts at the Lye Brook Wilderness during O&M would be less than shown in Table 3.4.1-7 and would be less than the applicable thresholds.

Soil, Vegetation, and Growth Analysis

Based on the modeled concentrations in the OCS Application (Mayflower Wind 2022b: Appendix C, Sections 5.4.3 and 5.4.4), it was determined that impacts on soils and vegetation would be lower than applicable thresholds and that O&M of the Proposed Action would lead to only limited growth and emissions. For further discussion of economic impacts see Section 3.6.3.

Visibility Analysis

Based on the modeled concentrations in the OCS Application (Mayflower Wind 2022b: Appendix C, Section 5.4.2), it was determined that O&M impacts from plume blight and contrast would be lower than applicable thresholds, as shown in Table 3.4.1-8.

Onshore O&M

Emissions from onshore O&M activities would be limited to periodic use of construction vehicles and equipment. Onshore O&M activities would include occasional inspections and repairs to the onshore substation and splice vaults, which would require minimal use of worker vehicles and construction equipment. Mayflower Wind intends to use port facilities at New Bedford and Fall River, Massachusetts to support O&M activities. BOEM anticipates that air quality impacts due to onshore O&M from the Proposed Action alone would be minor, intermittent, and occurring for short periods.

Avoided Emissions

Increases in renewable energy could lead to reductions in emissions from fossil-fueled power facilities. Mayflower Wind used the USEPA Avoided Emissions and Generation Tool (AVERT) (USEPA 2021b) to estimate the emissions avoided as a result of the Proposed Action. Once operational, the Proposed Action would result in annual avoided emissions of 692 tons of NO_X, 313 tons of SO_2, and 4,038,482 tons of CO_2 (COP Appendix G, Table 6-1; Mayflower Wind 2022a). The avoided CO_2 emissions are equivalent to the emissions generated by about 880,000 passenger vehicles in a year (USEPA 2020c). Accounting for construction emissions and assuming decommissioning emissions would be the same, and including emissions from future operations, operation of the Proposed Action would offset emissions related to its construction and eventual decommissioning within different time periods of operation depending on the pollutant: SO_2 would be offset in approximately 10 years of operation, and CO_2 in approximately 1 year. (NO_X emissions would not be offset during the project lifetime.) If emissions from future operations and decommissioning were not included, the times required for emissions to "break even" would be shorter. From that point, the Project would be offsetting emissions that would otherwise be generated from another source.

The potential health benefits of avoided emissions can be evaluated using USEPA's COBRA health impacts screening and mapping tool as discussed in Section 3.4.1.3. COBRA was used to analyze the avoided emissions that were calculated for the Proposed Action (COP Appendix G; Mayflower Wind 2022a). Table 3.4.1-12 presents the results.

Table 3.4.1-12. COBRA estimate of annual avoided health effects with Proposed Action

Discount Rate[a] (2023)	Monetized Total Health Benefits (million U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[a]	High Estimate[b]	Low Estimate[b]	High Estimate[b]
3%	$15.6	$35.1	1.400	3.167
7%	$13.6	30.9	1.400	3.167

[a] The discount rate is used to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the "time value of money" preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2020b).
[b] The low and high estimates are derived using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2020b).

The overall impacts of GHG emissions can be assessed using "social costs." The "social cost of carbon," "social cost of nitrous oxide," and "social cost of methane"—together, the "social cost of greenhouse gases" (SC-GHG)—are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year.

CEQ is currently updating its 2016 guidance document (CEQ 2016) on consideration of GHGs and climate change under NEPA. While CEQ works on updated guidance, it has instructed agencies to consider and use all tools and resources available to them in assessing GHG emissions and climate change effects including its 2016 GHG guidance document. The 2016 CEQ guidance noted that NEPA does not require monetizing costs and benefits but allows the use of the social cost of carbon, SC-GHG, or other monetized costs and benefits of GHGs in weighing the merits and drawbacks of alternative actions. The SC-GHG estimates that follow are presented for purposes of information and disclosure.

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

There are multiple sources of uncertainty inherent in the SC-GHG estimates. Some sources of uncertainty relate to physical effects of GHG emissions, human behavior, future population growth and economic changes, and potential adaptation (IWG 2021). To better understand and communicate the quantifiable uncertainty, the IWG method generates several thousand estimates of the social cost for a specific gas, emitted in a specific year, with a specific discount rate. These estimates create a frequency distribution based on different values for key uncertain climate model parameters. The shape and characteristics of that frequency distribution demonstrate the magnitude of uncertainty relative to the average or expected outcome.

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

Table 3.4.1-13 presents the SC-GHG associated with estimated emissions from the Proposed Action. These estimates represent the present value of future market and nonmarket costs associated with CO_2, methane, and nitrous oxide emissions. In accordance with IWG's recommendation, four estimates were calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and Mayflower Wind's estimates of emissions in each year. In Table 3.4.1-13, negative values represent social benefits of avoided GHG emissions. The negative values for net SC-GHG indicate that the impact of the Proposed Action on GHG emissions and climate would be a net benefit in terms of SC-GHG.

Table 3.4.1-13. Estimated social cost of GHGs associated with the Proposed Action

Description	Social Cost of GHGs (2020$)[a]			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Construction, Operation, and Decommissioning[a]	$64,000,000	$261,000,000	$404,000,000	$791,000,000
Avoided Emissions[b]	-$1,239,000,000	-$5,214,000,000	-$8,080,000,000	-$15,937,000,000
Net SC-GHG[b]	-$1,175,000,000	-$4,953,000,000	-$7,677,000,000	-$15,146,000,000

Estimates are the sum of the social costs for CO_2, methane, and nitrous oxide over the Project lifetime.
Estimates are rounded to the nearest $1,000,000.
[a] The following calendar years were assumed in calculating SC-GHG: construction 2023–2026, operation (35 years) 2027–2061, and decommissioning 2062–2063.
[b] Negative cost values indicate benefits.

Air Emissions–Decommissioning

Mayflower Wind would decommission the Proposed Action at the end of the Proposed Action's operational lifetime. Mayflower Wind anticipates that all structures above the seabed level or aboveground would be completely removed. The decommissioning sequence would generally be the reverse of the construction sequence, involve similar types and numbers of vessels, and use similar equipment.

The dismantling and removal of the turbine components (blades, nacelle, and tower) and other offshore components would largely be a "reverse installation" process subject to the same constraints as the original construction phase. Onshore decommissioning activities would include removing facilities and equipment and restoring the sites to pre-Project conditions where warranted. Emissions from decommissioning were not quantified but are expected to be less than for construction. Mayflower

Wind anticipates pursuing a separate OCS air permit for those activities because it is assumed that marine vessels, equipment, and construction technology will change substantially in the next 35 years and in the future will have lower emissions than current vessels and equipment. Mayflower Wind anticipates minor and temporary air quality impacts from the Proposed Action due to decommissioning.

Accidental Releases

The Proposed Action could release VOCs or HAPs because of accidental chemical spills. The Proposed Action would have up to about 75,000 gallons (284,000 liters) of coolants, 1,188,650 gallons (4.5 million liters) of oils and lubricants, and 332,300 gallons (1.3 million liters) of diesel fuel in its wind turbine and substation structures. Accidental releases including spills from vessel collisions and allisions may lead to short-term periods of VOC and HAP emissions through evaporation. VOC emissions also would be a precursor to ozone formation. Air quality impacts would be short term and limited to the local area at and around the accidental release location. BOEM anticipates that a major spill is very unlikely due to vessel and offshore wind energy industry safety measures as well as the distributed nature of the material. BOEM anticipates that these activities would have a negligible air quality impact as a result of the Proposed Action alone.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities.

Air emissions – offshore construction: Air quality impacts due to offshore wind projects occurring in the geographic analysis area are anticipated to be small relative to larger emissions sources, such as fossil-fueled power facilities. The largest air quality impacts are anticipated during construction, with smaller and more infrequent impacts anticipated during decommissioning. During the construction phase, the total emissions of criteria pollutants and ozone precursors from all offshore wind projects, including the Proposed Action, proposed to occur in the geographic analysis area, summed over all construction years, are estimated to be 34,496 tons of CO, 165,807 tons of NO_X, 8,808 tons of PM_{10}, 5,589 tons of $PM_{2.5}$, 4,441 tons of SO_2, 5,732 tons of VOCs, and 11,228,498 tons of CO_2 (Appendix D, Table D2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

The Proposed Action would incrementally contribute to the cumulative air quality impacts from ongoing and planned activities associated with offshore construction, which would be moderate during construction. The Proposed Action would add an average of approximately 22 percent of the total offshore wind project emissions that may generate impacts, depending on pollutant, due to construction activities occurring in the geographic analysis area. This suggests that most of the air quality impacts resulting from offshore wind development would not be due to the Proposed Action, and the addition of the Proposed Action would yield a relatively small contribution to the total air quality impacts. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed project locations. As a result, air quality impacts would shift spatially and temporally across the geographic analysis area. The largest combined air quality impacts from offshore wind activities would occur during overlapping construction and decommissioning of multiple offshore wind projects. Construction of the Proposed Action is anticipated to overlap with up to 10 other offshore wind projects, depending on the year, between 2024 and 2030 (Appendix D, Table D2-4). Most air quality impacts would occur offshore because the highest emissions would occur in the offshore region. Air quality impacts onshore would be less because of the distance from the Wind Farm Area to the nearest onshore areas (Martha's Vineyard and Nantucket). Although air quality offshore is subject to the NAAQS in federal waters and the OCS permit area, the amount of human exposure offshore is typically very low. Ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land. Cumulative impacts would be greatest during overlapping construction activities, but these effects would be short term in nature because the overlap in the geographic analysis area would be limited in time.

Air emissions – onshore construction: The contribution of the Proposed Action to cumulative air quality impacts from ongoing and planned activities associated with onshore construction would be minor. Emissions from ongoing and planned activities, including the Proposed Action, would be highly variable and limited in spatial extent at any given period. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air emissions – O&M: The contribution of O&M emissions of the Proposed Action to cumulative air quality impacts from ongoing and planned activities would be minor. O&M from ongoing and planned activities, including the Proposed Action, could begin in 2024. Emissions would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, air traffic (such as helicopters), and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions. Ongoing and planned activities, including the Proposed Action, are estimated to emit 1,477 tons per year of CO, 5,802 tons per year of NO_X, 176 tons per year of PM_{10}, 156 tons per year of $PM_{2.5}$, 103 tons per year of SO_2, 113 tons per year of VOCs, and 459,188 tons per year of CO_2 when all projects are operating (Appendix D, Table D2-4). Anticipated impacts on air quality from O&M emissions would be transient, small in magnitude, and localized. Additionally, some emissions associated with O&M activities could overlap with other projects' construction-related emissions. Comparison of the combined emissions from all offshore wind projects to the emissions contributions from the Proposed Action alone shown in Table 3.4.1-9 shows that the increases in air quality impacts from the Proposed Action would be small for most pollutants relative to those of the combined total of the other planned offshore wind projects. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the multiple offshore wind projects occurring in the geographic analysis area. A net improvement in air quality is expected on a regional scale as wind projects begin operation and displace emissions from fossil-fueled sources.

Air emissions – decommissioning: The contribution of decommissioning of the Proposed Action to the cumulative air quality impacts from ongoing and planned activities would be minor. The decommissioning process for all offshore wind projects is expected to be similar to that for Mayflower Wind, and impacts would be similar to those of Mayflower Wind decommissioning. Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. If decommissioning activities for projects overlap in time, then impacts could be greater for the duration of the overlap.

Accidental releases: Based on Appendix D, Table D3-3, there would be up to about 1,908,481 gallons (7.2 million liters) of coolants, 8,024,098 gallons (30.3 million liters) of oils and lubricants, and 2,061,364 gallons (7.8 million liters) of diesel fuel contained in the 1,069 structures among the Proposed Action and planned activities in the geographic analysis area. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the combined accidental release impacts on air quality from ongoing and planned activities including offshore wind activities, which would be negligible due to the short-term nature and localized potential effects. Accidental spills would occur infrequently over the 35-year period with a higher probability of spills during construction of projects. However, these spills would not be expected to contribute appreciably to overall impacts on air quality, as the total storage capacity in the geographic analysis area is considerably less than the existing volumes of hazardous liquids being transported by ongoing activities and is distributed among many different locations and containers.

Conclusions

Impacts of the Proposed Action: The Proposed Action would result in a net decrease in overall emissions over the region compared to the installation of a traditional fossil-fueled power facility. Although there would be some short-term air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. The Proposed Action would result in air quality-related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation (Table 3.4.1-12). As stated, the impact from air pollutant emissions is anticipated to be minor, and the impact from accidental releases is expected to be negligible. Considering all of the IPFs together, **minor** air quality impacts would be anticipated for a limited time during construction, maintenance, and decommissioning, but there would be a **minor beneficial** impact on air quality near the Wind Farm Area and the surrounding region overall to the extent that energy produced by the Proposed Action would displace energy produced by fossil-fueled power facilities. Mayflower Wind has proposed measures to reduce emissions including compliance with applicable fuel-efficiency, fuel sulfur content, and emissions standards (COP Volume 2, Table 16-1; Mayflower Wind 2022a). Because of the amounts of emissions, the fact that emissions would be spread out in time (7 years for construction[4] and then lesser emissions annually during operation), and the large geographic area over which they would be dispersed (throughout the 127,388-acre [51,552-hectare] Lease Area and the vessel routes from the onshore

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[4] As noted in Table 3.4.1-4, Mayflower Wind has revised its construction schedule to 7 years from 4 years; however, the Mayflower Wind COP Appendix G (the source for the emissions data in the EIS analysis) reflects 4 years of construction emissions. BOEM expects that impacts in each year of a 7-year construction schedule would be less than with a 4-year construction schedule because construction would be spread out over 7 years instead of 4 years.

facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS and Massachusetts AAQS.

Cumulative Impacts of the Proposed Action: BOEM anticipates that the cumulative impacts on air quality in the geographic analysis area would be **moderate** adverse and **moderate beneficial**. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on air quality would be noticeable. The main driver for this impact rating is emissions related to construction activities increasing commercial vessel traffic, air traffic, and truck and worker vehicle traffic. Combustion emissions from construction equipment and fugitive emissions would be higher during overlapping construction activities but short term in nature, because the overlap would be limited in time. Therefore, the adverse impact on air quality would likely be moderate because, while emissions would incrementally increase ambient pollutant concentrations, they are not expected to exceed the NAAQS and Massachusetts AAQS. The Proposed Action and other offshore wind projects would benefit air quality in the region surrounding the projects to the extent that energy produced by the projects would displace energy produced by fossil-fueled power facilities. Though the benefit is regional, BOEM anticipates a moderate beneficial impact because the magnitude of the potential reduction in emissions from displacing fossil-fueled-generated power would be small relative to total energy generation emissions in the area.

3.4.1.6 Impacts of Alternative C on Air Quality

Impacts of Alternative C: Both Alternative C-1 and Alternative C-2 would reduce the offshore export cable route distance and increase the onshore export cable route distance, though the total cable route distances would be similar to those of the Proposed Action. Alternative C-1 would reduce the offshore export cable route by 9 miles (14 kilometers) and increase the onshore export cable route by 9 miles (14 kilometers), while Alternative C-2 would reduce the total offshore export cable route by 12 miles (19 kilometers) and increase the total onshore export cable route by 13 miles (21 kilometers). Mile for mile, onshore construction has greater potential for localized air quality impacts than offshore construction because exposure of the public to emissions close to construction activities is much more likely onshore than offshore. As a result, with respect to cable construction, Alternative C-1 could have greater potential for air quality impacts onshore than the Proposed Action, and Alternative C-2 could have greater potential for air quality impacts onshore than Alternative C-1.

Alternative C would have the same number of WTGs and OSPs and the same onshore facilities as the Proposed Action, so the potential for accidental releases with Alternative C would be the same as for the Proposed Action.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative C would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternative C: The overall impacts of Alternative C on air quality, climate, and accidental releases would be similar to those of the Proposed Action. The same construction, O&M, and decommissioning activities as under the Proposed Action would still occur. Therefore, expected impacts associated with Alternative C alone would be **minor**. Alternative C-1 could have greater potential for air quality impacts onshore than the Proposed Action, and Alternative C-2 could have greater potential for air quality impacts onshore than Alternative C-1. However, the change in emissions associated with Alternative C-1 or Alternative C-2 would not change the impact magnitude. As under the Proposed Action, Alternative C would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, the cumulative impacts on air quality associated with Alternative C-1 and Alternative C-2 would be similar to the Proposed Action and result in **moderate** and **moderate beneficial** impacts.

3.4.1.7 Impacts of Alternative D on Air Quality

Impacts of Alternative D: Alternative D would install up to six fewer WTGs than the Proposed Action and, therefore, could have slightly lower emissions from offshore construction and operation compared to the Proposed Action. Avoided emissions and the associated benefits, including net reductions in regional GHG emissions, also could be less than for the Proposed Action due to the reduction in the number of WTGs. Additionally, Alternative D could have a slightly lower potential for accidental releases from offshore construction and operation compared to the Proposed Action as a result of the reduced number of WTGs.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternative D: The overall impacts of Alternative D on air quality, climate, and accidental releases would be similar to those of the Proposed Action. While Alternative D could have slightly fewer impacts from offshore construction and operation compared to the Proposed Action due to the reduction in the number of WTGs, the change in emissions would not change the impact magnitude. Therefore, expected impacts associated with Alternative D alone would be **minor.** As under the Proposed Action, Alternative D would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, the cumulative impacts on air quality associated with Alternative D would be similar to the Proposed Action and result in **moderate** and **moderate beneficial** impacts.

3.4.1.8 Impacts of Alternatives E and F on Air Quality

Impacts of Alternatives E and F: The air quality impacts associated with Alternative E would be generally similar to those of the Proposed Action. This alternative would have the same number of WTGs and same onshore facilities as the Proposed Action but would use different types of WTG and OSP foundation structures. Alternative E-1 would use piled foundations (monopile or piled jacket), Alternative E-2 would use suction bucket jackets, and Alternative E-3 would use GBS foundations. Construction emissions could differ among these foundation types because of differences in the types of equipment used, the numbers of vessel trips, and the duration of certain construction tasks. However, BOEM expects that emissions from foundation construction would not differ substantially among Alternative E-1, Alternative E-2, and Alternative E-3 and would be similar to the Proposed Action.

Alternative F would have the same number of WTGs as the Proposed Action, and all other Project components would be the same as with the Proposed Action. Reducing the number of Falmouth offshore export cables to up to three may slightly reduce emissions associated with cable-laying activities, but the emissions would not differ substantively from the Proposed Action and would not change the impact magnitude. Thus, the air quality and climate impacts associated with Alternative F would be approximately the same as those of the Proposed Action.

Cumulative Impacts of Alternatives E and F: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives E and F on air quality would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternatives E and F: The overall impacts of Alternative E on air quality, climate, and accidental releases would be generally similar to those of the Proposed Action because the only differences would be in the construction activity associated with offshore foundation installation. Expected impacts associated with Alternative E alone would be **minor**. The total offshore construction emissions are not expected to differ substantially among Alternative E-1, Alternative E-2, and Alternative E-3 from the offshore construction emissions for the Proposed Action. As under the Proposed Action, Alternative E would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

The overall impacts of Alternative F on air quality, climate, and accidental releases would be approximately the same as those of the Proposed Action because the reduction in the number of individual offshore cables along the same cable route are not anticipated to have a substantive reduction in emissions. As a result, Alternative F would have the same **minor** impacts on air quality as the Proposed Action. As under the Proposed Action, Alternative F would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

Cumulative Impacts of Alternatives E and F: In context of reasonably foreseeable environmental trends, the cumulative impacts on air quality associated with Alternative E and F would be similar to the Proposed Action and result in **moderate** and **moderate beneficial** impacts.

3.4.1.9 Proposed Mitigation Measures

No measures to mitigate impacts on air quality have been proposed for analysis.

3.4 Physical Resources

3.4.2 Water Quality

This section discusses potential impacts on water quality from the proposed Project, alternatives, and ongoing and planned activities in the water quality geographic analysis area. The water quality geographic analysis area, as shown on Figure 3.4.2-1, includes coastal waters within a 10-mile (16-kilometer) buffer around the Offshore Project area and a 15.5-mile (25-kilometer) buffer around the ports that may be used by the Project. In addition, the geographic analysis area includes an onshore component that includes any sub-watershed that is intersected by the Onshore Project area. The offshore geographic analysis area accounts for some transport of water masses due to ocean currents. The onshore geographic analysis area was chosen to capture the extent of the natural network of waterbodies that could be affected by construction and operation activities of the proposed Project.

3.4.2.1 Description of the Affected Environment and Future Baseline Conditions

Surface waters in the geographic analysis area include: (1) coastal onshore waterbodies that generally include freshwater ponds, streams, and rivers; and (2) coastal marine waters that generally include saline and tidal/estuarine waters, such as Nantucket Sound, Rhode Island Sound, Mount Hope Bay, Sakonnet River and the Atlantic Ocean. Surface waters within most of the geographic analysis area and all of the Onshore Project areas are coastal marine waters.

The following key parameters characterize water quality. Some of these parameters are accepted proxies for ecosystem health (e.g., dissolved oxygen [DO], nutrient levels), while others delineate coastal onshore waters from coastal marine waters (e.g., temperature, salinity):

- **Nutrients:** Key ocean nutrients include nitrogen and phosphorous. Photosynthetic marine organisms need nutrients to thrive (with nitrogen being the primary limiting nutrient), but excess nutrients can cause problematic algal blooms. Algal blooms can significantly lower DO concentration, and toxic algal blooms can contaminate human food sources. Both natural and human-derived sources of pollutants contribute to nutrient excess.
- **Dissolved oxygen:** The amount of DO in water determines the amount of oxygen that is available for aquatic life to use. Temperature strongly influences DO content, which is further influenced by local biological processes. For a marine system to maintain a healthy environment, DO concentrations should be above 5 mg/L; lower levels may affect sensitive organisms (USEPA 2000).
- **Chlorophyll a:** Chlorophyll *a* is a measure of how much photosynthetic life is present. Chlorophyll *a* levels are sensitive to changes in other water parameters, making it a good indicator of ecosystem health. USEPA considers estuarine and marine levels of chlorophyll *a* under 5 micrograms per liter (µg/L) to be good, 5 to 20 µg/L to be fair, and over 20 µg/L to be poor (USEPA 2015).
- **Salinity***:* Salinity, or salt concentration, also affects species distribution. In general, seasonal variation in the region is smaller than year-to-year variation and less predictable than temperature changes (Kaplan 2011).

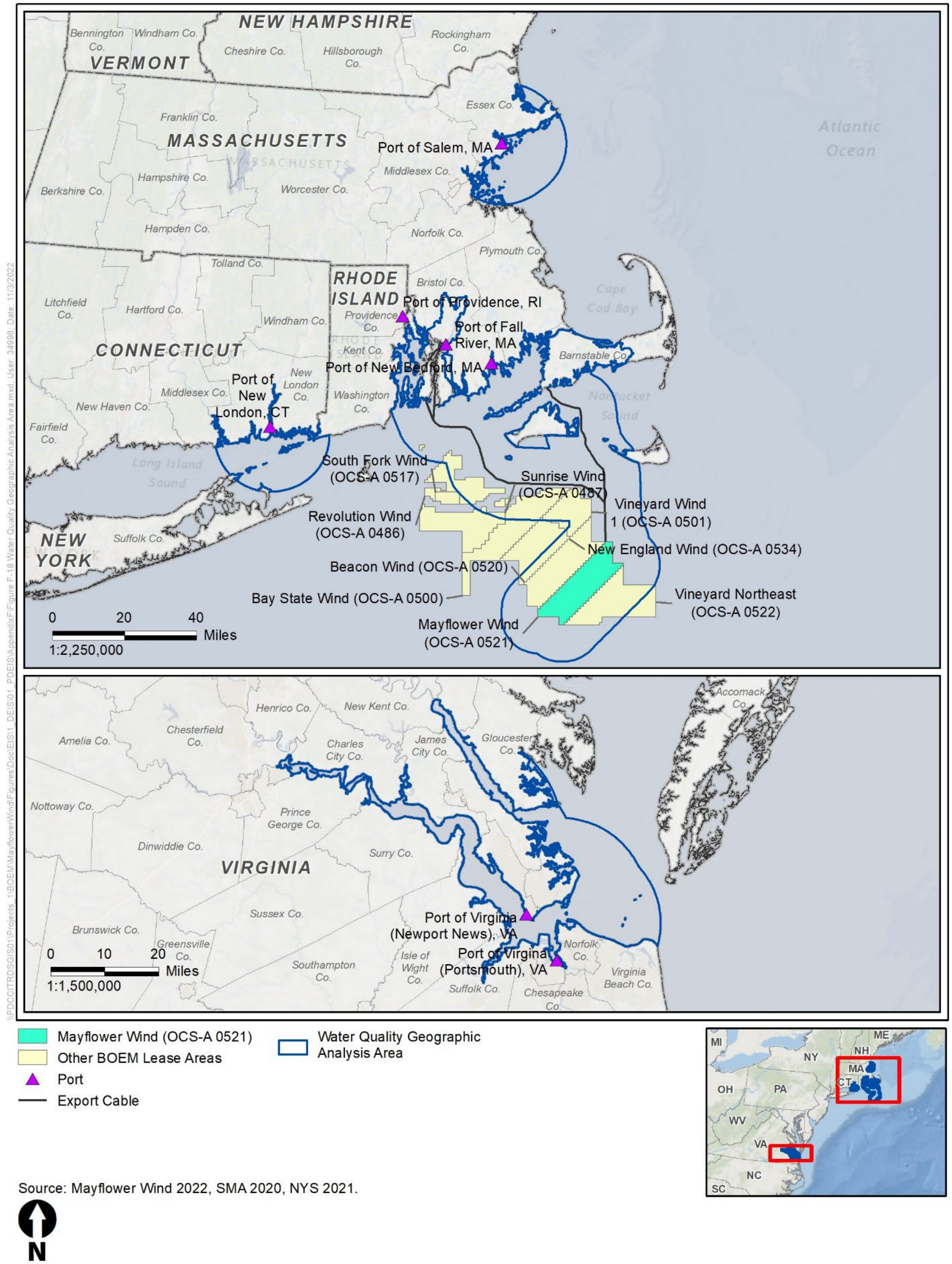

Figure 3.4.2-1. Water Quality geographic analysis area

- **Water temperature**: Water temperature heavily affects species distribution in the ocean. Large-scale changes to water temperature may affect seasonal phytoplankton blooms.
- **Turbidity:** Turbidity is a measure of water clarity, which is typically expressed as a concentration of total suspended solids (TSS) in the water column but can also be expressed as nephelometric turbidity units (NTU). Turbid water lets less light reach the seafloor, which may be detrimental to photosynthetic marine life (CCS 2017). In estuaries, a turbidity level of 0 to 10 NTUs is healthy while a turbidity level over 15 NTUs is detrimental (NOAA 2018). Marine waters generally have less turbidity than estuaries.

States also assess a variety of other water quality parameters as part of state requirements to evaluate and list state waters as impaired under CWA Section 303(d) requirements. Other water quality parameters assessed typically include, but are not limited to, concentrations of metals, pathogens, bacteria, pesticides, biotoxins, PCBs, and other chemicals. If a surface water is considered non-attaining under the assessment, this means a designated beneficial use (e.g., recreation, fish consumption) is impaired by an exceedance of one or more water quality parameters.

Water Quality Geographic Analysis Area: Coastal Marine Waters

This section presents water quality data for federal waters, mostly associated with the Lease Area, and offshore waters for the ECCs. Energy will be transmitted from up to five OSPs to landfall sites utilizing two ECCs that include one route to Falmouth, Massachusetts (Falmouth ECC) and one route to Brayton Point, Massachusetts (Brayton Point ECC). The Falmouth ECC state waters include Nantucket Sound, which is located between the south coast of Massachusetts and the Islands of Martha's Vineyard and Nantucket. The Brayton Point ECC state waters include the Sakonnet River, located east of Narragansett Bay in Rhode Island which connects Mount Hope Bay to the Rhode Island Sound. Mount Hope Bay is located between both Massachusetts and Rhode Island and is in the vicinity of the proposed export cable landfall locations at Brayton Point. Water quality of coastal marine waters in the geographic analysis area are summarized below, with more detailed water quality information included in COP Appendix H (Mayflower Wind 2022).

Federal Waters in the Geographic Analysis Area: Water quality data collected by the Northeast Fisheries Science Center (NEFSC) from 1963 to 2019 show that yearly surface water temperature averages ranged from approximately 41.4°F (5.2°C) to 61.7°F (16.5°C), while bottom water temperatures ranged from approximately 44.4°F (6.9°C) to 54.9°F (12.7°C). Salinity averages remained fairly stable; ranging only from approximately 32.7 practical salinity units (psu) to 32.9 psu at the surface and from approximately 33.3 to 33.5 psu near the bottom (COP Appendix H; Mayflower Wind 2022).

Long-term water temperature data are also available from the (NOAA National Data Buoy Center (NDBC) for two buoys located in federal waters in the general vicinity of the Offshore Project area. Station 44020 is located in Nantucket Sound at a water depth of 46.9 feet (14.3 meters) near the Falmouth ECC. Station 44097 is located near Block Island at a water depth of 158 feet (48.2 meters) near the Brayton Point ECC and the Lease Area. Data from 2009 through 2019 from the NDBC show that annual temperatures near the Falmouth ECC ranged from 39.0 F (3.9°C) to 69.6°F (20.9°C), while temperatures ranged from 45.7°F (7.6°C) to 67.3°F (19.6°C) near the Brayton Point ECC and Lease Area (COP Appendix H; Mayflower Wind 2022).

Falmouth ECC State Waters in the Geographic Analysis Area: The Center for Coastal Studies (CCS) began monitoring the water quality of the coastal waters of Cape Cod in 2006, and its program includes the only water quality monitoring that is regularly conducted in Nantucket Sound. Four sampling locations within Nantucket Sound are located in the general vicinity of the Falmouth ECC. Data collected from these stations are available from 2010 to 2016. Four sampling locations within Nantucket Sound are in the general vicinity of the Falmouth ECC. Data collected from these stations are available from 2010 to 2016. Three sampling stations are in coastal areas in the vicinity of the export cable landfall location in Falmouth. Data collected from these stations are available from 2014 to 2016 (CCS 2020). A sampling station at Oyster Pond-Falmouth is located near the alternate landfall locations. Table 3.4.2-1 and Table 3.4.2-2 present the seasonal results for the Nantucket Sound and coastal sampling stations, respectively. Winter sampling data were not available. Average seasonal results are summarized for water temperature, salinity, dissolved oxygen, chlorophyll *a*, turbidity, total nitrogen, and total phosphorus.

Table 3.4.2-1. Mean and standard deviation for water quality parameters measured in Nantucket Sound by CCS (2010–2016)

Season	Water Temperature (°C)	Salinity (psu)	DO (mg/L)	Chlorophyll *a* (µg/L)	Turbidity (NTU)	Total Nitrogen (µm)	Total Phosphorus (µm)
Spring (n=27)	12.9 ± 2.3	32.1 ± 0.25	9.8 ± 1.1	1.2 ± 0.53	0.47 ± 0.31	10.1 ± 3.5	0.61 ± 0.27
Summer (n=142)	20.5 ± 2.4	31.5 ± 1.4	7.6 ± 0.75	1.9 ± 0.83	0.59 ± 0.46	11.7 ± 4.8	0.71 ± 0.31
Fall (n=83)	18.2 ± 3.0	31.9 ± 0.25	7.7 ± 0.58	2.2 ± 1.1	0.51 ± 0.37	10.4 ± 3.1	0.76 ± 0.22

Source: COP Appendix H; Mayflower Wind 2022.
Results show mean ± 1 standard deviation; n= number of samples (not all samples were analyzed for all parameters).
Spring = March to May; Summer = June to August; Fall = September to November.
n = number of samples (not all samples were analyzed for all parameters).

Table 3.4.2-2. Mean and standard deviation for water quality parameters measured in coastal locations near Falmouth Cable Landfall(s) by CCS (2014–2016)

Season	Water Temperature (°C)	Salinity (psu)	DO (mg/L)	Chlorophyll *a* (µg/L)	Turbidity (NTU)	Total Nitrogen (µm)	Total Phosphorus (µm)
Spring (n=10)	18.4 ± 1.3	21.1 ± 13.3	7.0 ± 1.3	5.4± 2.2	2.2± 1.1	not sampled	not sampled
Summer (n=62)	24.1 ± 2.5	21.2 ± 12.6	6.7 ± 1.8	10.0 ± 6.3	2.3 ± 1.5	35.0 ± 12.5	1.4 ± 0.58
Fall (n=33)	19.2 ± 4.1	21.8 ± 12.6	7.2 ± 2.0	13.0 ± 12.8	2.8 ± 3.0	42.3 ± 21.5	1.4 ± 0.82

Source: COP Appendix H; Mayflower Wind 2022.
Results show mean ± 1 standard deviation; n= number of samples (not all samples were analyzed for all parameters).
Spring = March to May; Summer = June to August; Fall = September to November.
n= number of samples (not all samples were analyzed for all parameters).

The condition of coastal water was assessed by USEPA in the 2010 National Coastal Condition Assessment (NCCA) (USEPA 2015). Water quality data from the 2010 NCCA are available for eight stations within Nantucket Sound. Parameters measured in this assessment included chlorophyll *a*, dissolved inorganic nitrogen, dissolved inorganic phosphorus, DO at the bottom of the water column, and light transmissivity. Water quality results for the Nantucket Sound data set are summarized in Table 3.4.2-3. These water quality parameters were used to determine a Water Quality Index (WQI) for each sample characterized as Good, Fair, or Poor. As summarized in Table 3.4.2-4, in Nantucket Sound, 88 percent of the samples (seven of eight) received a WQI of Good and the remaining sample was Fair.

Table 3.4.2-3. Mean and standard deviation for water quality parameters in Nantucket Sound measured in the 2010 NCCA

Season	Chlorophyll *a* (µg/L)	Dissolved Inorganic Nitrogen (mg/L)	Dissolved Inorganic Phosphorus (mg/L)	DO (mg/L)	Light Transmissivity (% at 1 m depth)
Nantucket Sound (n=8)	18.4 ± 1.3	21.1 ± 13.3	7.0 ± 1.3	5.4± 2.2	2.2± 1.1

Source: COP Appendix H; Mayflower Wind 2022.
Results show mean ± 1 standard deviation; n= number of samples (not all samples were analyzed for all parameters).

Table 3.4.2-4. Summary of surface water parameter scores and WQI for the Nantucket Sound

Parameter	Good	Fair	Poor	No Data
Chlorophyll *a*	88%	12%	0%	0%
Dissolved Inorganic Nitrogen	100%	0%	0%	0%
Dissolved Inorganic Phosphorus	0%	100%	0%	0%
Dissolved Oxygen	88%	12%	0%	0%
Light Transmissivity	75%	0%	0%	25%
Overall WQI	88%	12%	0%	0%

Source: COP Appendix H; Mayflower Wind 2022.
Results show percent of samples within each category for individual parameters and overall WQI.

Brayton Point ECC State Waters: Data was collected by the United States Geological Survey at a buoy monitoring station in the Sakonnet River near Gould Island, Rhode Island. The Sakonnet River remains saline throughout the year due to tidal influence. Reaching peak temperatures in the summer months, the river also reaches its lowest DO (Table 3.4.2-5). Seasonal algal growth, seen as increased Chlorophyll *a*, as well as low DO levels have raised concern for the ecological health of the river. The primary causes of the observed water-quality impairments are the inputs of nutrients from wastewater management and stormwater runoff from the surrounding developed area (COP Appendix H; Mayflower Wind 2022).

Table 3.4.2-5. Mean and standard deviation for water quality parameters measured from the USGS Sakonnet River Station Buoy near Gould Island, Rhode Island (2018–2019)

Season	Water Temperature (°C)	Salinity (psu)	DO (mg/L)	Chlorophyll *a* (µg/L)	Turbidity (NTU)	Total Nitrogen (µm)	Total Phosphorus (µm)
Spring (n=2)	12.6 ± 0.2	28 ± 0.0	7.3 ± 0.4	NA	1.2± 0.0	0.21 ± 0.03	0.04 ±0.01
Summer (n=28)	22.3 ± 2.7	30.3 ± 0.8	6.1 ± 0.9	6.3 ± 4.6	2.4 ± 0.8	0.28 ± 0.07	0.07 ± 0.02
Fall (n=20)	17.7 ± 4.7	29.8 ± 1.2	7.0 ± 1.0	3.0 ± 1.4	2.5 ± 0.6	0.33 ± 0.08	0.08 ± 0.01

Source: COP Appendix H; Mayflower Wind 2022.
Results show mean ± 1 standard deviation; n = number of samples (not all samples were analyzed for all parameters).
Values for turbidity and salinity were only measured in 2018.
Spring = March to May; Summer = June to August; Fall = September to November.

The Massachusetts Department of Environmental Protection (MassDEP) operates two fixed-location buoys at the mouths of the Cole and Taunton Rivers to monitor water quality in Mount Hope Bay seasonally from May to November. The monitoring is part of the Narragansett Bay Fixed-Site Monitoring Network (NBFSMN) and provides data in the Massachusetts portion of Mount Hope Bay. Data collected from these stations are available for the 2017 and 2018 seasons as shown in Table 3.4.2-6 (COP Appendix H; Mayflower Wind 2022).

Table 3.4.2-6. Mean and standard deviation for water quality parameters measured in Mount Hope Bay by NBFSMN (2017–2018)

Year	Site	Water Temperature (°C)	Salinity (psu)	DO (mg/L)	Chlorophyll *a* (RFU)	Nitrate-N (mg/:)
2017	Taunton Buoy	20.3 ± 3.2	27.4 ± 1.2	7.4 ± 1.3	2.5 ± 2.2	0.12 ± 0.06
	Cole Buoy	20.5 ± 3.3	27.9 ± 1.9	7.9 ± 1.3	4.3 ± 3.7	0.13 ± 0.06
2018	Taunton Buoy	21.3 ± 4.3	27.2 ± 2.6	7.1 ± 1.2	2.7 ± 2.2	0.18 ± 0.08
	Cole Buoy	21.4 ± 4.4	27.5 ± 2.1	7.5 ± 1.2	2.7 ± 2.0	0.16 ± 0.06

Source: COP Appendix H; Mayflower Wind 2022.
Results show mean ± 1 standard deviation.

A buoy located near the proposed Brayton Point landfall site(s) and the Brayton Point ECC is located in Mount Hope Bay. Table 3.4.2-7 summarizes the temperature data between 2011 and 2020 (COP Appendix H; Mayflower Wind 2022).

Table 3.4.2-7. Mean and standard deviation for seasonal water temperature data from NOAA NDBC for Mount Hope Bay (2011–2020)

Season	Number of Samples	Water Temp (°C)
Spring	210,308	9.4 ± 4.2
Summer	207,469	22.7 ± 2.8
Fall	207,819	16.5 ± 4.8
Winter	209,750	4.5 ±2.5

Source: COP Appendix H; Mayflower Wind 2022.
Results show mean ± 1 standard deviation.
Spring = March to May; Summer = June to August; Fall = September to November, Winter = December to February.

303(d) Listed Impaired Waters: Assessment units listed as 303(d) impaired in the water quality geographic analysis area include, but are not limited to, Buzzards Bay, Outer New Bedford Harbor, New Bedford Inner Harbor, Mount Hope Bay, Upper Narragansett, Providence River, Newport Harbor/Coddington Cove, and associated tidal tributaries. These waters are non-attaining for fish consumption, ecological or recreational use, with causes including metals other than mercury, nutrients, oil and grease, trash, pathogens, total toxins, oxygen depletion, and PCBs (USEPA 2020).

Water Quality Specific to Proposed Ports

Mayflower Wind is considering multiple ports for marshalling during construction including New London, Connecticut; Providence, Rhode Island; New Bedford and Salem, Massachusetts; and Port of

Virginia marine terminals in Portsmouth and Newport News, Virginia; as well as ports in Canada. The Ports of New Bedford and Fall River, Massachusetts would be the most likely ports for O&M activity.

USEPA (2012) assessed water quality conditions along the coasts of the United States and developed a water quality index (good, fair, or poor) that evaluated five water quality parameters: nitrogen, phosphorus, chlorophyl *a*, water clarity (total suspended solids or turbidity), and DO. The overall water quality condition of the Northeast Coast, which includes geographic analysis area, is considered fair, with 9 percent of the coastal area rated poor and 53 percent rated fair. Phosphorus, chlorophyll *a*, DO, and water clarity ratings are all considered fair, while nitrogen rating is considered good (USEPA 2012).

303(d) Listed Impaired Waters: Assessment units listed as 303(d) impaired in the water quality geographic analysis area relative to proposed ports include, but are not limited to, Salem Harbor, Plum Island Sound, LIS EB Midshore - Stonington, LIS EB Shore - Wequetequock Cove, Stonington, LIS EB Inner - Pawcatuck River (02), Stonington, LIS EB Inner - Inner Wequetequock Cove, Stonington, Tidal Pawcatuck River, Thames River (Mouth), New London, LIS EB Inner - Thames River (middle), Ledyard and associated tidal tributaries. These waters are non-attaining for fish consumption, ecological, or recreational use, with causes including algal growth, unknown impaired biota, pathogens, and oxygen depletion (USEPA 2020).

Water Quality Geographic Analysis Area: Coastal Onshore Waters

As previously stated, surface waters within most of the geographic analysis area and all of the Onshore Project areas are coastal marine waters. The Falmouth underground export cable and transmission routes pass several small coastal ponds between the preferred and alternate export cable landfall locations and the onshore substation sites. The onshore export cable and alternate underground transmission routes do not cross any mapped rivers, streams, vernal pools, or waterbodies, but do pass within 0.6 mile (1 kilometer) of Cape Cod Canal, Great Pond, Grews Pond, and Long Pond. The underground onshore export cable routes between the preferred and alternate landfall locations and the onshore substation sites pass through residential areas containing small coastal ponds including Salt Pond, Sols Pond, Jones Pond, Grews Pond, Siders Pond, Shivericks Pond, an unnamed pond north of Shivericks Pond, Nyes Pond, and Morse Pond. The Falmouth onshore export cables do not cross any streams designated as impaired. One impaired waterbody, Little Pond, is adjacent to a Falmouth onshore export cable segment. The Little Pond assessment unit is non-supporting for ecological use and fish consumption caused by pathogens, and unknown causes.

The Brayton Point export cable corridor crosses over Aquidneck Island in route to the Brayton Point landfall locations. As the export cable crosses over Aquidneck Island it passes through residential and recreational areas. There are several freshwater streams and ponds present in the vicinity of the onshore export cable route options, including Founders Brook, which is listed as impaired. Founders Brook is non-supporting for recreational use due to pathogens. Numerous estuaries are also within the vicinity of the onshore export cable routes, including Old Orchard Cove, Long Neck Cove, and Mount Hope Bay. The assessment units listed as impaired within the geographic analysis area of the Brayton Point onshore cable routes include the Sakonnet River and Mount Hope Bay. The Sakonnet River assessment unit is non-attaining for fish consumption use caused by pathogens and unknown causes. The Mount Hope Bay assessment unit is non-attaining for ecological use and fish consumption use caused by nutrients, oxygen depletion, pathogens, and unknown causes.

Groundwater Quality

Several drinking water protection areas occur in the vicinity of the Falmouth transmission line and underground cable routes. These include multiple Zone I and Zone II Wellhead Protection areas, as well as surface water supply protection areas primarily surrounding Long Pond (COP Appendix H, Section 3.4.4.1, Figure 3-6; Mayflower Wind 2022). The USGS has investigated groundwater and surface water resources on Cape Cod for over 50 years. Groundwater is the sole source of drinking water and a major source of freshwater for domestic, industrial, and agricultural uses on the Cape. Groundwater discharged from aquifers also supports freshwater pond and stream ecosystems and coastal wetlands. In most areas, groundwater in the sand and gravel aquifers is shallow and susceptible to contamination from anthropogenic sources and saltwater intrusion. USGS activities include long-term monitoring of groundwater and pond levels and field research on groundwater contamination and plumes associated with Joint Base Cape Cod (JBCC), located north of the Falmouth Onshore Project area. Groundwater quality data in the vicinity of the Falmouth Onshore Project area were not identified (Mayflower Wind 2022).

The Rhode Island Department of Environmental Management (RIDEM) classifies the groundwater quality of the area surrounding the Brayton Point onshore export cable route options over Aquidneck Island as Class GA, which includes groundwater resources that are known or presumed to be suitable for drinking water use without treatment. However, the Aquidneck Island area is not considered a priority area (GAA classification), and approximately 70 percent of the state of Rhode Island overlies groundwater classified as GA. There are no drinking water protection areas (e.g., public wells, well head protection areas, drinking water reservoir watersheds) along the Brayton Point ECC. This includes the overland portion on Aquidneck Island (COP Appendix H, Section 3.4.4.1, Figure 3-6; Mayflower Wind 2022). Brayton Point is home to considerable past and former industrial use, and there has been past contamination identified in the groundwater. Even though there are no drinking water aquifers identified at the landing sites, data provided in the *2019 Annual Groundwater Monitoring and Corrective Action Report and Final Closure Report - Brayton Point CCR Basins A, B, and C* suggests that groundwater will be less than 6 feet (1.8 meters) below the ground surface at the landing sites (GEI Consultants 2019).

3.4.2.2 Impact Level Definitions for Water Quality

Definitions of potential impact levels are provided in Table 3.4.2-8. There are no beneficial impacts on water quality.

Table 3.4.2-8. Impact level definitions for water quality

Impact Level	Impact Type	Definition
Negligible	Adverse	Changes would be undetectable.
Minor	Adverse	Changes would be detectable but would not result in degradation of water quality in exceedance of water quality standards.
Moderate	Adverse	Changes would be detectable and would result in localized, short-term degradation of water quality in exceedance of water quality standards.
Major	Adverse	Changes would be detectable and would result in extensive, long-term degradation of water quality in exceedance of water quality standards.

3.4.2.3 Impacts of Alternative A – No Action on Water Quality

When analyzing the impacts of the No Action Alternative on water quality, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for water quality. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for water quality described in Section 3.4.2.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities within the geographic analysis area that contribute to impacts on water quality generally relate to or include terrestrial runoff, ground disturbance (e.g., construction) and erosion, terrestrial point and non-point source discharges, and atmospheric deposition. The deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). While water quality impacts may be temporary and localized (e.g., construction), and state and federal statutes, regulations and permitting requirements (e.g., Clean Water Act Section 402) avoid or minimize these impacts, issues with water quality can still persist.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on water quality include ongoing construction of the Vineyard Wind 1 project (62 WTGs and 1 OSP) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSP) in OCS-A 0517. Ongoing construction of these projects would affect water quality through the primary IPFs of accidental releases, anchoring, new cable emplacement and maintenance, port utilization, presence of structures, discharges/intakes, and land disturbance. Ongoing construction of the Vineyard Wind 1 and South Fork projects would have the same type of impacts on water quality that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that affect the water quality include onshore development activities (including urbanization, forestry practices, municipal waste discharges, and agriculture), marine transportation-related discharges, dredging and port improvement projects; commercial fishing, military use, new submarine cables and pipelines, and climate change (see Appendix D, *Planned Activities Scenario,* Section D.2 for a description of planned activities). Water quality impacts from these activities, especially from dredging and harbor, port, and terminal operations, are expected to be localized and temporary to permanent, depending on the nature of the activities and associated IPFs. Similar to ongoing activities, the deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). State and federal water quality protection requirements and permitting would result in avoiding and minimizing these impacts.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on water quality during construction, O&M, and decommissioning of the projects. The water quality geographic analysis area overlaps with most, but not all, of the Vineyard Wind Northeast (OCS-A 0522) and the Beacon Wind 1 (OCS-A 0520) lease areas. The geographic analysis area also has some overlap with the remainder of the lease areas in the Massachusetts/Rhode Island region. BOEM conservatively assumed in its analysis of water quality impacts that all 1,048 WTGs estimated for the Massachusetts/Rhode Island region lease areas would be sited within the water quality geographic analysis area. BOEM anticipates that there would be some construction overlap for offshore project components of these lease areas (Appendix D, Table D3-1).

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

Accidental releases: Other offshore wind activities could expose surface waters to contaminants (such as fuel, solid waste, or chemicals, solvents, oils, or grease from equipment) in the event of a spill or release during routine vessel use. Offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the Massachusetts and Rhode Island lease areas beginning in 2023 and continuing through 2030 and then lessen to near-baseline levels during operational activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic in the region associated with offshore wind construction could increase the probability of collisions and allisions, which could result in oil or chemical spills.

Based on the estimated construction schedules (Appendix D, Table D-2), offshore wind projects could occur with some overlapping construction schedules between 2023 and 2030. This EIS estimates that up to approximately 1,833,481 gallons (8,335,170 liters) of coolants, 6,835,448 gallons (31,073,946 liters) of oils, and 1,729,064 gallons (7,860,324 liters) of diesel fuel could be stored within WTG foundations and the OSPs in the water quality geographic analysis area. Other chemicals, including grease, paints, and sulfur hexafluoride, would also be used at the offshore wind projects, and black and gray water may be stored in sump tanks on facilities. BOEM has conducted extensive modeling to determine the likelihood and effects of a chemical spill at offshore wind facilities at three locations along the Atlantic Coast, including an area near the proposed Project area (Rhode Island-Massachusetts Wind Energy Area [WEA]) (Bejarano et al. 2013). Results of the model indicated a catastrophic, or maximum-case scenario, release of 129,000 gallons (488,318 liters) of oil mixture has a “Very Low” probability of occurring, meaning it could occur one time in 1,000 or more years. In other words, the likelihood of a given spill resulting in a release of the total container volume (such as from a WTG, OSP, or vessel) is low. The modeling effort also revealed the most likely type of spill (i.e., non-routine event) to occur is from the WTGs at a volume of 90 to 440 gallons (341 to 1,666 liters), at a rate of one time in 1 to 5 years, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 20 years. The likelihood of a spill occurring from multiple WTGs and OSPs at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. The modeling effort was conducted based on information collected from multiple companies and projects and would therefore apply to the other projects in the water quality geographic analysis area. For the purposes of this discussion, small-volume spills equate to the most likely spill volume between 90 and 440 gallons (341 to 1,666 liters) of oil mixture or up to 2,000 gallons (7,571 liters) of diesel fuel, while large-volume spills are defined as a catastrophic release of 129,000 gallons (488,318 liters) of material, based on modeling conducted by Bejarano et al. (2013). Small-volume spills could occur during maintenance or transfer of fluids, while low-probability small- or large-volume spills could occur due to vessel collisions, allisions with the WTGs/OSPs, or incidents such as toppling during a storm or earthquake.

All offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by USCG and BSEE. OSRPs are required for each project and would provide for rapid spill response, cleanup, and other measures that would help to minimize potential impacts on affected resources from spills. Vessels would also have their own onboard containment measures that would further reduce the impact of an allision. A release during construction or operation would generally be localized and short term and result in little change to water quality. In the unlikely event an allision or collision involving project vessels or components resulted in a large spill, impacts on water quality would be adverse and short term to long term, depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.

Accidental releases of trash and debris would be infrequent and negligible because operators would comply with federal and international requirements for management of shipboard trash. All vessels would also need to comply with the USCG ballast water management requirements outlined in 33 CFR 151 and 46 CFR 162; allowed vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids.

In summary, there is potential for moderate water quality impacts due to a maximum scenario accidental release, but due to the very low likelihood of a maximum scenario release occurring and the expected size of the most likely spill to be small and of low frequency, the overall impact of accidental releases is anticipated to be short term, localized, and minor, resulting in little change to water quality. As such, accidental releases from offshore wind development in the water quality geographic analysis area would not be expected to contribute appreciably to overall impacts on water quality.

Anchoring: Offshore wind activities would contribute to changes in offshore water quality from resuspension and deposition of sediments from anchoring during construction, installation, maintenance, and decommissioning of offshore components. BOEM estimates that approximately 2,134 acres (864 hectares) of seabed could be affected by anchoring in the water quality geographic analysis area. Disturbances to the seabed during anchoring would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to the anchorage area. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement (see new cable emplacement and maintenance IPF discussion below) and would therefore be unlikely to have an incremental impact beyond the immediate vicinity. If more than one project is being constructed during the same period, the impacts would be greater than for one project, and multiple areas would experience water quality impacts from anchoring but, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically. The overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be adverse, localized, and short term, resulting in a minor impact on ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

New cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. As described under the *Anchoring* IPF, these activities would contribute to changes in offshore water quality from the resuspension and deposition of sediment. Sediment dispersion modeling conducted for two other offshore wind projects (the Vineyard Wind 1 Project in Massachusetts and the Block Island Wind Farm in Rhode Island) were reviewed and evaluated, and general sediment conditions and hydrodynamics are similar to those in the Project area (COP Appendices F1 and F3 for detailed descriptions; Mayflower Wind 2022). The sediments within each project area were predominantly sands and current velocities were within similar ranges, indicating that the results of each modeling effort would be expected to be representative of the Project site. Turbidity concentrations greater than 10 mg/L would be short in duration up to 6 hours and limited to within approximately 164 to 656 feet (50 to 200 meters) of the trench in the offshore area. BOEM anticipates that offshore wind projects would use dredging only when necessary and rely on other cable laying methods for reduced impacts (such as jet plow or mechanical plow) where feasible. Due to the localized areas of disturbances and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, short term, and adverse, resulting in a minor impact on ambient water quality. If multiple projects are being constructed at the same time, the impacts would be greater than those identified for one project and would likely not overlap each other geographically due to the localized natures of the plumes. New cable emplacement and maintenance activities would not be expected to appreciably contribute to overall impacts on water quality.

Port utilization: Offshore wind development would use nearby ports and could also require port expansion or modification, resulting in increased vessel traffic or increased suspension and turbidity from any in-water work. These activities could also increase the risk of accidental spills or discharge. However, these actions would be localized, and port improvements would comply with all applicable permit requirements to minimize, reduce, or avoid impacts on water quality. As a result, port utilization impacts on water quality would be minor and not be expected to appreciably contribute to overall impacts on water quality.

Presence of structures: Reasonably foreseeable offshore wind projects are estimated to result in approximately 920 structures by 2030 in the water quality geographic analysis area (Appendix D, Table D3-1). These structures could disturb up to 1,247 acres (505 hectares) of seabed in the water quality geographic analysis area from foundation and scour protection installation and disrupt bottom current patterns, leading to increased movement, suspension, and deposition of sediments. Scouring, which could lead to impacts on water quality through the formation of sediment plumes (Harris et al. 2011), would generally occur in shallow areas with tidally dominated currents.

Offshore wind facilities have the potential to impact atmospheric and oceanographic processes through the presence of structures and the extraction of energy from the wind. There has been extensive research into characterizing and modeling atmospheric wakes created by wind turbines in order to design the layout of wind facilities and hydrodynamic wake/turbulence related to predicting seabed scour but relatively few studies have analyzed the hydrodynamic wakes coupled with the interaction of atmospheric wakes with the sea surface. Further, even fewer studies have analyzed wakes and their impact on regional scale oceanographic processes and potential secondary changes to primary production and ecosystems. Studies thus far in this topic have focused on ocean modeling rather than field measurement campaigns.

The general understanding of offshore wind–related impacts on hydrodynamics is derived primarily from European based studies. A synthesis of European studies by Van Berkel et al. (2020) summarized the potential effects of wind turbines on hydrodynamics, the wind field, and fisheries. Local to a wind facility, the range of potential impacts include increased turbulence downstream, remobilization of sediments, reduced flow inside wind farms, downstream changes in stratification, redistribution of water temperature, and changes in nutrient upwelling and primary productivity. Human-made structures, especially tall vertical structures such as foundations, alter local water flow at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). When water flows around the structure, turbulence is introduced that influences local current speed and direction. Turbulent wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles, there is a potential for hydrodynamic effects out to a kilometer from a monopile (Li et al. 2014). Direct observations of the influence of a monopile extended to at least 984 feet (300 meters); however, changes were indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,281 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis. In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017; refer to Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, Section 3.5.6, *Marine Mammals*, and Section 3.5.7, *Sea Turtles*, regarding hydrodynamic and atmospheric wake effects on primary production).

Results from a recent Johnson et al. (2021) hydrodynamic model of four different WTG build-out scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind. The results of the hydrodynamic model study show that introduction of the offshore wind structures into the offshore WEA modifies the oceanic responses of current magnitude, temperature, and wave heights by (1) reducing the current magnitude through added flow resistance, (2) influencing the temperature stratification by introducing additional mixing, and (3) reducing current magnitude and wave height by extracting of energy from the wind by the offshore wind turbines. Alterations in currents and mixing would affect water quality parameters such as temperature, DO, and salinity, but would vary seasonally and regionally. WTGs and the OSPs associated with reasonably foreseeable offshore wind projects would be placed in average water depths of 100 to 200 feet (30 to 60 meters) where current speeds are relatively low, and offshore cables would be buried where possible. Cable armoring would be used where burial is not possible, such as in hard-bottomed areas. BOEM anticipates that developers would implement BMPs to minimize seabed disturbance from foundations, scour, and cable installation. Adverse impacts on offshore water quality would be localized, short term, and minor. Presence of structures would not be expected to appreciably contribute to overall impacts on water quality.

The exposure of offshore wind structures, which are mainly made of steel, to the marine environment can result in corrosion without protective measures. Corrosion is a general problem for offshore infrastructures and corrosion protection systems are necessary to maintain their structural integrity. Protective measures for corrosion (e.g., coatings, cathodic protection systems) are often in direct contact with seawater and have different potentials for emissions, e.g., galvanic anodes emitting metals, such as aluminum, zinc, and indium, and organic coatings releasing organic compounds due to weathering and leaching. The current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact, especially if compared to other offshore activities, but these emissions may become more relevant for the marine environment with increased numbers of offshore wind projects and a better understanding of the potential long-term effects of corrosion protection systems (Kirchgeorg et al. 2018). Based on the current understanding of offshore wind structure corrosion effects on water quality, BOEM anticipates the potential impact to be minor.

Discharges/intakes: Other offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with offshore wind project construction is expected to occur regularly in the Massachusetts and Rhode Island lease areas beginning in 2023 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be staggered over time and localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162. Furthermore, each project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with offshore wind projects, BOEM expects impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

The WTGs and OSPs are generally self-contained and do not generate discharges under normal operating conditions. In the event of a spill related to an allision or other unexpected or low-probability event, impacts on water quality from discharges from the WTGs or OSPs during operation would be temporary. During decommissioning, all offshore wind structures would be drained of fluid chemicals via vessel, dismantled, and removed. BOEM anticipates decommissioning to have temporary impacts on water quality, with a return to baseline conditions.

Other offshore wind projects in the geographic analysis area may use HVDC substations that would convert AC to DC before transmission to onshore project components. As described in a recent white paper produced by BOEM (Middleton 2022), these HVDC systems are cooled by an open-loop system that intakes cool sea water and discharges warmer water back into the ocean. Chemicals such as bleach (sodium hypochlorite) would be used in order to prevent growth in the system and keep pipes clean. The warm water discharged is generally considered to have a minimal effect as it will be absorbed by the surrounding water and returned to ambient temperatures. Even though localized effects on water quality due to discharge of warmer water that may contain bleach could take place in the area immediately surrounding the outlet pipe, they are expected to be extremely minimal due to the much larger mass of the surrounding ocean. Potential impacts on water quality to surrounding sea water would require permits through the EPA National Pollutant Discharge Elimination System (Middleton 2022).

Due to the staggered increase in vessels from various projects; the current regulatory requirements administered by USEPA, USACE, USCG, and BSEE; and the restricted allowable discharges, the overall impact of discharges from vessels is anticipated to be localized and short term. Based on the above, BOEM anticipates discharges to have a minor impact on water quality, as the level of impact in the water quality geographic analysis area from offshore wind development would be similar to existing conditions and would not be expected to appreciably contribute to overall impacts on water quality.

Land disturbance: Other offshore wind development could include onshore components that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during the construction and installation of onshore components (e.g., equipment, substation). Construction and installation of onshore components near waterbodies may involve ground disturbance, which could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially erode the soils, resulting in sedimentation of nearby surface waters and subsequent increased turbidity. It is assumed that an SWPPP and erosion and sedimentation controls would likely be implemented during the construction period to minimize impacts, resulting in infrequent and temporary erosion and sedimentation events.

In addition, onshore construction and installation activities would involve the use of fuel and lubricating and hydraulic oils. Use of heavy equipment onshore could result in potential spills during active use or refueling activities. It is assumed that a Spill Prevention, Control, and Countermeasure (SPCC) plan would be prepared for each project in accordance with applicable regulatory requirements and would outline spill prevention plans and measures to contain and clean up spills if they were to occur. Additional mitigation and minimization measures (such as refueling away from wetlands, waterbodies, or known private or community potable wells) would be in place to decrease impacts on water quality. Impacts on water quality would be limited to periods of onshore construction and periodic maintenance over the life of each project.

Overall, the impacts from onshore activities that occur near waterbodies could result in temporary introduction of sediments or pollutants into coastal waters in small amounts where erosion and sediment controls fail. Land disturbance for offshore wind developments that are at a distance from waterbodies and that implement erosion and sediment control measures would be less likely to affect water quality. In addition, the impacts would be localized to areas where onshore components were being built near waterbodies. While it is possible that multiple projects could be under construction at the same time, the likelihood that construction of the onshore components overlaps in time or space is minimal, and the total amount of erosion that occurs and impacts on water quality at any one given time could be minimal. Land disturbance from offshore wind development is anticipated to be localized, short term, and minor, and would not be expected to appreciably contribute to overall impacts on water quality.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, water quality would continue to follow current regional trends and be affected by ongoing activities. BOEM expects ongoing non-offshore wind and offshore wind activities to have temporary impacts on water quality primarily through accidental releases and sediment suspension related to vessel traffic, port utilization, presence of structures, discharges, and land disturbance. BOEM anticipates that the impacts of ongoing activities, including construction of the Vineyard Wind 1 and South Fork projects, ongoing vessel traffic, military use, commercial activities, recreational activities, and land disturbance, would be **minor**.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue to affect water quality in the geographic analysis area. Planned non-offshore wind activities, including new submarine cables and pipelines, onshore development, marine surveys, and port improvements, would incrementally contribute to cumulative impacts on water quality. Similarly, planned offshore wind projects would also contribute to water quality impacts from sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; sediment contamination; discharges from the WTGs and OSP during operation; sediment plumes due to scour; and erosion and sedimentation from onshore construction. Construction and decommissioning activities associated with planned offshore wind activities would lead to increases in sediment suspension and turbidity in the offshore lease areas during the first 7 years of construction of projects and in the latter part of the 30-year life spans of offshore wind projects due to decommissioning activities. However, sediment suspension and turbidity increases would be temporary and localized, and BOEM anticipates the impact to be minor. BOEM has considered the possibility of impacts resulting from accidental releases; a moderate impact could occur if there was a large-volume, catastrophic release. However, the probability of catastrophic release occurring is very low and the expected size of the most likely spill would be very small and of low frequency. Therefore, the cumulative impacts of the No Action Alternative on water quality from ongoing and planned activities would be **minor** because any potential detectable impacts are not anticipated to exceed water quality standards.

3.4.2.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed Project design parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on water quality.

- The amount of vessel use during installation, operations, and decommissioning.
- The number of WTGs and OSPs and the amount of cable laid determines the area of seafloor and volume of sediment disturbed by installation.
- Installation methods chosen and the duration of installation.
- Proximity to sensitive water sources and mitigation measures used for onshore proposed-Project activities.
- In the event of a non-routine event such as a spill, the quantity and type of oil, lubricants, or other chemicals contained in the WTGs, vessels, and other proposed-Project equipment.

Variability of the proposed-Project design as a result of the PDE includes the exact number of WTGs and OSPs (determining the total area of foundation footprints); the number of monopile, piled jacket, suction-bucket, and/or gravity-based foundations; the total length of interarray cable; the total area of scour protection needed; and the number, type, and frequency of vessels used in each phase of the proposed Project. Changes in the design may affect the magnitude (number of structures and vessels), location (WTG and other Project element layouts), and mechanism (installation method, non-routine event) of water quality impacts.

Mayflower Wind has committed to measures to minimize impacts on water quality. See COP Volume 2, Table 16.1 for a complete list of avoidance, minimization, and mitigation measures (AMMs) proposed for use during construction, O&M, and decommissioning of the Project (Mayflower Wind 2022).

3.4.2.5 Impacts of Alternative B – Proposed Action on Water Quality

The Proposed Action would contribute to impacts through all the IPFs named in Section 3.4.2.3, *Offshore Wind Activities (without Proposed Action)*. The most impactful IPFs would likely include new cable emplacement and maintenance that could cause noticeable temporary impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredged material disposal.

Accidental releases: Similar to offshore wind projects without the Proposed Action, chemicals (e.g., coolants, oils, diesel fuel, other chemicals) would be used and stored in facilities and black and gray water may be stored in sump tanks on facilities. The Proposed Action would have a maximum of 75,000 gallons (283,905 liters) of coolants, 1,188,650 (4,499,527 liters) of oils and lubricants, and 332,300 gallons (1,257,891 liters) of diesel stored within WTG foundations and OSPs (COP Volume 1, Section 3.3.17, Table 3-26; Mayflower Wind 2022). As discussed previously, the risk of a spill from any single offshore structure would be low, and any effects would likely be localized. A reduction in the number of WTGs required due to increased capacity would result in a smaller total amount of materials being stored offshore. Modeling conducted for an area near the proposed Project area (Rhode Island-Massachusetts WEA) indicates that the most likely type of spill (i.e., non-routine event) to occur during the life of a project is 90 to 440 gallons (341 to 1,666 liters), which would have brief, localized impacts on water quality (Bejarano et al. 2013). One difference between the Proposed Action and the Rhode Island-Massachusetts WEA is that there would be more WTGs under the Proposed Action (147 instead of 130 that were modeled), which would lead to a slight increased likelihood of spill events compared to the Bejarano et al. model (Bejarano et al. 2013). There is potential for moderate water quality impacts due to a maximum-case scenario accidental release, but due to the very low likelihood of a maximum-case scenario release occurring and the expected size of the most likely spill to be small and of low frequency, the overall impact is anticipated to be short term, localized, and minor, resulting in little change to water quality.

Increased vessel traffic in the region associated with the Proposed Action could increase the probability of collisions and allisions, which could possibly result in oil or chemical spills. However, collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Project: USCG requirement for lighting on vessels, NOAA vessel speed restrictions, the proposed spacing of WTGs and OSP, the lighting and marking plan that would be implemented, and the inclusion of proposed Project components on navigation charts. Mayflower Wind would implement its OSRP (COP Appendix AA; Mayflower Wind 2022), which would provide for rapid spill response, cleanup, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events. In the unlikely event an allision or collision involving vessels or components associated with the Proposed Action resulted in a large spill, impacts from the Proposed Action alone on water quality would be short term to long term depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. In addition, Mayflower Wind has committed to developing a Project-specific SPCC plan in the SWPPP to prevent accidental releases of oils and other hazardous materials to the extent practical (COP Volume 2, Table 16-1; Mayflower Wind 2022). With implementation of this measure, risk of fuel spills and leaks from vessels would be minimized and any impact would be considered minor.

Onshore construction activities would require heavy equipment use or HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action would result in minor, temporary, and long-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

Mayflower Wind anticipates the Port of New Bedford's MCT as the primary port to be used for Project activities. The New Bedford MCT has been expanded to accommodate offshore wind projects. Further investments in port upgrades and general infrastructure improvements at the New Bedford MCT site and/or other ports in the region are expected in the future. Mayflower Wind would also use the ports of New London, Connecticut; Providence, Rhode Island; Fall River and Salem, Massachusetts; and the Port of Virginia marine terminals in Portsmouth and Newport News, Virginia. BOEM anticipates that use of the port facilities would result in minor impacts on water quality because a potential release at the facility would likely be relatively small and would be cleaned up in accordance with federal and state regulations.

Anchoring: There would be increased vessel anchoring during the construction, installation, O&M, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels. Impacts on water quality from the Proposed Action alone due to anchoring would be localized, short term, and minor during construction and decommissioning. Mayflower Wind anticipates daily averages of between 15 and 35 vessels depending upon the construction activities, with an expected maximum of 50 vessels in the Lease Area at one time. The number of vessels is anticipated to result in 441.8 acres (178.8 square kilometers) of impact from anchoring. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts.

Cable emplacement and maintenance: The installation of array cables and offshore export cables would include site-preparation activities (e.g., sandwave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which can cause temporary increases in turbidity and sediment resuspension. Other projects using similar installation methods (e.g., jet plowing, pile driving) have been characterized as having minor impacts on water quality due to the short-term and localized nature of the disturbance (Latham et al. 2017). To evaluate the impacts of offshore export cable and interarray cable installation, a sediment transport model was developed to evaluate potential suspended sediment transport and deposition (COP Appendix F3; Mayflower Wind 2022). Results of the sediment dispersion modeling indicated that the water column concentration (TSS) and the sediment deposition pattern and thickness were mostly influenced by properties of the trench sediments (i.e., grain size distribution) disturbed during the jet trenching operations and localized current velocities. The dimensions of the trench, the advance rate, and the loss rate (a conservative loss rate of 25 percent representative of the jetting or mechanical trenching and 100 percent for the HDD pit dredging) to the water column, specified the total amount of sediments resuspended. The response was short lived for all but the finest grade sediments such as silts and clays. The fine sediments settle more slowly than coarser sediments resulting in the suspended silt and clay sediments being transported farther with the tidal currents than coarser sediments, increasing higher water column concentrations and durations of plumes. The Mount Hope Bay and the Sakonnet River segments, where higher portions of silt and clay are found in the sediments, exhibit this impact. The higher-level concentrations (100 mg/L and up) were somewhat contained in the Sakonnet River but covered a larger area in Mount Hope Bay where a part of the export cables ran perpendicular to the currents which, combined with the fine grade resuspended sediments, increased the overall material transport extending the maximum 100 mg/L concentration a little over 0.62 mile (1 kilometer). Concentrations reached levels of 500 mg/L but were short lived and persist for approximately 30 minutes to an hour. Concentrations in the range of 200 mg/L or more were not expected to endure for longer than about 2 hours, while the lowest concentrations, in the 10 mg/L range, may last many hours after resuspension. In regions with larger grain sizes, sediments dropped back to the sea floor more quickly, keeping concentrations low, and within a few meters of the trenching tool. The associated deposition footprint area was also small. Concentrations of 100 mg/L were predicted to be within 160 feet (50 meters) of the route centerline and decreased in less than 15 minutes. The sections of the offshore ECC segment that had higher amounts of fine sediments had higher transport of the model predicted TSS concentrations showing the 100 mg/L concentration extending to 984 feet (300 meters). The 100 mg/L TSS concentration level or greater covered a total of 6,070 acres (25 square kilometers) along the entire length of the Brayton Point ECC (COP Appendix F3; Mayflower Wind 2022).

The HDD exit pit dredging impacts were smaller compared with the impact resulting from cable installation. The source was assumed to be at a single point and continuous over a 1-hour period, releasing 100 percent of the dredged material into the water column. The TSS concentrations exceeding 100 mg/L travelled a maximum distance of 0.2 mile (0.32 kilometer) and dissipated in a little over an hour at the Brayton Point site but were half that at the Aquidneck Island sites. The area coverage of the 100 mg/L or greater level was contained within an average of 12 acres (5 hectares).

The depositional footprint resulting from the cable installation occurred relatively locally along the majority of the ECC route where the mass settles out quickly. Deposition thicknesses of 0.04 inch (1 millimeter) and greater are mostly limited to a corridor with a maximum width of 100 to 115 feet (30 to 35 meters) around the cable centerline. In the areas where there are finer grain sediments, the 0.04-inch (1-millimeter) thickness contour distance can increase locally to 540 feet (165 meters) from the ECC indicative centerline. The sedimentation footprint for HDD sites was very small with a maximum coverage of the 0.04-inch (1-millimeter) thickness contour of only 1.2 acres (0.5 hectare), extending a maximum distance of 312 feet (95 meters) and 2.5 acres (1 hectare) for the 0.02-inch (0.5-millimeter) thickness contour, extending a maximum distance of 518 feet (158 meters) from the HDD site. Deposition thicknesses are greater if the location of the release is fixed. Cable burial operations are mobile and thus will produce smaller maximum deposit thicknesses. The total coverage of the 0.04-inch (1-millimeter) and 0.02-inch (0.5-millimeter) thickness levels along the entire ECC route was 892 acres (361 hectares) and 1,312 acres (531 hectares), respectively.

These impacts on water quality for finer sediments are anticipated to be localized adjacent to the trench and temporary in nature. Therefore, given the known hydrodynamic conditions within the area of the Project and the expected BMPs associated with jet plowing technologies, no long-term impacts on water quality are anticipated following cable installation activities. BOEM anticipates the Proposed Action alone would have negligible, long-term impacts on water quality via this mechanism. Overall, impacts on water quality from the Proposed Action due to cable emplacement and resulting suspension of sediment and turbidity would be short term and minor.

Port utilization: The current bearing capacity of existing ports was considered suitable for WTGs, requiring no port modifications for supporting offshore wind energy development (DOE 2014). During construction, several ports may be used, including the Ports of New London, Connecticut; Providence, Rhode Island; New Bedford and Salem, Massachusetts; and Port of Virginia marine terminals in Portsmouth and Newport News, Virginia. The Ports of New Bedford and Fall River, Massachusetts would be the most likely ports for O&M activity. The impacts on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in ship traffic at the ports would be small; multiple authorities regulate water quality impacts from these operations (BOEM 2019). Therefore, the impacts of the Proposed Action alone on water quality from port utilization would be negligible.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area. Dock facilities and other structures are concentrated along the coastline. The Proposed Action would add up to 147 WTGs, 5 OSPs, and related Project elements, which would increase seabed disturbance and potential water quality impacts. As described in Section 3.4.2.3, *Impacts of Alternative A – No Action on Water Quality*, offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind.

Disturbances from offshore wind structures would be localized but, depending on the hydrologic conditions, have the potential to affect water quality through altering mixing patterns and the formation of sediment plumes. The addition of scour protection would further minimize effects on local sediment transport. The impacts from the Proposed Action on water quality due to the presence of structures would be negligible to minor during construction, O&M, and conceptual decommissioning. In addition, as described in Section 3.4.2.3, the exposure of offshore wind structures to the marine environment can result in emissions of metals and organic compounds from corrosion protection systems. However, the current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact (Kirchgeorg et al. 2018).

Discharges/intakes: During construction of the Proposed Action, vessel traffic would increase in and around the Wind Farm Area, leading to potential discharges of uncontaminated water and treated liquid wastes. Table 3-25 of the COP lists types of waste potentially produced by the Proposed Action (COP Volume 1, Section 3.3.16, Table 3-25; Mayflower Wind 2022). Mayflower Wind would only be allowed to discharge uncontaminated water (e.g., uncontaminated ballast water and uncontaminated water used for vessel air conditioning) or treated liquid wastes overboard (e.g., treated deck drainage and sumps). Other waste such as sewage and solid waste or chemicals, solvents, oils, and greases from equipment, vessels, or facilities would be stored and properly disposed of on land or incinerated offshore.

Mayflower Wind expects substantially less vessel use during routine O&M than during construction. Vessel use would consist of scheduled inspection and maintenance activities, with corrective maintenance as needed. In a year, the Proposed Action would generate a maximum of 700 crew vessel trips, 30 jack-up vessel trips, 100 heavy transport vessel trips, 280 airplane trips, and 2,080 helicopter trips (COP Volume 1, Section 3.3.14.1, Table 3-21; Mayflower Wind 2022). The proposed Project would require all vessels to comply with regulatory requirements related to the prevention and control of discharges, accidental spills, and nonindigenous species. All vessels would need to comply with waste and water management regulations described in Section 3.4.2.3, including USCG ballast water management requirements and USCG bilge water regulation. The bilge water from the proposed Project would either be retained onboard vessels in a holding tank and discharged to an onshore reception facility or treated onboard, after which the treated water could be discharged overboard. In addition, bilge water would not be allowed to be discharged into the sea unless the oil content of the bilge water without dilution is less than 15 parts per million (33 CFR Part 151.10). For vessels operating within 3 nautical miles (5.6 kilometers) from shore, bilge water regulations under USEPA's National Pollutant Discharge Elimination System program apply to any of the proposed Project's vessels that are covered by a Vessel General Permit (those that are 79 feet [24 meters] or greater in length). Bilge discharges within 3 nautical miles (5.6 kilometers) from shore are subject to the rules in Section 2.2.2 of the Vessel General Permit and must occur in compliance with 40 CFR Parts 110, 116, and 117, and 33 CFR Part 151.10. With implementation of these AMMs and the described regulatory requirements, the temporary impact of routine vessel discharge is expected to be minor.

The WTGs and OSPs are generally self-contained and do not generate discharges under normal operating conditions. In the event of a spill related to an allision or other unexpected or low-probability event, impacts on water quality from discharges from the WTGs or OSPs during operation would be temporary. During decommissioning, Mayflower Wind would drain all fluid chemicals from the WTGs and OSPs and dismantle and remove them. BOEM anticipates decommissioning to have temporary impacts on water quality, with a return to baseline conditions.

Mayflower Wind has proposed the use of one or more HVDC converter platforms, which would require seawater to be pumped in to cool the electrical equipment and then discharged back into the ocean. Mayflower Wind developed an NPDES permit application for one offshore HVDC converter station in the Lease Area (in an approximate location, see Appendix B, Figure B-2) (TetraTech and Normandeau Associates, Inc. 2022). The HVDC converter station is expected to withdraw cooling water from the ocean at a rate of approximately 8 to 10 million gallons per day and maintain an intake velocity of less than 0.5 feet per second to minimize impingement impacts.[1] Mayflower Wind modeled thermal plumes from HVDC cooling water discharge to predict water temperature changes around the discharge location during critical tidal conditions in summer and winter months (TetraTech and Normandeau Associates, Inc. 2022). The physical mixing processes in a plume takes place in two regions: the near-field and far-field. The region influenced by the discharge conditions in a plume is the near-field region (NFR). As the plume travels further away from the source, the path and dilution of the plume is influenced by the ambient conditions. This region is called the far-field region (FFR). Results were analyzed at the edge of the NFR because this region is representative of strong initial mixing and is controlled by the discharge conditions. Four scenarios were modeled to provide the expected maximum extent of the plume (maximum tidal velocities) and maximum concentrations of the plume (minimum tidal velocities). See Table 3.4.2-9 for results of plume modeling for each scenario and Appendix B, Figures B-3 through B-6 for a visual of the extent of the plumes.

Table 3.4.2-9. Results from thermal plume modeling conducted for Mayflower Wind HVDC OSP

Parameter	Scenario 1: Winter Max. Current Speed	Scenario 2: Winter Min. Current Speed	Scenario 3: Summer Max. Current Speed	Scenario 4: Summer Min. Current Speed
Atlantic Ocean Temperature at the edge of NFR, °F	54.4	39.6	60.8	60.8
Temperature change at the edge of NFR in the Atlantic Ocean, °F	0.3	0.0	0.3	0.3
Dilution ratio at the edge of NFR in the Atlantic Ocean	110.6	5,126.7	98.7	114.6
NFR distance,[a] feet	306	2,661	272	1,436
NFR distance when temperature change of 5°F is met, feet	43	-757[b]	36	2

Source: TetraTech and Normandeau Associates, Inc. 2022.
[a] Distance from the diffuser.
[b] Negative sign represents the plume moving against direction of ocean current.

The temperature change at the edge of the NFR ranged from 0.0 °F to 0.3 °F. During maximum current speeds in summer and winter months, the location of the NFR from the discharge point ranged from 272 to 306 feet (83 to 93 meters), and the edge of the NFR ranged from 1,436 to 2,661 feet (438 to 811 meters) during minimum current speeds. The width of thermal plumes in the NFR ranged from approximately 9.8 to 6,562 feet (3 to 2,000 meters). The largest potential impact based on size of the plume resulted from Scenario 4 where the area of the plume in the NFR was approximately 9,422,601 square feet (6,562 by 1,436 feet) or 216 acres. Considering the slight increases in water temperatures and small size of the thermal plume area (maximum of 216 acres), in the context of the overall size of the Lease Area (127,388 acres), minimal impacts on water temperature are anticipated. Based on results of the thermal plume modeling, impacts from the discharge are expected to be localized and minimal, especially where the plume is controlled by discharge characteristics (NFR). Bleach (sodium

[1] EPA considers intake velocities less than 0.5 feet per second the best technology available to minimize impingement impacts.

hypochlorite) would be used to inhibit marine growth in the HVDC cooling equipment (COP Volume 1, Section 3.4.5; Mayflower Wind 2022). A hypochlorite generator would produce the bleach by seawater electrolysis. These generators are designed to achieve a hypochlorite solution flow rate of sufficient concentration, corresponding with a 0 to 2 parts per million equivalent free chlorine concentration in the seawater intake lines (TetraTech and Normandeau Associates, Inc. 2022). This concentration is small and is equivalent to 0.0002 percent per unit volume. No chemicals are involved in the cleaning cycles of the HVDC converter. The impact on water quality from the discharge of warm seawater with small concentrations of bleach would be negligible. Impacts would be localized to the area immediately surrounding the outlet pipe.

Overall, the impacts on water quality from the Proposed Action would be short term and minor during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in fewer impacts.

Land disturbance: Construction and installation of onshore components (e.g., substations, cable installation) would disturb ground and lead to unvegetated or otherwise unstable soils until permanent stabilization is achieved. Onshore construction would disturb the ground with typical depths of up to 8 feet (2.4 meters) (e.g., trenching for onshore cable installation) but could be deeper depending on survey results and potential utility crossings, which could have potential to interact with groundwater if groundwater were shallow enough to interact with the disturbance. Any contaminants spilled during construction would be localized, contained, and cleaned up per permitting requirements and Mayflower Wind's OSRP, and therefore, would not be anticipated to reach groundwater or have any effect on groundwater quality. The Falmouth and Brayton Point substation sites would require approximately 26 acres (10.5 hectares) and 7.5 acres (3 hectares), respectively, to accommodate the area for the substation equipment and buildings, energy storage, stormwater management, and landscaping. Total temporary and permanent disturbance associated with onshore components is approximately 65 acres (26.5 hectares) (COP Volume 1, Table 3-39; Mayflower Wind 2022). Precipitation events could potentially erode the soils and discharge sediment-laden runoff into nearby surface waters, leading to increased turbidity. Mayflower Wind would implement erosion and sedimentation controls during the construction period. Construction would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. The incremental increases in land disturbance from the Proposed Action would be small, and AMMs, such as the use of an OSRP and SWPPP, would be implemented. As such, impacts from the Proposed Action on water quality from land disturbance would be negligible to minor.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Ongoing and planned non-offshore wind activities related to onshore development, terrestrial runoff and discharges, marine transportation-related discharges, dredging and port improvement projects, commercial fishing, military use, submarine cables and pipelines, atmospheric deposition, and climate change would contribute to impacts on water quality through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, port utilization, presence of structures, discharges, and land disturbance. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities in the geographic analysis area would also contribute to water quality impacts associated with the same IPFs.

The Proposed Action would contribute to the combined accidental release impacts on water quality from ongoing and planned activities including offshore wind. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including the Proposed Action, to appreciably contribute to impacts on water quality resulting from oil and chemical spills. The Proposed Action would contribute to the combined anchoring impacts on water quality from ongoing and planned activities including offshore wind. The contribution from the Proposed Action to increased sediment concentration and turbidity would be additive with the impact(s) of any and all other cable installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended. Multiple offshore wind projects may overlap in cable installation activity in the geographic analysis area and contribute to these temporary impacts (refer to Appendix D for construction schedules of specific projects). The Proposed Action would contribute to the combined port utilization impact on water quality from ongoing and planned activities, which is anticipated to be minor due to the need for minimal port modifications or expansions and the small increase in ship traffic. The cumulative impacts of combined accidental releases, anchoring, and port utilization would likely be temporary (during construction), localized, and minor.

The presence of structures from the Proposed Action and other offshore wind projects would increase seabed disturbance and potential water quality impacts. In the water quality geographic analysis area, offshore wind activities including the Proposed Action would result in 2,994 acres (1,212 hectares) of impact from installation of foundations and scour protection, 13,720 acres (5,552 hectares) of impact from installation of offshore and interarray cables, and 1,401 acres (567 hectares) of impact from hard protection for offshore cables and interarray cables. Of these seabed disturbances, the Proposed Action would contribute 4,988 acres, or 28 percent. The impacts would be mostly localized and are not anticipated to degrade regional water quality. Cumulative impacts on water quality would likely be minor and constant over the lifespans of the reasonably foreseeable activities.

Impacts on water quality from the Proposed Action due to discharges would be additive with the impact(s) of any and all discharges, including those of other offshore wind activities that occur within the water quality geographic analysis area during the same timeframe. Vessel traffic (e.g., fisheries use, recreational use, shipping activities, military uses) in the region would overlap with vessel routes and port cities expected to be used for the Proposed Action, and vessel traffic would increase under the Proposed Action. Discharge events would mostly be staggered over time and localized, and all vessels would be required to comply with regulatory requirements related to prevention and control of discharges, accidental spills, and nonindigenous species administered by USEPA, USACE, USCG, and BSEE. Therefore, the cumulative impacts on water quality would likely be short term, localized, and minor primarily during construction and to a lesser extent during decommissioning and operations.

Cumulative impacts of land disturbance impacts on water quality would likely be localized, short term, and minor due to the low likelihood that construction of onshore components would overlap in time and space, and the minimal amount of expected discharge of sediment-laden runoff into nearby waterbodies.

Overall, the cumulative impact on water quality would likely be minor but could increase to moderate in the unlikely event of a large-volume, catastrophic release. In the context of reasonably foreseeable environmental trends, the Proposed Action could contribute a detectable increment to the cumulative impacts on water quality.

Conclusions

Impacts of the Proposed Action: BOEM anticipates the impacts on water quality resulting from the Proposed Action would be **minor**. Impacts from routine activities including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying, dredging, vessel discharges, sediment contamination, discharges from the WTGs or OSP during operation, sediment plumes due to scour, and erosion and sedimentation from onshore construction, would be negligible to minor. Impacts from non-routine activities, such as accidental releases, would be minor from small spills. While a larger spill could have moderate impacts on water quality, the likelihood of a spill this size is very unlikely. The impacts associated with the Proposed Action are likely to be temporary or small in proportion to the geographic analysis area, and the resource would recover completely after decommissioning.

Cumulative Impacts of the Proposed Action: BOEM anticipates that the cumulative impacts on water quality in the geographic analysis area would be **minor**. BOEM has considered the possibility of a **moderate** impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on water quality would be detectable should a large-volume, catastrophic release occur. The Proposed Action would contribute to the cumulative impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures.

3.4.2.6 Impacts of Alternatives C, D, E, and F on Water Quality

Impacts of Alternatives C, D, E, and F: The impacts resulting from the installation of offshore wind infrastructure under Alternatives C, D, E, and F would be either the same or less than those described under the Proposed Action due to the same (Alternatives C and E) or reduced (Alternatives D and F) number of structures and offshore export cables in the Wind Farm Area. While Alternative F would still have the same number of overall offshore structures in the Lease Area, the reduced number of Falmouth export cables using HVDC technology would require the construction of an HDVC converter station OSP that may otherwise not be necessary under the Proposed Action. While the reduced number of structures and offshore export cables may slightly reduce localized water quality impacts during construction and operations, the difference in impacts compared to the Proposed Action would not be materially different. BOEM expects that the modifications to the Brayton Point export cable route under Alternative C-1 and Alternative C-2 would slightly reduce the potential for offshore water quality impacts because cable emplacement would be avoided in the Sakonnet River. Onshore, however, Alternative C-1 and Alternative C-2 would slightly increase the potential water quality impacts because of the longer onshore cable routes. Because the cables would be installed largely within existing road ROWs and mitigation measures, such as the use of an SPCC plan and SWPPP, would be implemented, Alternative C-1 and Alternative C-2 are not expected to significantly change the potential impacts on water quality. Similarly, reducing the number of Falmouth offshore export cables from five to three under Alternative F as compared to the Proposed Action is not expected to substantively change the potential impacts on water quality because cable emplacement would still result in short-term and localized sediment suspension. The addition of another HVDC converter station OSP under Alternative F for the Falmouth export cables (in addition to the HVDC OSP already proposed for Brayton Point) would slightly increase impacts on water temperature during operations. As previously stated for the Proposed Action, the proposed HVDC converter OSP would use an open-loop cooling system that would cause a slight, localized increase in water temperature in the vicinity of the effluent diffuser. However, based on thermal plume modeling conducted for the Project, impacts on water quality from the effluent created by the HVDC structure are expected to be minimal, and a second OSP would not substantially change the overall impact rating given the small area that would be affected. In addition, the discharge of bleach from a second HVDC converter would have little effect on water quality around the discharge location due to the very low concentrations of bleach.

The GBS foundations proposed under Alternative E-3 would require larger disturbance footprints than the piled foundations and suction bucket foundations under Alternative E-1 and Alternative E-2, but the maximum disturbance footprint in the PDE was already assumed under the Proposed Action, and there would be no meaningful change in impacts on water quality.

Cumulative Impacts of Alternatives C, D, E, and F: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives C, D, E, and F on water quality would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternatives C, D, E, and F: The expected **minor** impacts associated with the Proposed Action would not change substantially under Alternatives C, D, E, and F. The same construction and installation, O&M, and conceptual decommissioning activities would still occur, albeit at differing scales in some cases. Alternative C-1 and Alternative C-2 would result in similar, but not materially different, minor impacts on water quality in relation to sediment disturbance and turbidity and onshore ground disturbance. Alternative D may result in slightly less, but not materially different, minor impacts on water quality due to a reduced number of WTGs that would be constructed and maintained. Alternative E-1, E-2, and E-3 would result in similar minor impacts as the Proposed Action from installation of different foundation types. Alternative F would result in the same minor impacts on water quality from the modification to the Falmouth offshore export cables. The addition of an HVDC converter station OSP using an open-loop cooling system would cause a slight increase in impacts on water temperature but would not be substantially different from the Proposed Action.

Cumulative Impacts of Alternatives C, D, E, and F: In the context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternatives C, D, E, and F would be the same as the Proposed Action—**minor**, but with a possibility of a **moderate** impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur.

3.4.2.7 Proposed Mitigation Measures

No measures to mitigate impacts on water quality have been proposed for analysis.

3.5 Biological Resources

3.5.1 Bats

This section discusses the potential impacts on bat populations from the proposed Project, alternatives, and ongoing and planned activities in the bat geographic analysis area. The bat geographic analysis area, as shown on Figure 3.5.1-1, includes the United States coastline from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. The geographic analysis area for bats was established to capture most of the movement range for migratory species. The offshore limit was established to capture the migratory movement of most species in this group, while the onshore limits cover onshore habitats used by species that may be affected by onshore and offshore components of the proposed Project.

3.5.1.1 Description of the Affected Environment and Future Baseline Conditions

The number of bat species in the geographic analysis area varies by state, ranging from eight species (Rhode Island, New Hampshire, and Maine) to 17 (Virginia and North Carolina) (RIDEM n.d.; Maine Department of Inland Fisheries and Wildlife 2021; New Hampshire Fish and Game n.d.; Virginia Department of Wildlife Resources 2021; North Carolina Wildlife Resources Commission 2017).

There are nine species of bats known to occur in Massachusetts and Rhode Island, eight of which may be present in the Project area and six that are year-round residents. These species can be broken down into cave-hibernating bats and migratory tree bats based on their wintering strategy. Bats are terrestrial species that spend almost their entire lives on or over land. On occasion, tree bats can occur offshore during spring and fall migration and under very specific conditions like low wind and high temperatures. Recent studies, combined with historical anecdotal accounts, indicate that migratory tree bats sporadically travel offshore during spring and fall migration, with 80 percent of acoustic detections occurring in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Stantec 2016a). However, unlike tree bats, the likelihood of detecting a *Myotis* species or other cave bat is substantially less in offshore areas (Pelletier et al. 2013). Table 3.5.1-1 shows the bats that are present in Massachusetts and Rhode Island and their associated conservation status.

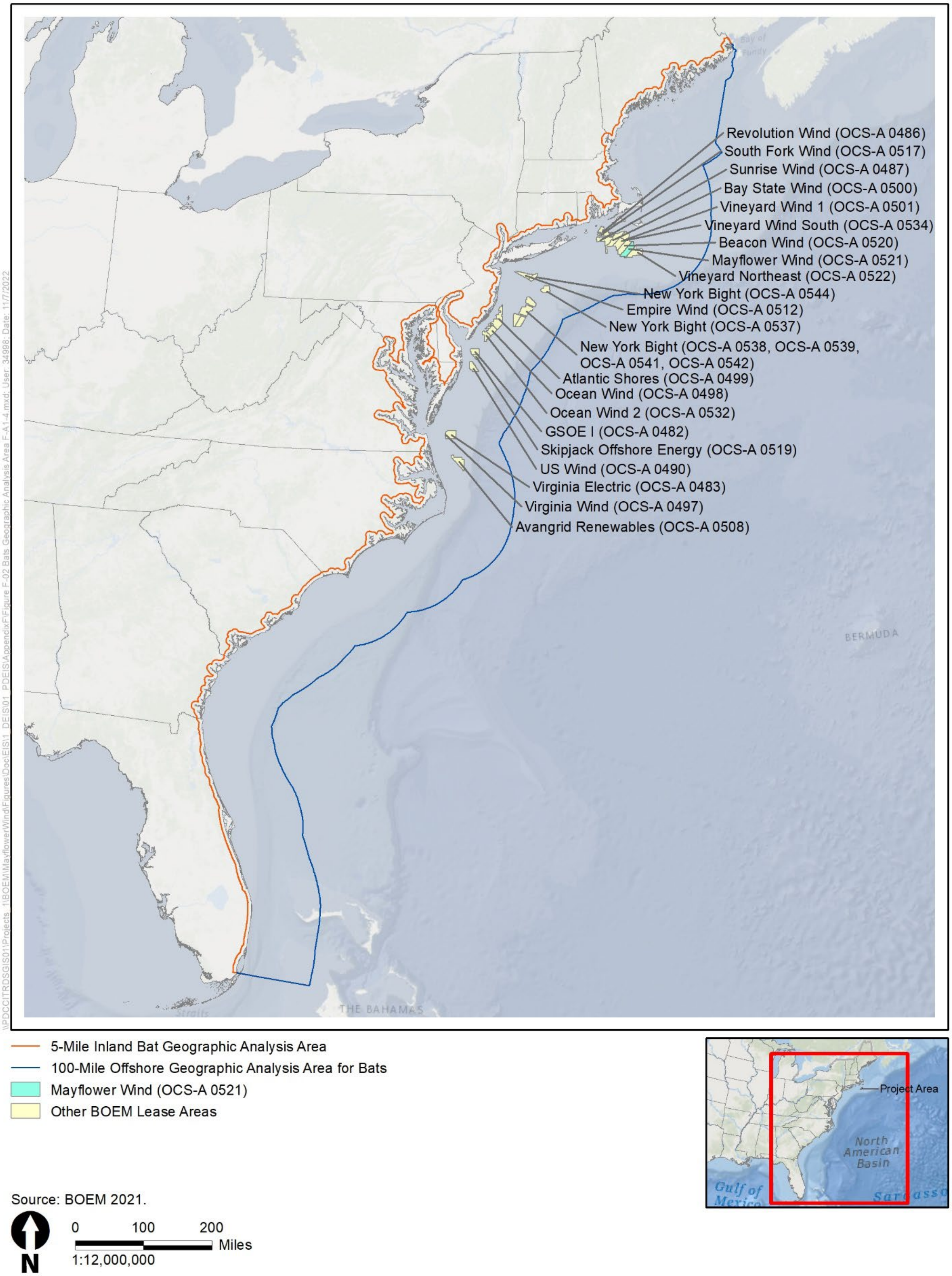

Figure 3.5.1-1. Bats geographic analysis area

Table 3.5.1-1. Bats present in Massachusetts and Rhode Island and their conservation status

Common Name	Scientific Name	Massachusetts State (MESA)	Rhode Island State (RINH)	Federal Status
Cave-Hibernating Bats				
Eastern small-footed bat	*Myotis leibii*	Endangered	SGCN	-
Little brown bat	*Myotis lucifugus*	Endangered	SGCN	Under Review [d]
Northern long-eared bat [a]	*Myotis septentrionalis*	Endangered	SGCN	Endangered
Indiana bat [b]	*Myotis sodalist*	Endangered	-	Endangered
Tri-colored bat [c]	*Perimyotis subflavus*	Endangered	SGCN	Under Review [e]
Big brown bat	*Eptesicus fuscus*	-	SGCN	-
Migratory Tree Bats				
Eastern red bat	*Lasiurus borealis*	-	SGCN	-
Hoary bat	*Lasiurus cinereus*	-	SGCN	-
Silver-haired bat	*Lasionycteris noctivagans*	-	SGCN	-

Source: Mayflower Wind 2022; USFWS 2021; Massachusetts Endangered Species Act 2017; RIDEM 2015
[a] USFWS reclassified the species as endangered as of January 30, 2023.
[b] Range does not indicate species presence in Project area.
[c] USFWS proposed to list the species as endangered as of September 14, 2022.
[d] Currently under a USFWS discretionary status review. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate.
[e] Currently under a USFWS discretionary status review. Results of the review may be to list the species as threatened instead of endangered, or that the species does not warrant listing as either an endangered species or a threatened species.

Bat species can be classified as migratory tree-roosting bats (tree bats) or cave-hibernating bats based on their wintering strategy. Tree-roosting bats with continental migratory patterns that may occur in the Project area include the silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*). Cave-hibernating bats that may occur in the Project area include the big brown bat (*Eptesicus fuscus*), tri-colored bat (*Perimyotis subflavus*), and three *Myotis* species: the eastern small-footed bat (*Myotis leibii*), little brown bat (*Myotics lucifugus*), and northern long-eared bat (*Myotis septentrionalis*). The tri-colored bat and the three *Myotis* species are listed as endangered under the Massachusetts ESA. In addition, the northern-long eared bat was listed by USFWS as federally threatened in 2015 and recently reclassified as endangered (effective January 30, 2023) (USFWS 2022), the tri-colored bat has been petitioned for federal listing, and the little brown bat federal listing is under review. All eight bat species in the Project area are listed as Species of Great Conservation Need in the 2015 State Wildlife Action Plan for Rhode Island (Mayflower Wind 2022).

The presence of bats has been documented in the offshore marine environment in the United States (Cryan and Brown 2007; Stantec 2016a; Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013). Bats have been documented temporarily roosting on structures (i.e., lighthouses) on nearshore islands (Dowling et al. 2017), and there is evidence of eastern red bats migrating offshore in the Atlantic. In a mid-Atlantic study conducted during the spring and fall of 2009 and 2010, the maximum distance that bats were detected from shore was 13.6 miles (21.9 kilometers) with an average distance of 5.2 miles (8.4 kilometers), and the eastern red bat represented 78 percent of all bat detections offshore (Sjollema et al. 2014). In Maine, bats were detected on islands up to 25.8 miles (41.6 kilometers) from the mainland. In addition, eastern red bats were detected in the mid-Atlantic up to 27.3 miles (44 kilometers) offshore by high-definition video aerial surveys (Hatch et al. 2013). At this time, there is some uncertainty regarding the level of bat use of the OCS. However, available data indicate that bat activity levels are generally greater onshore compared to offshore (Hein et al. 2021). For example, a bat migration study in the North Sea off Belgium found that the number of bat detections was up to 24 times higher at onshore locations compared to the offshore locations within a wind farm (Brabant et al. 2021).

Cave-hibernating bats hibernate regionally in caves, mines, and other structures (e.g., buildings) and feed primarily on insects in terrestrial and fresh-water habitats. In the mid-Atlantic, the maximum distance *Myotis* bats were detected offshore was 7.2 miles (11.5 kilometers) (Sjollema et al. 2014). A recent nano-tracking study on Martha's Vineyard recorded little brown bat movements off the island in late August and early September, with one individual flying from Martha's Vineyard to Cape Cod (Dowling et al. 2017). Big brown bats (*Eptesicus fuscus*) were also detected migrating from the island later in the year (October–November). Research based on Block Island and other coastal Rhode Island locations indicated *Myotis* species migrated short distances between the islands and the mainland primarily from July to September (Smith and McWilliams 2016). Therefore, use of the offshore environment by cave-hibernating species is likely to be limited to the fall migration period, and exposure to the Wind Farm Area is very unlikely compared to migratory tree bats based on acoustic studies that indicate cave bats remain primarily nearshore or between islands and the mainland during migration periods (Stantec 2018; Thompson et al. 2015; Tetra Tech and DeTect 2012; Ahlén et al. 2009).

Tree bats are more likely to be detected in the offshore environment than cave-hibernating bats. Tree bats migrate long distances to overwinter and have been documented using coastlines and islands offshore during migration (Normandeau Associates 2014; Hatch et al. 2013; Johnson et al. 2011). Eastern red bats have been detected migrating from Martha's Vineyard late in the fall, with one bat tracked as far south as Maryland (Dowling et al. 2017). During a long-term study of bat movements conducted from 2012 to 2014 in the coastal, nearshore, and offshore environments of the northeast, mid-Atlantic, and Great Lakes (Stantec 2016a; Pelletier et al. 2014), bat calls were detected from 3 to 80 miles (5–130 kilometers) offshore with detections approximately 9 to 30 miles (14–49 kilometers) southeast of Montauk and Block Island, west of the Project area. Eastern red bats and other migrants represented the most frequently observed species with peak activity during the spring and fall migrations. Use of the offshore Project area is expected to be primarily limited to migration periods.

Onshore coastal areas throughout the geographic analysis area provide habitats that support a diversity of bat species. All bat species present in Massachusetts and Rhode Island (migratory and non-migratory) are nocturnal insectivores that use a variety of forested and open habitats (e.g., waterways, lakes, other waterbodies, agricultural fields) during the summer for foraging and forested habitats for roosting. Roost selection is species-dependent, and while some of these species roost solely in the foliage of trees, others select dead and dying trees where they roost in peeling bark or inside crevices. The Falmouth onshore Project area is within the Atlantic coastal pine barren region and includes natural vegetation consisting of stunted oaks (Quercussp.; primarily scrub oak [*Quercus ilicifolia*]) and pines

(*Pinus* sp.; primarily pitch pine [*Pinus rigida*]) (Swain 2020). The Brayton Point onshore Project area is located within the Northeastern Coastal Zone region and natural communities are limited as the project is routed within/underneath developed areas, maintained recreational areas, and road services. Aquidneck Island is within the Narragansett/Bristol Lowland region and vegetation varies with oak-pine forests and oak-hickory due to coastal influences, with cranberry bogs and wetlands abundant within the mixed forest (Mayflower Wind 2022). See COP Appendix I2 Bat Risk Assessment, Tables 4-1 and 4-2 for a complete list of natural communities within the Falmouth onshore Project area and Brayton Point onshore Project area, respectively.

There are two buildable substation site options under consideration for the Falmouth onshore Project area, which would require up to 26.0 acres (10.5 hectares) of land and are both located in previously disturbed areas, which are not likely to provide suitable habitat for summer foraging and/or roosting. The Aquidneck Island cable landfall locations are in Portsmouth, Rhode Island and all onshore underground export cable system route options and landfall locations consist of developed land, developed recreation, impervious surfaces (roads), and wetlands. The Brayton Point cable landfall locations are in Somerset, Massachusetts and all landfall options are devoid of natural communities as the area consists of roads and former industrial uses, and the converter station will be constructed on up to 7.5 acres (3.0 hectares) of primarily disturbed and developed land. Although there are no bat data available specific to the Onshore Project area, several mist-netting, acoustic and telemetry surveys at Camp Edwards Joint Base Cape Cod located 8.1 miles (13.1 kilometers) from the Falmouth POI and proposed onshore substation site confirmed the presence of the northern long-eared bat, eastern small-footed bat, little brown bat, and tri-colored bat; no roosts were identified within 0.25 mile (0.4 kilometer) of the proposed Project area (COP Volume 2, Section 6.2.1.2, Mayflower Wind 2022). However, the RIDEM did not identify any presence of northern long-eared bat, eastern small-footed bat, little brown bat, and tri-colored bat in the Rhode Island portions of the Brayton Point export cable corridor (Jordan 2021).

Caves and mines provide key habitat for cave-hibernating bats. These locations serve as winter hibernacula, fall swarm locations (areas where mating takes place in the fall months), and summer roosting locations for some individuals. For a bat hibernaculum to be occupied within a cave or mine, suitable conditions for temperature, humidity and airflow and minimal disturbance must be met (McAney 1999). The locations for the onshore substation and converter station are not expected to contain caves or mines suitable for winter hibernacula for any cave-hibernating bat species.

The northern long-eared bat is the only bat species listed under the ESA that may occur in the Project area (USFWS 2021). Several mist-netting and acoustic and telemetry surveys at Camp Edwards Joint Base Cape Cod confirmed the presence of northern long-eared bats on Cape Cod and portions of the onshore Project components in Falmouth overlap Massachusetts Priority Habitat 213. However, the Brayton Point Onshore Project area is sited within an existing industrial area and the isolated and fragmented nature of the nearby forest lowers the likelihood of northern long-eared bat presence. The nearest maternity colonies are located 34.8 miles (56.0 kilometers) east near Sandwich, Massachusetts, and the nearest hibernaculum is located 40.4 miles (65.0 kilometers) north in Wellesley, Massachusetts (Mayflower Wind 2022). It is not expected that northern long-eared bats would be exposed to the offshore Wind Farm Area. A recent tracking study on Martha's Vineyard (July–October 2016) did not record any offshore movements (Dowling et al. 2017). If northern long-eared bat were to migrate over water, movements would likely be near the mainland. The related little brown bat has been documented to migrate from Martha's Vineyard to Cape Cod, and northern long-eared bat may likewise migrate to mainland hibernacula from these islands in August and September (Mayflower Wind 2022). Given that there is little evidence of use of the offshore environment by northern long-eared bat, exposure to the proposed Wind Farm Area, if it occurs, is anticipated to be minimal. BOEM is preparing a Biological Assessment (BA) pursuant to Section 7 of the ESA that will provide a detailed discussion of ESA-listed species and potential impacts of the Project. Results of ESA consultation with USFWS will be included in the Final EIS.

Cave bat species, including the northern long-eared bat, are experiencing drastic declines due to White Nose Syndrome (WNS) caused by the fungus *Pseudogymnoascus destructans* (MassWildlife 2022). WNS was confirmed as present in Massachusetts in 2008, and Rhode Island in 2016 (Whitenosesyndrome.org 2022; USFWS 2018). Declines in populations of the northern long-eared bat are ongoing as the disease continues to spread throughout the species range (USFWS 2015). Other cave-hibernating species with confirmed presence of WNS include the big brown bat, eastern small-footed bat, little brown bat, and the tri-colored bat (USFWS 2018). Proposed Project-related impacts have the potential to affect cave bat populations already affected by WNS. The unprecedented mortality of more than 5.5 million bats in northeastern North America as of 2015 reduces the likelihood of many individuals being present within the onshore portions of the proposed Project area (USFWS 2015). However, given the drastic reduction in cave bat populations in the region, the biological significance of mortality resulting from the proposed Project, if any, may be increased.

3.5.1.2 Impact Level Definitions for Bats

The definitions of potential adverse impact levels for bats are provided in Table 3.5.1-2. There would be no beneficial impacts on bats.

Table 3.5.1-2. Impact level definitions for bats

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
Moderate	Adverse	Impacts are unavoidable but would not result in population-level effects or threaten overall habitat function.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level effects on species.

3.5.1.3 Impacts of Alternative A - No Action on Bats

When analyzing the impacts of the No Action Alternative on bats, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for bats. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for bats described in Section 3.5.1.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on bats are generally associated with onshore construction and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bat species through temporary and permanent habitat removal and temporary noise impacts, which could cause avoidance behavior and displacement. Mortality of individual bats could occur, but population-level effects would not be anticipated. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on bats include the following.

- Continued O&M of the Block Island project (five WTGs) installed in state waters.
- Continued O&M of the CVOW Project (two WTGs) installed in OCS-A 0497.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect bats through the primary IPFs of noise, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and land disturbance that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect bats include new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (Appendix D, *Planned Activities Scenario*, for a complete description of planned activities). These activities may result in temporary or permanent displacement and injury or mortality to individual bats, but population-level effects would not be expected.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on bats during construction, O&M, and decommissioning of the projects. Planned offshore wind activities include offshore wind energy development activities on the Atlantic OCS other than the Proposed Action determined by BOEM to be reasonably foreseeable (see Appendix D, Attachment 2 for a complete description of planned offshore wind activities).

Offshore wind activities may affect bats through the following primary IPFs.

Noise: Anthropogenic noise associated with offshore wind development, including noise from pile-driving and construction activities offshore and construction activities onshore, has the potential to result in impacts on bats. BOEM anticipates that noise impacts would be negligible because noise would be temporary and highly localized. In the planned activities scenario (Appendix D, *Planned Activities Scenario*), the construction of 2,945 offshore structures (other than the Proposed Action) and associated OSP would create noise and may temporarily affect migrating tree bats, if conducted at night during the spring or fall migration periods.

The greatest impact of noise would likely be caused by pile-driving activities during installation of foundations for offshore wind structures. Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 4 to 6 hours per day at a time, over an 8-year period. Noise from construction activity would be short-term, temporary, and highly localized. Auditory impacts are not expected to occur, because recent research has shown that bats may be less sensitive to temporary threshold shifts) than other terrestrial mammals (Simmons et al. 2016). Habitat-related impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would likely be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur, as little use of the OCS is expected, and only during spring and fall migration.

Habitat-related impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would likely be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur, because little use of the OCS is expected by tree bats, and only during spring and fall migration.

Potential for short-term, temporary, localized habitat impacts arising from onshore construction of required offshore wind development infrastructure noise exists; however, no auditory impacts on cave-hibernating or tree bats would be expected to occur. Recent literature suggests that bats are less susceptible to temporary or permanent hearing loss from exposure to intense sounds (Simmons et al.

2016), and bats are tolerant to anthropogenic noise as documented instances have shown bats roosting in noisy environments near airports and highways (Brack et al. 2004). However, nighttime work outside of normal hours may be required on an as-needed basis. Some temporary displacement or avoidance of potentially suitable foraging habitat could occur, but these impacts would not be expected to be biologically significant. Some bats roosting in the vicinity of construction activities may be disturbed during construction but would be expected to move to a different roost farther from the construction noise. This would not be expected to result in any impacts, because frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998).

Non-routine activities associated with the offshore wind facilities would generally require intense, temporary activity to address emergency conditions. The noise made by onshore construction equipment or offshore repair vessels could temporarily deter bats from approaching the site of a given non-routine event. Impacts on bats, if any, would be temporary and last only as long as repair or remediation activities were necessary to address these non-routine events. Given the temporary and localized nature of potential impacts and the expected biologically insignificant response to those impacts, no individual fitness or population-level impacts would be expected to occur as a result of onshore or offshore noise associated with offshore wind development, and so overall impacts would be negligible.

Presence of structures: Offshore wind-related activities would add up to 2,945 WTGs and OSPs on the OCS that could result in potential impacts on bats. Cave bats are less likely to fly offshore (even during fall migration) (Sjollema et al. 2014); therefore, exposure to construction vessels during construction or maintenance activities, or the rotor-swept zone (RSZ) of operating WTGs in the wind lease areas, is expected to be negligible, if exposure occurs at all (BOEM 2015; Pelletier et al. 2013). Tree bats, however, may pass through the offshore wind lease areas during the fall migration with potential to encounter vessels during construction and decommissioning of WTGs, OSPs, and offshore export cable corridors. During the installation of WTGs at the Block Island Wind Farm, some unidentified bats were observed roosting on the vessels during daytime hours. One photo taken by a crew member during this time captured an eastern red bat roosting below an elevated deck in August (Stantec 2016b).

As discussed above, while bats have been documented on offshore islands, relatively little bat activity has been documented over open water habitat similar to the conditions in the Project Wind Farm Area. Several authors, such as Cryan and Barclay (2009), Cryan et al. (2014), and Kunz et al. (2007), discuss several hypotheses as to why bats may be attracted to WTGs. Many of these, including the creation of linear corridors, altered habitat conditions, or thermal inversions, would not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007). Solick and Newman (2021) suggest the offshore structures may serve as shelter from adverse weather conditions or provide an area to rest from a long flight. Other hypotheses associated with the Atlantic OCS regarding bat attraction to WTGs include bats perceiving the WTGs as potential roosts, potentially increased prey base, visual attraction, disorientation due to electromagnetic fields (EMF) or decompression, or attraction due to mating strategies (Arnett et al. 2008; Cryan 2007; Kunz et al. 2007). However, no definitive answer as to why bats appear to be attracted to WTGs has been postulated, despite intensive studies at onshore wind facilities. Smallwood and Bell (2020) found that bats were twice as likely to travel through the RSZ of active WTGs than inactive ones and were more likely to experience flight interruptions or be struck by blades from active WTGs onshore. As such, it is possible that some migrating bats may encounter, and perhaps be attracted to, operational WTGs and interact with turbine blades in the RSZ (Ahlén et al. 2007; Arnett et al. 2008; Cryan et al. 2014; Cryan and Barclay 2009), in addition to OSP and non-operational WTG towers to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects (OSP and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the bases of onshore turbine towers (Choi et al. 2020).

Tree bat species that may encounter the operating WTGs in the offshore wind lease areas include the eastern red bat, hoary bat, and silver-haired bat. Offshore O&M would present a seasonal risk factor to migratory tree bats that may use the offshore habitats during fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during fall migration, the overall occurrence of bats on the OCS is relatively very low (Stantec 2016b). Furthermore, unlike with terrestrial migration routes, there are no landscape features that would concentrate bats and thereby increase exposure to the offshore wind lease areas. Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with offshore wind development. With the proposed up to 1-nm (1.9-kilometer) spacing between structures associated with offshore wind development in the Massachusetts and Rhode Island lease areas and the distribution of anticipated projects, individual bats migrating over the OCS within the RSZ of project WTGs would likely pass through projects with only slight course corrections, if any, to avoid operating WTGs. Unlike with terrestrial migration routes, there are no landscape features that would concentrate migrating tree bats and increase exposure to offshore wind lease areas on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016). Additionally, the potential collision risk to migrating tree bats varies with climatic conditions. For example, bat activity is associated with relatively low wind speeds and warm temperatures (Arnett et al. 2008; Cryan and Brown 2007; Fiedler 2004; Kerns et al. 2005). Given the rarity of tree bats in the offshore environment, WTGs being widely spaced, and the patchiness of projects, the likelihood of collisions is expected to be low and impacts on bats would be negligible. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions would be extremely low, because bat activity is suppressed during periods of strong winds, low temperatures, and rain (Arnett et al. 2008; Erickson et al. 2002).

Land disturbance (onshore construction): Onshore construction of offshore wind development infrastructure would be required over the next 8 years and has the potential to result in impacts due to habitat loss or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities. Construction would be expected to require only small amounts of habitat removal, if any, and would occur in previously disturbed areas to the extent possible. As such, onshore construction impacts associated with offshore wind development would be short-term, minor, and no injury or mortality of individual bats would be expected. Furthermore, no individual or population-level effects are expected to occur. As such, onshore construction impacts associated with offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

In addition to electrical infrastructure, some amount of habitat conversion may result from port expansion activities required to meet the demands for fabrication, construction, transportation, and installation of wind energy structures. The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in permanent habitat loss for local bat populations. However, the incremental increase from offshore wind development would be a minimal contribution in the port expansion required to meet increased commercial, industrial, and recreational demand (BOEM 2019).

Impacts of Alternative A on ESA-Listed Species

The northern long-eared bat is the only bat species listed under the ESA that may be affected by offshore wind activities. As described above, northern long-eared bats are not expected to use the OCS in any significant numbers, if at all. The IPFs described previously for all bats would also apply to the northern long-eared bat. Any future federal activities that could affect the northern long-eared bat would need to comply with ESA Section 7 to ensure that the proposed activities do not jeopardize the continued existence of the species.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, bats would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on bats primarily through the onshore construction impacts, the presence of structures, and climate change. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, ongoing offshore wind activities would not appreciably contribute to impacts on bats. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. The No Action Alternative would result in **minor** impacts on bats.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and bats would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on bats due to habitat loss from increased onshore construction. BOEM anticipates cumulative impacts of the No Action Alternative would likely be **minor** because bat presence on the OCS is anticipated to be limited, and onshore bat habitat impacts are expected to be minimal.

3.5.1.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project buildout as defined in the PDE would result in impacts similar to or less than those described in the following sections. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on bats.

- The onshore substation/converter stations, which could require the removal of forested habitat.
- The number, size, and location of WTGs.
- The routing variants within the selected onshore cable export route.
- The time of year during which construction occurs.

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

- Number of WTGs, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to bats.
- Onshore export cable routes and substation/converter station footprints: the route chosen (including variants within the general route) and substation/converter station footprint would determine the amount of habitat affected.
- Season of construction: the active season for bats in this area is from April through October. Construction outside of this window would have a lesser impact on bats than construction during the active season.

Mayflower Wind has committed to measures to minimize impacts on bats, including avoiding locating onshore facilities near known hibernacula and roosting colonies, minimizing lighting to reduce potential attraction of bats to vessels and vehicles during construction, and developing and implementing a Post-Construction Monitoring Plan to evaluate and mitigate for potential collision risk for bat species (Appendix G, *Mitigation and Monitoring*).

3.5.1.5 Impacts of Alternative B - Proposed Action on Bats

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

Noise: Pile-driving noise and onshore and offshore construction noise associated with the Proposed Action alone is expected to result in short-term, temporary, negligible, and highly localized impacts. The Proposed Action would include a maximum of 149 WTG/OSP positions. Each WTG requires one monopile or three to eight pin piles, and each OSP requires one monopile or up to 27 pin piles with each pin pile or monopile requiring 2 or 4 hours of driving to install, respectively. Auditory impacts are not expected to occur; recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

Normal operation of the substation/converter station may generate a small amount of noise into the surrounding environment. Operational noise, however, is expected to be significantly less than noise associated with construction and bats are not likely to be sensitive to such disturbances. COP Appendix U1, *In-Air Acoustic Assessment*, Tables 5-1 and 5-2 provides the primary noise sources and reference levels for substation sites and HDD operations, respectively. To avoid, mitigate, and minimize noise impacts during onshore construction activities, Mayflower Wind is requiring construction equipment to be operated such that the construction-related noise levels comply with applicable sections of the MassDEP Air Quality Regulation at 310 CMR 7.10, which would minimize impacts on bats (COP Appendix U1, In-Air Acoustic Assessment Report, Section 5.2.3).

Presence of structures: Migration disturbance and turbine strikes are impacts on bats that could result from the presence of structures in the OCS and are described in detail in Section 3.5.1.3, *Impacts of Alternative A – No Action on Bats*. Up to 149 WTG/OSP positions on the OCS could contain structures resulting from the proposed Project where few currently exist. The structures and associated bat impacts would have the potential to occur until decommissioning of the proposed Project is complete. There is currently some uncertainty regarding the level of bat use of the OCS and the ultimate consequences of mortality, if any, associated with operating WTGs. However, existing data from meteorological buoys provide the best opportunity to further define bat use of open-water habitat far from shore where Mayflower Wind would site the proposed Project WTGs. Relatively few (372) bat passes were detected at meteorological buoy sites, and use was sporadic when compared to sites on offshore islands (Stantec 2016b). In addition, recent data from 3 years of post-construction monitoring around Block Island Wind Farm found relatively low numbers of bats present only during the fall, and no recorded presence of northern long-eared bats (Stantec 2020). While many of the bats that were detected around Block Island Wind Farm were present at wind speeds below Mayflower Wind's proposed WTG cut-in speed of 5.6 to 8.9 miles per hour, there were a number of bats present at or above the cut-in speed, which could indicate vulnerability for bats when WTG blades are turning. However, as previously mentioned, available data indicate that bat activity levels are generally lower offshore compared to onshore (Hein et al. 2021). Migratory tree-roosting bats have been recorded 21.0 and 27.0 miles (33.8 and 44.5 kilometers) offshore but are unlikely to be exposed to WTGs within the Lease Area, which is 29.8 miles (48.0 kilometers) south of Martha's Vineyard, 23.0 miles (37.0 kilometers) south of Nantucket, and 44.7 miles (72.0 kilometers) from the mainland at Nobska Point in Falmouth, Massachusetts. Therefore, because available information indicating bat presence on the OCS is limited, BOEM anticipates the presence of structures to have a negligible impact on bat populations.

Land disturbance (onshore construction): Impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities occur during the active season (generally, April through October). These impacts may result in displacement or direct injury or death of bat species in the Onshore Project area through tree trimming or removal, or the disruption of bat activity resulting in roost abandonment or significant energy expenditure during pup-rearing or migratory periods. Tree trimming and clearing could potentially cause injury or mortality of individuals, particularly juveniles who are unable to flush from a roost, if occupied by bats at the time of removal. Additionally, there would be some potential loss of potentially suitable roosting or foraging habitat. However, impacts to bat habitat from onshore construction would be limited because Mayflower Wind's facilities would follow previously disturbed areas, which would result in no further additional habitat fragmentation, significant new open spaces, or open corridors. Where necessary, construction of onshore facilities may require clearing and permanent removal of some trees along the edge of the construction corridor. The HVDC Brayton Point converter station and the proposed Falmouth substation sites would be located in previously disturbed areas, which are not likely to provide suitable habitat for summer foraging and/or roosting. Overall, onshore construction disturbances are expected to be short-term for bats but would have permanent effects including new aboveground structures and lost habitat from limited tree clearing required for the onshore substation and converter station. Additionally, routine ground disturbance would likely occur during O&M near the onshore converter station/substation. This would result in permanent alteration of natural habitats, which were disturbed prior during the construction phase. To avoid and minimize impacts on bats, Mayflower Wind has not sited onshore Project infrastructure near key habitat locations for cave-hibernating species. Onshore export cables would be underground from the landfall locations to the onshore substation and converter station, and the converter station and substation would be constructed in open areas where tree clearing is expected to be minimal. Mayflower Wind would coordinate as necessary with USFWS, the Massachusetts Division of Fish and Wildlife, and RIDEM to determine appropriate mitigation measures, and by adhering to seasonal restrictions, the risk of direct mortality or injury during construction would be avoided.

BOEM anticipates that impacts would be minor given the limited amount of habitat removal and that any potential impact would be avoided or significantly reduced due to Mayflower Wind's proposed Project's AMMs. Therefore, impacts would not result in individual fitness or population-level effects.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Ongoing and planned non-offshore wind activities related to submarine cables and pipelines, onshore construction, marine minerals extraction, and port expansions would contribute to impacts on bats through the primary IPFs of noise, presence of structures, and land disturbance. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of noise, presence of structures, and land disturbance. Given the infrequent and limited anticipated use of the OCS by migrating tree bats and given that cave bats do not typically occur on the OCS, offshore wind activities would not appreciably contribute to impacts on bats. Temporary disturbance and permanent loss of onshore habitat may occur as a result of constructing onshore infrastructure such as onshore substations and onshore export cables for offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness of population-level effects in the geographic analysis area. Ongoing and planned offshore wind activities in combination with the proposed Action would result in an estimated 2,945 WTGs and OSPs, of which the Proposed Action would contribute 149 or about 5 percent.

The cumulative impacts on bats would likely be minor because the occurrence of bats offshore is low, and onshore habitat loss is expected to be minimal. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative noise, presence of structures, and land disturbance impacts on bats.

Impacts of Alternative B on ESA-Listed Species

The northern long-eared bat is the only bat species listed under the ESA that may be affected by the proposed Project. As stated previously, the presence of northern long-eared bat on the offshore environment would generally be limited, with more potential effects from onshore activities. BOEM is preparing a BA for the potential effects on USFWS federally listed species. A preliminary draft found that the Proposed Action was *not likely to adversely affect*, or had *no effect*, on listed species. There is no critical habitat designated for this species. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing and results of the consultation will be presented in the Final EIS.

Conclusions

Impacts of the Proposed Action: BOEM anticipates construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have overall **minor** impacts on bats, especially if tree clearing is conducted outside the active season. The primary risks would be from potential onshore removal of habitat and operation of the offshore WTGs, which could lead to negligible to minor long-term impacts in the form of mortality, although BOEM anticipates this to be rare. Noise effects from construction are expected to be limited to temporary and localized behavioral avoidance of pile-driving or construction activity that would cease once construction is complete.

Cumulative Impacts of the Proposed Action: BOEM anticipates that the cumulative impacts on bats in the geographic analysis area would be **minor**. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on bats would be undetectable. Because the occurrence of bats offshore is low, the Proposed Action would contribute to the cumulative impacts primarily through the permanent impacts from onshore habitat loss related to onshore cable installation and substation construction.

3.5.1.6 Impacts of Alternative C on Bats

Impacts of Alternative C: Under Alternative C, the export cable route to Brayton Point would be rerouted onshore to avoid sensitive fish habitat in the Sakonnet River. The new overland portions of Alternative C-1 and Alternative C-2 would largely be sited in public road ROWs to the extent possible. The primary impacts of Alternative C affecting bats would be habitat loss from tree disturbance, which would result in both temporary and permanent impacts. In addition to the forest area disturbed under the Proposed Action, 4.95 acres, 2.59 acres, and 15.46 acres of forest habitat could be disturbed under Alternative C-1 (eastern variation), Alternative C-1 (western variation), and Alternative C-2, respectively (refer to Section 3.5.4, *Coastal Habitat and Fauna*). This impact may affect bat foraging, roosting, or maternity colonies. While the area of forest disturbance would be greater than the Proposed Action, the potential impact on bats would remain minor.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Impacts of Alternative C on ESA-Listed Species

Under Alternative C, the impact conclusion for the northern long-eared bat is the same as the Proposed Action. Under Alternative C, potential impacts on the northern long-eared bat include habitat loss from forest disturbance, which may be used by this species for foraging, roosting, or maternity colonies. While the area of forest disturbance would be slightly greater under Alternative C compared to the Proposed Action, it is not anticipated to change the overall impact level.

Conclusions

Impacts of Alternative C: The anticipated minor impacts associated with the Project would not change substantially under Alternative C. While Alternative C would result in a greater area of forest disturbance along the onshore export cable routes than the Proposed Action, the overall affected area would be small and the same construction, O&M, and decommissioning impacts would still occur. Alternative C would have overall **minor** impacts on bats.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C to the cumulative impacts on bats would be similar to the Proposed Action and would be **minor**. This impact rating is driven primarily by ongoing activities, as well as minor disturbance and habitat removal associated with onshore construction of Alternative C.

3.5.1.7 Impacts of Alternatives D, E, and F on Bats

Impacts of Alternatives D, E, and F: Impacts on bats resulting from construction and installation, O&M, and decommissioning of the Project under Alternatives D, E, and F would be the same as those described for the Proposed Action. Under Alternative D, potential impacts on bats from the presence of structures could be reduced with the removal of up to six WTGs, but any such differences compared to the Proposed Action would likely be immeasurable. None of the differences between Alternatives E and F and the Proposed Action would have the potential to significantly reduce or increase impacts on bats from the analyzed IPFs. Given the infrequent and limited use of the OCS by bats during the spring and fall migration, BOEM does not anticipate impacts to be materially different than those described for the Proposed Action.

Cumulative Impacts of Alternatives D, E, and F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives D, E, and F would be similar to those described for the Proposed Action.

Impacts of Alternatives D, E and F on ESA-Listed Species

Under Alternatives D, E, and F, the impact conclusion for the northern long-eared bat is the same as the Proposed Action for the same reasons described for all bats above. Northern long-eared bats are not expected to use the OCS in any significant numbers, if at all, and BOEM does not anticipate impacts to be measurably different than those described for the Proposed Action.

Conclusions

Impacts of Alternatives D, E, and F: All conclusions reached for the Proposed Action regarding impacts on bats and the ESA-listed northern long-eared bat would also apply to Alternatives D, E, and F. Alternative D would reduce the number of WTGs and noise impacts compared to the Proposed Action in the northern Lease Area but would have similar overall impacts on bats. Alternatives E and F would have the same WTG number and overall Wind Farm Area footprint as the Proposed Action and would have similar impacts on bats. Therefore, the overall **minor** impacts would be similar among the Proposed Action and Alternatives D, E, and F.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives D, E, and F would be similar to those described for the Proposed Action and would be **minor**.

3.5.1.8 Proposed Mitigation Measures

The following mitigation measures are proposed to minimize impacts on bats (Appendix G, Table G-2). If the measures analyzed below are adopted by BOEM, some adverse impacts on bats could be further reduced.

If the reported post-construction bat monitoring results (generated as part Mayflower Wind's bird and bat Post-Construction Monitoring Plan [COP Volume 2, Table 16-1, Mayflower Wind 2022]) indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Mayflower Wind must make recommendations for new mitigation measures or monitoring methods. In addition, an Annual Bird and Bat Mortality Report would be required. Mayflower Wind must submit an annual report covering each calendar year, due by January 31 of the following year, documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning.

3.5 Biological Resources

3.5.2 Benthic Resources

This section discusses potential impacts on benthic resources, other than fishes and commercially important benthic invertebrates, from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The benthic geographic analysis area, as shown on Figure 3.5.2-1 includes both a 10-mile (16.1-kilometer) radius/buffer around the Wind Farm Area and a 330-foot (100-meter) buffer around each ECC. Finfish, invertebrates, and essential fish habitat are addressed in Section 3.5.5.

3.5.2.1 Description of the Affected Environment and Future Baseline Conditions

The description of benthic resources in this section is supported by studies conducted by Mayflower Wind, as well as other studies reviewed in the literature (COP Section 6.6, Appendix M, and Appendix K; Mayflower Wind 2022). Seasonal benthic surveys were conducted in the Lease Area and along the Falmouth ECC to characterize the benthic resources in the Offshore Project area (Mayflower Wind 2022). Benthic habitat surveys conducted for the proposed Project included Sediment Profile Imaging (SPI)/Plan View (PV) imagery data, and benthic grab samples throughout the Offshore Project area. Benthic epifaunal and infaunal species abundance were analyzed using benthic grabs as well as seafloor imagery captured by the benthic survey SPI/PV camera and a video camera that was affixed to the benthic grab apparatus. Submerged aquatic vegetation (SAV) surveys consisting of single-beam echo sounding, side-scan sonar, and underwater towed video were completed at three landfall location options in Falmouth, Massachusetts (Mayflower Wind 2022). Two landfall locations are under consideration for the Brayton Point ECC where a previously unmapped section of interpreted SAV was identified near the shoreline closest to the Aquidneck Island landfall (COP Appendix E; Mayflower Wind 2022).

A larger-scale, non-Project-specific study was also undertaken that characterized offshore wind lease areas in the northeast WEAs (Guida et al. 2017). This study compiled data from numerous sources, including from NOAA-National Centers for Environmental Information for bathymetric data, NEFSC for physical and biological oceanography, NEFSC fisheries independent trawl survey for demersal fish and shellfish, and USGS usSEABED data for surficial sediment data (USGS 2005).

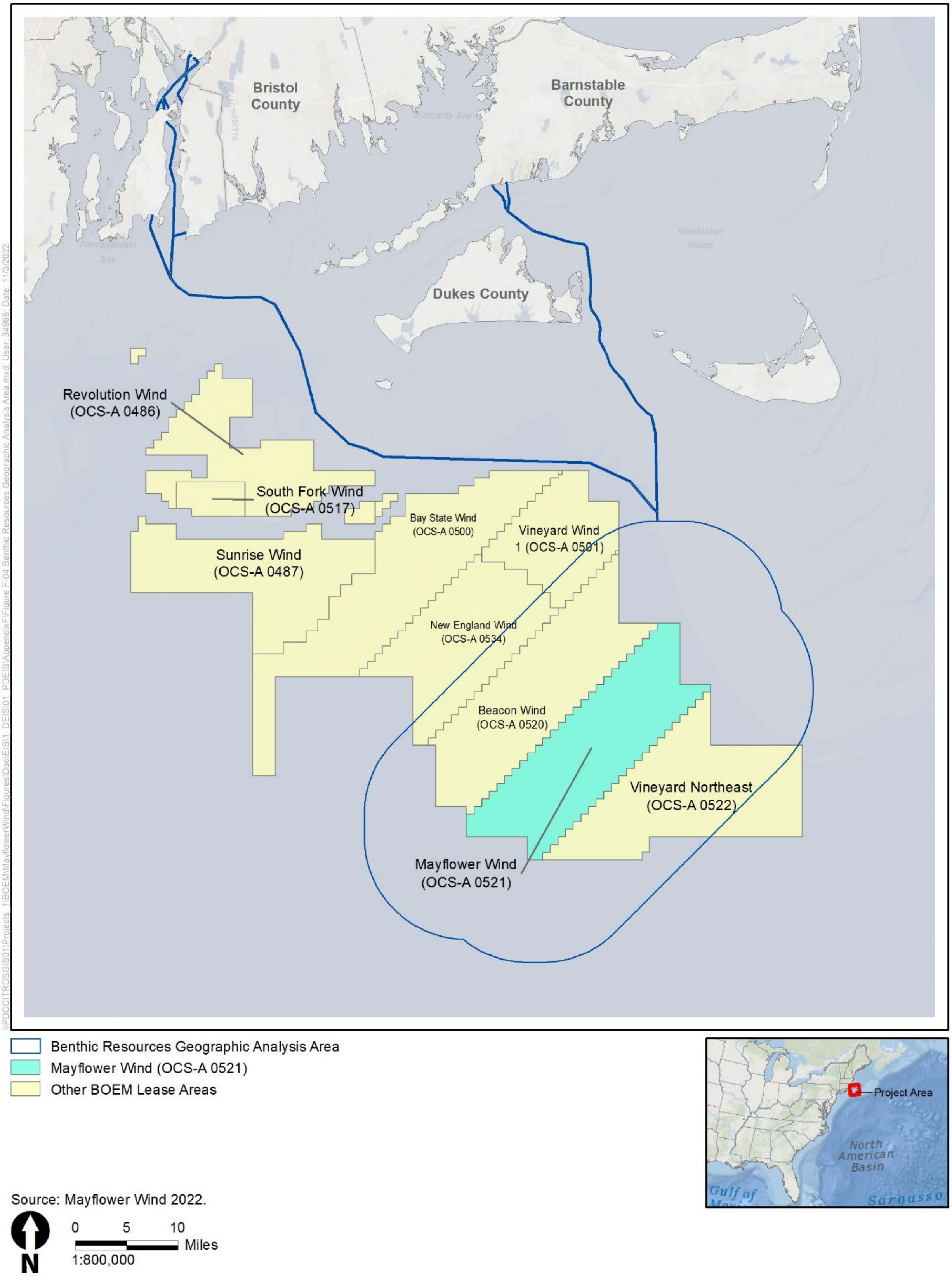

Figure 3.5.2-1. Benthic resources geographic analysis area

Offshore Project Area

The Wind Farm Area covers approximately 127,388 acres (51,552 hectares) on the Northeast Outer Continental Shelf off the southern coast of Massachusetts (Mayflower Wind 2022), with two ECCs extending from the Wind Farm Area into the Narragansett Bay and to the Falmouth, Massachusetts, coastline. The seafloor of the Wind Farm Area is mostly flat with gentle slopes ranging from less than 1.0° to 4.9°. The central section of the Lease Area comprises ridges with moderate slopes (5.0° to 9.9°) and shallow channels (Mayflower Wind 2022). Water depths within the Lease Area range from 121.72 feet (37.1 meters) to 208.3 feet (63.5 meters), with deeper waters in the southwestern portion. The average depth is 164.0 feet (50.0 meters), and the deepest depth is 206.7 feet (63.1 meters) (Mayflower Wind 2022). There are no hard corals within the vicinity of the Lease Area according to the NOAA Deep-Sea Coral Data Portal (NOAA 2022), and only sea pens were documented in the 1960s south of the Lease Area in deeper waters (Mayflower Wind 2022).

Benthic resources include the seafloor, substrate, and communities of bottom-dwelling organisms that live within these habitats. Benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble and boulder) habitats, as well as consolidated sediment (i.e., pavement), which can occur in scour zones, and biogenic habitats (e.g., eelgrass and worm tubes) created by structure-forming species. Sediments from grab samples within the Lease Area were largely classified as Coastal and Marine Ecological Classification Standard (CMECS) Subclass Fine Unconsolidated Substrate, or dominated by sand or finer sediment size (< 5 percent gravel). Only one sample was classified as Coarse Unconsolidated Substrate (≥ 5 percent gravel; Mayflower Wind 2022). The Lease Area was mainly soft bottom habitat with little relief and no complex habitat-forming features. Total organic carbon (TOC) was low with the majority of samples containing less than 1 percent TOC.

Benthic epifauna were sampled by beam trawl across the Massachusetts offshore wind lease area with sand shrimp and sand dollars comprising 88 percent of individuals collected (Guida et al. 2017). Mobile crustaceans and mollusks were dominant in 2020 benthic samples and are commonly associated with the soft sediments of the Lease Area (Mayflower Wind 2022). Infaunal communities of the Lease Area consisted mainly of soft-sediment burrowing infauna, with the eastern portion consisting of clam beds and tube-building *Ampelisca* beds (Mayflower Wind 2022). The western portion of the Lease Area also contained *Ampelisca* beds, as well as small surface-burrowing polychaete worm beds. Results of a seagrass and macroalgae evaluation of the Offshore Project area found no SAV in the Lease Area.

Inshore Project Area

The Falmouth ECC extends from the Lease Area through Muskeget Channel and ends at one of the two proposed landfall locations in Falmouth, Massachusetts (Worcester Avenue with alternate sites at Shore Street and Central Park). The Brayton Point ECC extends from the Lease Area through the Rhode Island Sound, up the Sakonnet River, over Aquidneck Island, and into Mount Hope Bay before making landfall at one of the two proposed locations in Somerset, Massachusetts.

Similar to the Lease Area, the southern portion of the Falmouth ECC (between the Lease Area and the Muskeget Channel) consisted mainly of fine and soft sediments. Samples in this southern section were mainly Fine Unconsolidated sediment, with three samples as Coarse Unconsolidated sediment (≥ 5 percent gravel; Mayflower Wind 2022). Most samples (approximately 90 percent) were sand, with three samples consisting of Muddy Sand (COP Appendix M; Mayflower Wind 2022). Further sand classification indicated a transition of Fine/Very Fine Sand to Medium and Very Coarse/Coarse Sand as sampling occurred more north and away from the Lease Area. The only complex habitats observed were three gravelly samples. TOC was less than 1 percent in all samples (COP Appendix M; Mayflower Wind 2022).

The northern Falmouth ECC sediment samples were more variable, with a further transition to coarser sediments as the corridor proceeds through the Muskeget Channel north towards the Nantucket Sound and landfall. Gravelly samples dominated the Muskeget Channel and south of the Nantucket Sound Main Channel, with a transition to soft-bottom habitat as all samples within the Nantucket Sound Main Channel were classified as sand (Mayflower Wind 2022). Complex habitat was observed in the remaining samples north of the Nantucket Main Channel, with two samples classified as Biogenic Shell Substrate (*Crepidula* reef). Some Gravel Pavement was noted in the SPI/PV images, and Gravel/Gravelly samples were observed throughout the northern section of the Falmouth ECC. TOC was undetectable in the majority of samples, with one sample containing slightly above 1 percent.

A benthic survey was conducted along the Brayton Point ECC in Summer 2021 and Spring 2022. Sediments followed similar patterns as the Falmouth ECC, with finer sediments in the southern section near the Lease Area becoming coarser as sampling proceeded north. In federal waters, over 90 percent of benthic habitat was mapped as sand or finer (Appendix M.3, Mayflower Wind 2022). Gravelly Sand to Sandy Gravel, including Boulders, were present in the Rhode Island Sound where an area of glacial till southwest of Martha's Vineyard provides heterogenous substrate and hardbottom substrate (COP Volume 2, Section 6.6.1.6.4; Mayflower Wind 2022). Sand or finer sediments dominated Rhode Island state waters as well with 88 percent of the benthic habitat, and coarse sediments consisting of 8.5 percent Mixed-Sized Gravel in Muddy Sand/Sand, 3.1 percent Glacial Moraine A, and 0.1 percent Bedrock (Appendix M.3, Mayflower Wind 2022). Additionally, 22.2 percent of the Rhode Island state waters had Crepidula Substrate as a CMECS Substrate classifier, and 3.1 percent had Boulder Field(s) as a Substrate classifier (Appendix M.3, Mayflower Wind 2022). Sediments in the Sakonnet River were finer sands to silts with areas of boulders, including anthropogenic rock dumps that provide hardbottom habitat, and isolated mounds associated with *Crepidula* reefs (Mayflower Wind 2022; USGS 2005).

The infauna sampled along the southern Falmouth ECC closely matched the eastern Lease Area, dominated by clam beds and large tube-building fauna. The northern Falmouth ECC had a heterogenous array of species including soft-sediment bryozoans and mobile burrowing crustaceans (Mayflower Wind 2022). Sampling within the Brayton Point ECC showed soft sediment fauna was the dominant CMECS biotic subclass observed along the entire Brayton Point ECC, characterized by clam beds, larger tube-building, mobile crustaceans, and surface-burrowing fauna, with much more diversity in the southern portion of the ECC.

Submerged aquatic vegetation beds were identified at the Falmouth landfall areas from a review of eelgrass field surveys completed in August 2020 (Mayflower Wind 2022). The seagrass and macroalgae characterization surveys did not identify SAV in the southern portion of the Falmouth ECC, but macroalgae was identified in approximately two-thirds of the survey locations during benthic grabs of the northern section of the Falmouth ECC (COP Appendix K and Appendix M; Mayflower Wind 2022). A previously unmapped section of interpreted SAV was identified near the Aquidneck Island landfall of the Brayton Point ECC (COP Appendix E; Mayflower Wind 2022).

3.5.2.2 Impact Level Definitions for Benthic Resources

Impact level definitions for benthic resources are provided in Table 3.5.2-1.

Table 3.5.2-1. Definitions of impact levels for benthic resources

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

3.5.2.3 Impacts of Alternative A – No Action on Benthic Resources

When analyzing the impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for benthic resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for benthic resources described in Section 3.5.2.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on benthic resources are generally associated with inshore dredging, coastal development, offshore construction, including bottom disturbance and habitat conversion, and climate change. Regular vessel anchoring related to ongoing military, survey, commercial, and recreational activities would continue to cause temporary to permanent direct (injury to or mortality of organisms and physical damage to habitats) and indirect (increased turbidity) impacts in the immediate area where anchors and chains meet the seafloor. Cable emplacement and maintenance activities cause infrequent disturbance to benthic resources and short-term increases in suspended fine sediments as well as sediment deposition. EMFs continuously emanate from existing undersea telecommunication and electrical power transmission cables, and new cables are infrequently installed in the geographic analysis area. Underwater noise impacts occur due to pile driving, which periodically occurs in nearshore areas during construction and repair of piers, bridges, pilings, and seawalls. The presence of structures can be detrimental to benthic organisms due to habitat conversion and lost fishing gear, which can cause disturbance, injury, and loss, or could be beneficial by serving to provide relief and habitat to structure-oriented fishes and invertebrates. Ongoing commercial and recreational fishing for finfish and shellfish that disturbs the seafloor (e.g., trawling and dredging) would continue to affect benthic resources in the foreseeable future. Increased port utilization and expansion would result in more numerous vessel visits and cause increased vessel noise and increased suspended sediment concentrations. Ongoing sediment dredging for navigational purposes and other activities that cause seabed profile alterations would result in fine sediment resuspension and deposition, habitat alteration, and injury to and mortality of benthic resources.

Impacts associated with climate change (ocean acidification and warming, sea level rise, altered habitat/ecology) have the potential to alter species distributions and increase individual mortality and disease occurrence. Increased sea temperatures have been shown to affect the natural ecology of the ocean, including benthic resources. Sea surface temperatures along the Atlantic coast rose up to 1°C since 1960 (Friedland and Hare 2007) and continue to rise. Ocean acidification caused by atmospheric CO_2 may contribute to reduced settlement, growth, and reproduction of benthic resources such as echinoderms, crustaceans, corals, and bivalves (Kurihara 2008). Warming of ocean waters is expected to influence the distribution and migration of benthic resources and may influence the frequencies of various diseases (Hoegh-Guldberg and Bruno 2010; Brothers et al. 2016).

The geographic analysis area overlaps a portion of the Vineyard Wind 1 project in OCS-A 0501, which has an approved COP. Ongoing construction of the Vineyard Wind 1 project would affect benthic resources through the primary IPFs of accidental releases, cable emplacement and maintenance, noise, and land disturbance. Ongoing offshore wind activities would have the same type of impacts that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity. Regarding benthic impacts specific to Muskeget

Channel, after BOEM's COP approval of Vineyard Wind 1, Vineyard Wind 1 selected the Eastern Muskeget route for the offshore export cable route. Hard/complex bottoms cover much of the Muskeget area (BOEM 2021a). The maximum total area of hard/complex bottom and rugged seafloor that exists within the installation corridor in Muskeget Channel for the Eastern Muskeget route is approximately 1,520 acres (615 hectares) (BOEM 2021a). The total disturbance area of hard bottom/coarse deposits, complex seafloor/sand waves, and biogenic surfaces within the Eastern Muskeget route is 28.8 acres (11.7 hectares), or a relatively small subset of this area (BOEM 2021a). The total temporarily disturbed area of hard bottom/coarse deposits, complex seafloor/sand waves, and biogenic surfaces within the Eastern Muskeget route is 1,424 acres (576 hectares), which is estimated as sediment deposition greater than 1 millimeter that may extend up to 328 feet (100 meters) from the proposed cable installation (BOEM 2021a).

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect benthic resources include new submarine cables and pipelines, oil and gas activities, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Appendix D, *Planned Activities Scenario*, for a complete description of planned activities). Impacts from planned non-offshore wind activities would be similar to those from ongoing activities and may include temporary and permanent impacts on benthic resources from disturbance, injury, mortality, habitat degradation, and habitat conversion. While these impacts would have localized effects on benthic resources, population-level effects would not be expected.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on benthic resources during construction, O&M, and decommissioning of the projects. In addition to the ongoing construction of the Vineyard Wind 1 project, the geographic analysis area overlaps other planned offshore wind activities including the entirety of OCS-A 0520 (Beacon Wind) and portions of OCS-A 0534 (New England Wind) and OCS-A 0522 (Vineyard Wind Northeast). BOEM expects other offshore wind activities to affect benthic resources through the following primary IPFs.

Accidental releases: Accidental releases may increase due to offshore wind activities, with gradually increasing vessel traffic over the next 35 years. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Accidental releases of hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to contact benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. In most cases, the corresponding impacts on benthic resources are unlikely to be detectable unless there is a catastrophic spill (e.g., an accident involving a tanker ship). Large-scale spills may be accompanied by the use of chemical dispersants during post-spill response. Crude oil treated with dispersants (specifically Corexit 9500A) has been shown to have higher toxicity to marine zooplankton and meroplankton than either the crude oil or dispersant alone (Rico-Martinez et al. 2012; Almeda et al. 2014a, 2014b). Benthic resources with planktonic larval stages may be susceptible to this toxicity, which may affect subsequent recruitment.

Nonnative or invasive species can be accidentally released in the discharge of ballast water and bilge water during vessel activities. Increased vessel traffic throughout the construction phase of offshore wind projects would increase the risk of accidental releases of invasive species. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and USEPA National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim at least in part to prevent the release and movement of invasive species. Adherence to these regulations would reduce the likelihood of discharge of ballast or bilge water contaminated with invasive species. Although the likelihood of invasive species becoming established due to offshore wind-related activities is low, the impacts of invasive species could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna. Indirect impacts could result from competition with invasive species for food or habitat, and/or loss of foraging opportunities if preferred prey is no longer available due to competition with invasive species. Such an outcome, however, is considered highly unlikely. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities (e.g., trans-oceanic shipping).

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

The overall impacts of accidental releases on benthic resources are likely to be minor because large-scale releases are unlikely and impacts from small-scale releases would be localized and short-term, resulting in little change to benthic resources. As such, accidental releases from offshore wind development would not be expected to appreciably contribute to overall impacts on benthic resources.

Anchoring: Offshore wind activities would increase vessel anchoring during survey activities and during construction, installation, maintenance, and decommissioning of offshore components. In addition, anchoring or mooring of meteorological towers or buoys could be increased. Anchoring would cause increased turbidity levels and would have the potential for physical contact to cause mortality of benthic resources. Using the assumptions in Appendix D, Table D2-2, anchoring could affect up to 1,008 acres (408 hectares) of seabed from ongoing and planned offshore wind projects in the geographic analysis area. Most impacts would be minor because impacts would be localized, turbidity would be temporary, and mortality of benthic resources from contact would be recovered in the short-term. Degradation of sensitive habitats and resources, such as eelgrass beds and hard-bottom habitats, if it occurs, could be long-term to permanent, resulting in moderate impacts.

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

Electromagnetic fields: The marine environment continuously generates a variable ambient EMF. EMF would also emanate from new offshore ECCs and interarray cables constructed for offshore wind projects. Offshore wind projects in the geographic analysis area will add 2,285 miles (3,677 kilometers) of cable that would produce EMF in the immediate vicinity of cables for each project during operation (Appendix D, Table D2-1). Vineyard Wind I includes options for offshore ECCs options of 220–275 kV HVAC or one bundled 320–500 kV HVDC designs. Vineyard Wind I includes HVAC cable design for 66–132 kV interarray cables. BOEM would require these future submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. EMF effects from these projects on benthic habitats would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). EMF strength diminishes rapidly with distance, and EMF that could elicit a behavioral response in an organism would likely extend less than 50 feet (15.2 meters) from each cable.

Impacts of EMF on benthic habitats is an emerging field of study; as a result, there is a high degree of uncertainty regarding the nature and magnitude of effects on all potential receptors (Gill and Desender 2020). Recent reviews by Bilinski (2021), Gill and Desender (2020), Albert et al. (2020), and Snyder et al. (2019) of the effects of EMF on marine organisms in field and laboratory studies concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. Behavioral impacts from EMF, though observed at higher levels than are representative of offshore wind projects, were documented for lobsters near a direct current cable (Hutchison et al. 2018) and a domestic electrical power cable (Hutchison et al. 2020), including subtle changes in activity (e.g., broader search areas, subtle effects on positioning, and a tendency to cluster near the EMF source). There was no evidence of the cable acting as a barrier to lobster movement, and no effects were observed for lobster movement speed or distance traveled. Additionally, faunal responses to EMF by marine fauna, including crustaceans and mollusks, include attraction to the source, interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, increased burrowing by polychaetes, increased exploratory and foraging behavior, and physiological and developmental effects (Bilinski 2021; Jakubowska et al. 2019; Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011). Burrowing infauna may be exposed to stronger EMF, but little information is available regarding the potential consequences. Non-mobile infauna would be unable to move to avoid EMF. Any effects, however, would be local and would not have population-level impacts due to the small scale of the impact relative to the available benthic habitat in the geographic analysis area.

Other studies, however, have found that EMF does not affect invertebrate behavior. For example, Schultz et al. (2010) and Woodruff et al. (2012, 2013) conducted laboratory experiments exposing American lobster (*Homarus americanus*) and Dungeness crab (*Metacarcinus magister*) to EMF fields ranging from 3,000 to 10,000 milligauss and found that EMF did not affect their behavior. Assuming the other wind projects with HVAC cables in the geographic analysis area have similar array and export cable voltages as the Proposed Action, the induced magnetic field levels expected for the offshore wind projects are two to three orders of magnitude lower than those tested by Schultz et al. (2010) and Woodruff et al. (2012, 2013). Similarly, a field experiment in Southern California and Puget Sound, Washington, found no evidence that the catchability of two crab species was influenced by the animals crossing an energized low-frequency submarine alternating current power cable (35 and 69 kV, respectively) to enter a baited trap. Whether the cables were unburied or lightly buried did not influence the crab responses (Love et al. 2017). While these voltages are between two and eight times lower than those expected for the offshore wind projects, the array and export cables would be shielded and buried at depth to reduce potential EMF from cable operation.

EMF levels would be highest at the seabed near cable segments that cannot be fully buried and are laid on the bed surface under protective rock or concrete blankets. Invertebrates in proximity to these areas could experience detectable EMF levels and minimal associated behavioral effects. These unburied cable segments would be short and widely dispersed. CSA Ocean Sciences, Inc. (2019) and Exponent (2018) found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling species. The information presented above indicates that EMF impacts on benthic fauna would be biologically insignificant, highly localized, and limited to the immediate vicinity of cables, and would be undetectable beyond a short distance; however, localized impacts would persist as long as cables are in operation (anticipated to be around 35 years or until decommissioning). The affected area would represent an insignificant portion of the available benthic habitat; therefore, impacts from other offshore wind activities on benthic resources would be minor.

Cable emplacement and maintenance: New construction of offshore submarine cables would cause short-term disturbance of seafloor habitats and injury and mortality of benthic resources in the immediate vicinity of the cable emplacement activities. The cable routes for other offshore wind projects have not been fully determined at this time. However, at least one other offshore wind developer has proposed to install export cables through complex habitats within Muskeget Channel – New England Wind. As stated in the draft EIS for New England Wind, New England Wind's offshore export cable corridor is largely the same as the corridor already approved by BOEM for Vineyard Wind 1 (see *Impacts of the No Action Alternative*). As such, impacts on benthic habitat are anticipated to be similar to Vineyard Wind 1. Both export and interarray cables are anticipated to be constructed through 2030 for other offshore wind projects within lease areas that are within or overlap the geographic analysis area (Appendix D, Table D2-1). The total area disturbed from new cable emplacement would be a small fraction of available habitat in the geographic analysis area and would be expected to recover relatively quickly. Impacts associated with cable emplacement in sensitive habitats such as areas with

SAV or complex habitat such as cobble and boulders, where present, may take longer to recover. No SAV disturbance is expected from Vineyard Wind 1 or New England Wind cable installation (BOEM 2021a; BOEM 2022). While direct disturbance of eelgrass will be avoided, sedimentation impacts may occur, which will be temporary and potentially mitigated with the use of turbidity curtains.

Seafloor preparations made prior to installation of structures and cables, and as a result of dredging and mechanical trenching during cable installation, can cause localized, short-term impacts (e.g., habitat alteration, injury, mortality) on benthic resources through seabed profile alterations and through sediment deposition. The level of impact from seabed profile alterations could depend on the time of year that they occur, especially if these alterations overlap with times and places of high benthic organism abundance or reproductive activity. However, recolonization rates of benthic habitats are driven by the types of benthic communities inhabiting the area surrounding the affected region. Benthic communities that are well-adapted to disturbance within their habitats (e.g., mobile soft sediments) are likely to quickly recolonize a disturbed area. However, communities not well adapted to frequent disturbance (e.g., deep boulder epifaunal communities) may take upwards of a year to begin recolonization and/or for seabed recovery to occur, and likely more than a year to reach the level of community diversity that existed prior to disturbance. Associated seabed recovery is defined here as the natural infilling of sediment in construction trenches and associated recolonization of epifaunal and benthic infaunal communities to support pre-disturbance ecological function, which will vary by species and nature of the disturbance. For example, benthic communities disturbed by sand mining was examined on the east coast of the United States, and Brooks et al. (2006) found that seabed recovery and/or recolonization ranged from 3 months to 2.5 years.

Locations, amounts, and timing of dredging for offshore wind projects are not known at this time. The need for dredging depends on local seafloor conditions, assuming the areal extent of such impacts is proportional to the length of cable installed. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance, although full recovery of the benthic faunal assemblage may require several years (Wilber and Clarke 2007). Mechanical trenching, used in more resistant sediments (e.g., gravel and cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line installation in the trench. Coarser sand and gravel substrates typically take longer to recover to pre-disturbance conditions than habitats with finer grain sizes (Wilber and Clarke 2007). The installation of WTG foundations and hard surfaces such as scour and cable protection will alter local hydrodynamic patterns. This may have a resulting impact on local sedimentation and sediment migration patterns. Impacts would be minor because seabed profile alterations, while locally intense, 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 could cause sediment suspension during periods of active construction or maintenance, after which the sediment would be deposited on the seafloor. Sediment deposition can result in adverse impacts on benthic resources, including smothering and changes to sediment quality profiles. The tolerance of benthic organisms to be covered by sediment (sedimentation) varies among species. Demersal winter flounder eggs were shown to have delayed hatching with as little as 0.04 inch (1 millimeter) of sedimentation (Berry et al. 2011). The sensitivity to sedimentation for shellfish varies by species and life stage. Some sessile shellfish may only tolerate 0.4–0.8 inch (1–2 centimeters) while other benthic organisms can survive burial in upward of 8 inches (20 centimeters) (Essink 1999). Areas closest to the disturbance would receive higher percentages of coarser, more rapidly settling sediments while finer sediments would settle over greater distances and be more diffuse. The greatest impacts would therefore be at the smallest spatial scales. The level of impact from sediment deposition and burial could depend on the time of year that it occurs, especially if it overlaps with times and places of high benthic organism abundance or reproductive activity.

Increased turbidity would occur during cable emplacement activities over the course of the construction of the wind farms in the geographic analysis area. Disturbed seafloor from construction of these projects may affect benthic resources; assuming other offshore wind projects use installation procedures similar to those proposed in the COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance. Particularly where routes intersect sensitive or complex habitat, impacts may be long term to permanent. For SAV, damage to seagrass blades may be more quickly recovered; however, damage to or uprooting of rhizomes may take years to recover from (Orth et al. 2017). Modeled simulations of dragging impacts on eelgrass further suggested recovery of eelgrass beds may take 6 years, and 20 years or longer under conditions less conducive to eelgrass growth (Neckles et al. 2005). Increased turbidity due to bottom disturbances associated with cable emplacement would reduce light availability to SAV. This short- to long-term impact would be most pronounced in the immediate vicinity of the disturbance. However, while mitigating impacts on SAV including eelgrass presents challenges, mitigation measures taken in or near the geographic analysis area may include HDD and/or turbidity curtains.

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

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

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

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

Overall, impacts through this IPF would be minor to moderate because they would be localized, turbidity would be present during construction for brief periods, and mortality from contact would be recovered in the short term. Any necessary dredging prior to cable installation could also contribute additional impacts.

Noise: Sound from offshore wind activities includes sound pressure, particle motion, and vibration. Sound pressure is the fluctuation in the density of the medium (e.g., sediments) due to the sound, particle motion refers to the movement of particles that make up the medium during that sound, and vibrations are initiated by direct contact of a sound source with the substrate, such as during pile driving, and by sound energy entering the substrate through the water from intense sources, such as seismic air guns (Popper et al. 2022). Sound pressure is heard by most terrestrial animals, including humans, and is not discussed further. However, most fishes, including all elasmobranchs and likely all sound-detecting invertebrates, hear via particle motion (Popper et al. 2022; Carroll et al. 2017). Fishes and aquatic invertebrates that live in, on, or close to the substrate (e.g., the seabed) may also be affected by vibrations. Sound pressure and particle motion can also emanate from the substrate back into the water column as a result of such vibrations (Hawkins et al. 2021). In a review of potential impacts of sound on fishes and aquatic invertebrates from offshore wind activities, Popper et al. (2022) identified substantial gaps in the understanding of these effects and concluded these gaps preclude an assessment of the potential impacts of sound from offshore development.

Noise can cause bivalves to close their valves and burrow deeper when subjected to noise and vibration stimuli, reducing respiration and other processes, and potentially causing mortality (Roberts et al. 2016), although the duration of pile driving and small radius of potential effects on infaunal organisms is expected to be on the order of hours. With impulse impacts, such as those from pile driving, physiological sound thresholds may be exceeded for some species, resulting in injury or mortality, especially for affected species in the immediate vicinity. Noise transmitted through water or the seabed sediments would also be expected to affect benthic invertebrates. However, data are not available to adequately quantify these impacts (Popper et al. 2022).

Noise, in terms of sound pressure levels (SPL), from construction, pile driving, G&G survey activities, O&M, and trenching/cable burial could contribute to impacts on benthic resources. The most impactful noise is expected to result from pile driving. Noise from pile driving would occur during installation of foundations for offshore structures. This noise would be produced intermittently during installation of each foundation. One or more projects may install more than one foundation per day, either sequentially or simultaneously. Construction of offshore wind facilities in the geographic analysis area would likely occur over an assumed 5-year construction period, with up to 585 WTGs (Appendix D, Table D2-1). Noise transmitted through water and through the seabed can cause injury to or mortality of benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions. The affected areas would likely be recolonized in the short-term. In the planned activities scenario, noise from pile driving that causes behavioral changes could affect the same populations or individuals multiple times in a year or in sequential years, although impacts are expected to be minor.

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could also disturb benthic resources in the immediate vicinity of the investigation and cause temporary behavioral changes. G&G noise would occur intermittently over an assumed 5-year construction period (Appendix D, Table D2-1). G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity, impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves for shallow penetration of the seabed. Seismic surveys are not expected in the geographic analysis area for benthic resources. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources, but may overlap with behavioral impacts of pile-driving noise. Overlapping sound sources are not anticipated to result in a greater, more-intense sound; rather, the louder sound prevents the softer sound from being detected. Noise from G&G surveys is therefore expected to have a minor impact on benthic resources.

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

Port utilization: Increases in port utilization due to other offshore wind projects would lead to increased vessel traffic over the next 35 years. This increase in vessel traffic would be at its peak during construction activities between 2023 to 2030 and would decrease during operations but increase again during decommissioning (Appendix D, Table D2-1). 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 disturbance and mortality of individuals and short-term to permanent habitat alteration. Existing ports are heavily modified or impaired benthic environments, and future port projects would likely implement BMPs to minimize impacts (e.g., stormwater management and turbidity curtains). The degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities. Increased vessel traffic around ports would also increase physical impacts of vessel operation, including impacts of wakes on shallow and shoreline habitats as well as erosion, scour, and turbidity impacts from vessels operating in shallower inshore waters.

Impacts of port utilization associated with planned wind-related activities would be localized and range from short term and minor (for water quality and vessel noise impacts) to permanent and moderate (for port expansion activities that heavily modify benthic environments).

Presence of structures: The presence of structures can lead to impacts on benthic resources through fishing gear entanglement, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic resources, and habitat conversion. Invasive species also have the potential to use foundations as stepping stones to expand their geographic range (Adams et al. 2014). These impacts may arise from foundations and scour/cable protection. Ongoing and planned offshore wind development would add up to 944 acres (382 hectares) of foundation and scour protection and 772 acres (312 hectares) of new hard protection atop cables (Appendix D, Table D2-2). In the geographic analysis area, structures are anticipated predominantly on sandy bottom, with the exception of cable protection, which is more likely to be needed where cables pass through hard-bottom habitats. The potential locations of cable protection for other offshore wind activities have not been fully determined at this time; however, any addition of scour protection/hard-bottom habitat would represent substantial new hard-bottom habitat, as the geographic analysis area is predominantly composed of fine substrates. Installation of these structures would result in direct mortality of benthic organisms within the footprint of disturbance, suspension of sediments, increased turbidity, and burial of benthic organisms in immediate proximity to foundations or below scour/cable protection.

The presence of structures would increase the risk of gear loss or damage by entanglement. Fishing gear potentially entangled or lost on underwater structures includes mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks). Lost gear actively continues to fish and may drift with currents. Marine organisms may become trapped or ensnared in lost or drifting gear, also known as "ghost" fishing gear, leading to injury or mortality. The intermittent impacts at any one location would likely be localized and short-term, although the risk of occurrence would persist as long as the structures and debris remain.

Human-made structures, especially tall vertical structures such as foundations, alter local water flow (hydrodynamics) at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Finfish aggregate trends along the mid-Atlantic shelf have been shifting northeast into deeper waters (NOAA 2022); the presence of structures may reinforce these trends. The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be undetectable to small, to be localized, and to vary seasonally. Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables, create uncommon vertical relief in a mostly soft-bottom landscape. Structure-oriented fishes would be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect benthic communities in the immediate vicinity of the structure. These impacts are expected to be local and to persist as long as the structures remain. Depending on the balance of attraction and production, newly placed structures may affect the distribution of fish and shellfish among existing natural habitat, artificial reef sites, and newly emplaced structures.

The presence of structures would also result in new hard surfaces that could provide new habitat for recruitment of hard-bottom species (Daigle 2011). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). The potential effects of wind farms on offshore ecosystem functioning have been studied using simulations calibrated with field observations (Raoux et al. 2017; Pezy et al. 2018). These studies found increased biomass for benthic fish and invertebrates.

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

Impacts of Alternative A on ESA-Listed Species

No benthic species in the geographic analysis area are ESA-Listed; therefore, there will be no impacts on ESA-Listed species from Alternative A.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, benthic resources would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing short-term, long-term, and permanent impacts (e.g., disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources primarily through regular maritime activity, offshore construction impacts, cable emplacement, presence of structures, and climate change. Offshore wind activities are expected to involve several IPFs, primarily new cable emplacement and the presence of structures (i.e., foundations and scour/cable protection). However, habitat disturbance from offshore construction is expected to be minimal, and recovery of benthic communities is expected over time. BOEM anticipates the No Action Alternative to result in **negligible** to **moderate** impacts on benthic resources.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and benthic resources would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on benthic resources through pile-driving noise, anchoring, new cable emplacement, the presence of structures during operations of offshore facilities (i.e., foundations, cable, and scour protection), climate change, and ongoing seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear. Considering all of the IPFs together, BOEM anticipates that the No Action Alternative, when combined with planned non-offshore wind activities and other offshore wind activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts resulting from emplacement of structures (conversion of habitat from soft to hard bottom).

3.5.2.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on benthic resources.

- The total amount of scour protection for the foundations, interarray cables, and offshore ECCs that results in long-term habitat alteration.
- The installation method of the export cable in the offshore ECCs and for interarray and interlink cables in the Wind Farm Area and the resulting amount of habitat temporarily altered.
- The number and type of foundations used for the WTGs and OSPs.
- The methods used for cable laying and landfalls, as well as the types of vessels used and the amount of anchoring.
- The amount of pre-cable-laying dredging or preparation, if any, and its location.
- The time of year when foundation and cable installations occur.

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

- The number, size, location, and amount of scour protection for WTG and OSP foundations: The level of impact related to foundations is proportional to the number of foundations installed; fewer foundations would present less hazard to benthic organisms.

- Offshore ECCs footprints: The route chosen (including variants within the general route) would determine the amount of habitat affected.
- Season of construction: Spring and summer are the primary spawning seasons for many benthic invertebrates and fish that lay demersal eggs. Project activities during these seasons would likely have greater impacts due to localized disruption of these processes and impacts on reproductive processes and sensitive early life stages.

Mayflower Wind has committed to measures to minimize impacts on benthic resources, including employing industry standard cable burial and cable shielding methods to reduce potential effects on benthic resources, burying cables, where possible, to allow for benthic recolonization after construction is complete, and designing scour protection to reduce sedimentation (COP Volume 2, Table 16-1; Mayflower Wind 2022).

3.5.2.5 Impacts of Alternative B – Proposed Action on Benthic Resources

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

Accidental releases: As discussed in Section 3.5.2.3, *Impacts of Alternative A,* non-routine events such as oil or chemical spills, potentially amplified by the use of chemical dispersants, can have adverse or lethal effects on marine life. However, modeling by Bejarano et al. (2013) predicts that the impact of smaller spills on benthic fauna would be low. Larger spills are unlikely but could have a larger impact on benthic fauna due to adverse effects on water quality (see Section 3.4.2). The Proposed Action would likely have little to no impact on benthic resources through the accidental release of trash and debris. In addition, accidental releases of nonnative/invasive species could affect benthic resources. Increasing vessel traffic throughout construction of the Project would increase the risk of accidental releases of invasive species. The risk of this type of release would be increased by the additional vessel traffic associated with the Proposed Action, especially traffic from foreign ports, primarily during construction. In total, the Proposed Action would generate approximately 6,600 vessel trips during the construction and installation phase. However, vessels would be required to adhere to existing state and federal regulations related to ballast and bilge water discharge, and adherence to these regulations would reduce the likelihood of discharge of ballast or bilge water contaminated with invasive species. The potential impacts on benthic resources are described in Section 3.5.2.3.

Anchoring: Vessel anchoring from the Proposed Action would cause short-term impacts in the immediate area where anchors and chains meet the seafloor, resulting in up to 441.8 acres (178.8 hectares) of seabed disturbance. Impacts on benthic resources would be greatest for sensitive benthic habitats (e.g., eelgrass beds, hard-bottom habitats). All impacts would be localized, turbidity would be temporary, and mortality from physical contact would be recovered in the short-term. Where eelgrass is present within all three landfall locations under consideration for the Falmouth ECC, HDD is proposed to avoid impacts with a punchout location deeper than the deepest eelgrass extent. While anchor placement and chain sweep may damage seagrass blades, anchor drag and retrieval may damage or uproot seagrass rhizomes, which may take years to recover (Orth et al. 2017). While avoidance of impacts on sensitive habitats from anchoring may not always be possible, to minimize anchoring impacts, Mayflower Wind has committed to avoiding habitat loss to benthic resources during construction by selecting lower impact construction methods where possible, which would include avoiding anchoring on sensitive habitat (COP Volume 2, Section 16, Table 16-1; Mayflower Wind 2022). Impacts are anticipated to be minor to moderate.

Discharges/intakes: There would be increased potential for discharges from vessels during construction, operations, and decommissioning. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, particularly during construction and decommissioning, and the discharges would be staggered over time and localized. Impacts on benthic resources from vessel discharges, if any, would be localized, short-term, and negligible.

During operation, there would be increased intake and discharge from the HVDC converter OSP in the Lease Area, which requires continuous cooling water withdrawals and subsequent discharge of heated effluent back into receiving waters. Mayflower Wind developed an NPDES permit application for one offshore HVDC converter OSP in the Lease Area (in an approximate location, see Appendix B, Figure B-2) (TetraTech and Normandeau Associates, Inc. 2022). The HVDC converter OSP is expected to withdraw cooling water from the ocean at a rate of approximately 8 to 10 million gallons per day and maintain an intake velocity of less than 0.5 feet per second. Raw seawater will be withdrawn through up to three intake pipes located approximately 32.8 feet (10 meters) above the seafloor and range from approximately 25 to 115 feet (7.6 to 35.0 meters) below the surface. A seawater lift pump will pump water into an inline seawater filter with a mesh size that ranges from 250 microns to 25 millimeters to screen debris and keeps organisms from the pump shaft.[1]

The potential effects on benthic resources may occur during water withdrawals and would include the entrainment of eggs and larval life stages. In the absence of site-specific plankton densities, Mayflower Wind, in their NPDES permit application, evaluated an impact assessment for the Northeast Gateway Project where a bioenergetic model was used to address impacts of the removal of zooplankton and small fish. While the model was ultimately used to assess removal of excessive biomass of prey items beyond natural variability and recovery rates, the Northeast Gateway Project was expected to utilize up to 56 million gallons per day and was found to have negligible impacts on the entrainment of zooplankton. Therefore, Mayflower Wind OSP operations, which will use considerably less cooling water (up to ten million gallons per day), is expected to entrain proportionally lower numbers of zooplankton. Mayflower Wind further estimated entrainment abundance of ichthyoplankton from cooling water withdrawal at the OSP using EcoMon plankton data from 1977 through 2019. Given the limitations of recent data immediately in the vicinity of the intake location, the minimum, mean, and maximum larval densities observed within 10 miles (16 kilometers) of the OSP location over the full time series were

[1] Additional characteristics of the Cooling Water Intake System at the Mayflower Wind OSP Converter Station are included in the NPDES permit application submitted to the USEPA in October 2022 (TetraTech and Normandeau Associates, Inc. 2022).

used to extrapolate the range of entrainment abundance assuming a water withdrawal rate of 10 million gallons per day. The annual entrainment abundance of fish larvae was estimated to range from 8.4 million to 176.2 million with a mean estimate of 84.0 million. Based on monthly mean larval densities and excluding unidentified fish, the taxa with the highest estimated larval entrainment annually were hakes (*Urophycis* spp.: 3.94 million), Atlantic herring (*Clupea harengus*: 3.92 million), sand lances (*Ammodytes spp.*: 3.3 million), summer flounder (*Paralichthys dentatus*: 1.4 million) and silver hake (*Merluccius bilinearis*: 0.50 million (TetraTech and Normandeau Associates, Inc. 2022).[2]

The potential effects on benthic resources may also arise from thermal impacts due to subsequent heated discharge effluent released back into receiving waters. A total effluent discharge was estimated at eight to ten million gallons per day. Mayflower Wind modeled the thermal plumes of the discharged cooling seawater from the OSP, and results indicate localized increases in water temperature within the vicinity of the discharge location. Based on the modeling results, however, the effluent discharges were found to be minimal. The maximum size of the thermal plume in winter and summer (defined as a 0.3°F water temperature differential from ambient) will have a near field release ranging from 272 to 306 feet (83 to 93 meters), respectively (TetraTech and Normandeau Associates, Inc. 2022).

While BOEM expects an increase in discharges and intakes during O&M, impacts on benthic resources from the HVDC converter OSP would be long term and minor.

Electromagnetic fields: During operation, powered alternating current transmission cables would produce EMF (Taormina et al. 2018). To minimize EMF generated by cables, all cabling under the Proposed Action would include electric shielding (COP Volume 2, Section 16, Table 16-1; Mayflower Wind 2022). The strength of the EMF increases with electrical current, but rapidly decreases with distance from the cable (Taormina et al. 2018). Mayflower Wind would also bury export cables to a target burial depth of up to 3.2 to 13.1 feet (1 to 4 meters) below the surface and interarray cables to a target burial depth of 3.2 to 8.2 feet (1 to 2.5 meters) below the surface, well below the aerobic sediment layer where most benthic infauna live. Target burial depths would be determined following detailed design. The Mayflower Wind PDE includes a maximum case scenario for up to five export cables of 345 kV HVAC in the Falmouth ECC and up to six export cables 320 kV HVDC in the Brayton Point ECC. Interarray cables will have a nominal voltage of 60–72.5 kV. In some areas, it is possible that cable would be unable to be buried to the target depth and would instead be placed on or near the seafloor with overlying cable protection. Impacts of EMF are anticipated to be greater where this occurs, as the distance between the cable and biological receptors would be reduced.

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[2] As further described in the NPDES application (TetraTech and Normandeau Associates, Inc. 2022), due to limitations in the available data, there are uncertainties in these results. For example, entrainment estimates do not fully capture the annual entrainment abundance of all fish and life stages, as all fish eggs and the larvae of less common taxa are excluded from the publicly available EcoMon data set. Additionally, the estimates assume the 1977–2019 time series is representative of the current and future species composition, and that abundance will remain constant each year. The data also represents sampling of ichthyoplankton at various depths, whereas the OSP intake would withdraw water from a discrete depth in the water column (32.8 feet [10 meters] above the seafloor). This may result in overestimation of larval entrainment, as individuals settling in demersal habitats or floating on the surface may not be susceptible to the intake flow.

The scientific literature provides some evidence of faunal responses to EMF by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011), although some reviews (Gill and Desender 2020 and Albert et al. 2020) indicate the relatively low intensity of EMF associated with marine renewable projects would not result in impacts. Effects of EMF may include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). For example, *Cancer* crabs were attracted to EMF exposed shelters and showed significant reductions in their time spent roaming (Scott et al. 2021). Studies on the effects of EMF on marine animals have mostly been restricted to commercially important species (Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*). The consequences of anthropogenic EMF have not been well studied in benthic resources (Gill and Desender 2020; Albert et al. 2020; Snyder et al. 2019). However, the effects of EMF have been studied in bivalves (Jakubowska-Lehrmann et al. 2022; Malagolia et al. 2004). Jakubowska-Lehrmann et al. (2022) examined if exposure to EMF (50 Hz) would affect the bioenergetics and physiological processes in the cockle (*Cerastoderma glaucum*). As a result, increased protein carbonylation was observed and a significant inhibition of acetylcholinesterase activity indicating neurotoxicity and oxidative damage to the species. Additionally, Malagoli et al. (2004) exposed the mussel (*Mytilus galloprovincialis*) to EMF (50 Hz) and observed the expression of heat shock proteins indicating cellular stress response.

While considered a localized phenomenon, electricity produced during operation may further increase temperatures within the surrounding sediment and water where benthic resources may reside (Riefolo et al. 2016; Tabassum-Abbasi et al. 2014). Thermal impacts are expected to result in a slight increase in temperature a few centimeters from the cable and benthic resources within the general vicinity may experience negative effects from the increased temperature (Tabassum-Abbasi et al. 2014). An increase in temperature near the cable has been shown to modify the chemical and physical properties of the substratum resulting in spatial changes in benthic community structure, physiological changes to benthic organisms, and an alteration of the oxygen concentration profile, which could then indirectly impact the development of microorganisms (Taormina et al. 2018). The heat emission produced would be higher in HVAC cables than compared to HVDC cables at an equal transmission rate (Taormina et al. 2018). Further studies need to be completed to accurately assess long-term impacts of EMFs on the surrounding ecosystem as in-situ investigations are lacking.

Furthermore, the available information suggests that benthic invertebrates with limited mobility would not be affected by Project-associated EMF (Exponent 2018). In the case of mobile species, an individual exposed to EMF would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on whether previous exposure to EMF would influence the impacts of future exposure. Therefore, BOEM expects localized and long-term and minor impacts on benthic resources from EMF from the Proposed Action.

Cable emplacement and maintenance: Cable emplacement activities would result in mortality, injury, or displacement of benthic fauna in the path of construction as well as possible damage to sensitive habitats such as SAV. Mayflower Wind would use HDD for the installation of the offshore export cables beneath the shallower nearshore areas at all landfall locations, which is expected to substantially reduce impacts of sediment disturbance on SAV resources and avoid direct physical disturbance to eelgrass at the offshore export cable approach to the Falmouth landfalls. The final cable corridor selection and cable micro-routing within the selected corridor in the northern portion of the Falmouth ECC and Muskeget Channel will further seek to avoid complex habitats that may be expected to have a slower recovery to preconstruction conditions. The presence of eelgrass beds would be considered in the evaluation of export cable corridor landfall locations, and while HDD exit pit dredging is anticipated to disturb the seabed, it would be located outside of eelgrass beds and planned to only disturb 0.10 acre (404.7 square meters) of benthic area per HDD exit pit (Mayflower Wind 2022). Based on modeling, turbidity levels associated with the HDD exit pit dredging in Falmouth had concentrations exceeding 100 mg/L (0.0008 lb/gal) found at a maximum distance of 188 feet (36 meters) and affecting a cumulative area not exceeding 1 acre (0.4 hectare; Mayflower Wind 2022). Modeling of HDD exit pit dredge impacts for Brayton Point revealed concentrations exceeding 100 mg/L found at a maximum distance of 0.2 mile (0.32 kilometer) and contained within an average of 12 acres (5 hectares). Although an eelgrass burial experiment has shown that increased mortality can occur with sediment burial of 25 percent of eelgrass blade height over multiple weeks (Mills and Fonseca 2003), the small area of sediment disturbance of each HDD exit pit would have far less sedimentation and would occur temporarily. Eelgrasses are known to tolerate short-term periods of increased turbidity naturally during storm events (Lewis and Erftemeijer 2006), and suspended sediments from HDD are not expected to negatively affect adjacent eelgrass beds.

Within the Project area, SAV presence was found in the northern portion of the Falmouth, Massachusetts, ECC and near the shoreline closest to the southern Aquidneck Island landfall. No eelgrass or macroalgae were found to be present in the southern part of the ECCs or the Lease Area (Mayflower Wind 2022). Under the Proposed Action, there are three landfall locations under consideration for the Falmouth ECC: Worcester Avenue (preferred), Central Park, and Shore Street, with varying degrees of potential impacts on SAV. Continuous SAV bed coverage, consisting primarily of eelgrass was identified on the approach to both Mill Road and the Shore Street landfall sites. SAV at the Worcester Avenue approach was sparsely distributed in comparison with Mill Road and Shore Street with several large areas devoid of SAV. However, shallower depths present at the Worcester Avenue approach allows SAV to extend farther offshore (Mayflower Wind 2022).

Cable laying and construction would also result in the resuspension and nearby deposition of sediments as discussed in COP Volume 2, Section 6.6.2.2.1 (Mayflower Wind 2022). In areas where displaced sediment is thick enough, organisms may be buried, which could result in mortality of benthic organisms through smothering, irritation to respiratory structures, or a reduction in feeding success. However, benthic species have a range of susceptibility to sedimentation based on life stage, mobility, and feeding mechanisms. To assess the potential impacts from cable emplacement (including HDD exit pit), Scour Modeling and Sediment Plume Impact Modeling were conducted (COP Appendix F1 and Appendix F3; Mayflower Wind 2022). Within all simulated scenarios, the maximum total suspended solids level dropped below 10 mg/L within 2 hours and below 1 mg/L after less than 4 hours (Mayflower Wind 2022). The redeposition of sediment within the Lease Area and offshore export cables is expected to occur relatively locally. A majority of the released mass is expected to settle quickly and not be transported for long by currents. Deposition thickness which exceeds 0.20 inch (5 millimeters) is limited to a corridor of maximum width 79 feet (24 meters) around the cable route, although such thickness can be locally observed up to 590 feet (180 meters) from the cable route. Within the vicinity of the interarray cables and a deeper section of the offshore export cables, a thicker layer of deposits is observed over a smaller area due to the consequence of lower currents present within these areas, which allows for less transport of sediment away from the cable installation site. Sediment within the Lease Area is largely classified as CMECS Subclass Fine Unconsolidated Substrate (Section 3.5.2.1, *Description of the Affected Environment and Future Baseline Conditions*). Substantial impacts on seagrass outside of the immediate vicinity of the cable due to sedimentation from the one-time installation of cables are unlikely. Seagrasses have vertical structure that can accommodate a degree of burial greater than would be expected from the one-time resuspension and settling of dredged material (Lewis and Erftemeijer 2006). In most locations, the affected areas are expected to recover naturally, and impacts associated with jet plow cable installation are expected to recover in a matter of weeks, allowing for rapid recolonization (MMS 2009). Mechanical trenching, which could be used in coarser sediments, could result in more intense disturbances and a greater width of the impact corridor, and corresponding seabed scars are expected to recover naturally. As with other impacts related to disturbance of benthic habitat, benthic assemblages would be expected to recover in the short term, resulting in negligible impacts on benthic resources.

BOEM expects the Proposed Action alone to lead to unavoidable, short- to long-term impacts on benthic resources from this IPF. Despite unavoidable mortality, damage, or displacement of invertebrate organisms, the area affected by the construction footprint for interarray cable emplacement would be just 1 percent of the 127,388-acre (51,552-hectare) Lease Area, and the area affected within the ECCs would similarly represent a small fraction of available benthic habitat. BOEM does not expect population-level impacts on benthic species (i.e., generally accepted ecological and fisheries methods would be unable to detect a change in population, which is the number of individuals of a particular species that live within the geographic analysis area) as a result of the Proposed Action. Benthic fauna would recolonize disturbed areas that have not been displaced by new structures in the short term (Byrnes et al. 2004). Impacts may also result from associated sediment deposition and burial. Recovery of seagrass following benthic disturbance may occur over longer time frames, extending into long-term impacts over multiple years.

The seafloor would be disturbed by cable trenches, dredging (if required), anchoring, and cable protection. Offshore construction could also cause adverse impacts on benthic communities from loss or conversion of habitat. Based on the activities described in the COP, the Proposed Action may affect SAV at the Falmouth ECC landfall site; however, HDD allows for the cable to go into a punchout location deeper than the deepest extent of eelgrass observed in SAV surveys and avoid direct impacts on any areas with potential to support SAV beds (Mayflower Wind 2022). Habitat features in the form of ridges and troughs, sand waves, and boulders (greater than 20 inches [50 centimeters]) are present in the Lease Area and ECCs; however, disturbance for cable emplacement would be temporary and short term. Estimates of maximum seabed preparation impacts is estimated as 5 percent sand wave dredging, 10 percent boulder clearance, and a grapnel run over all cable routes within the Lease Area. This would occur over a total of 302 acres (122 hectares) within the Lease Area between the interarray cable routes (99 acres [40 hectares]) and the two ECCs (203 acres [82 hectares]). Furthermore, cable emplacement and maintenance activities may flatten depressions and small sand waves, temporarily reducing benthic habitat suitability for species within the cable footprint. Prey organisms that use these habitats would also be displaced, potentially affecting habitat suitability for fish species. Trenching may leave behind temporary depressions. The extent of these natural features is difficult to quantify, as they are continually reshaped by natural sediment transport processes. Natural recovery from anthropogenic disturbance is likely to occur within several months of the disturbance, depending on timing relative to winter storm events. Due to their mobility, it is expected that the sand wave profiles would rapidly return after cable installation. Although it is anticipated that hydrodynamics would be altered by the presence of structures, it is not expected that this would be to a degree that prevents the processes of sand wave formation and migration.

Array cables would be installed via hydroplow where possible, with alternative methods to include use of a jetting tool (jetting ROV or jetting sled), vertical injection, mechanical cutting ROV system, and plowing (pre-cut and mechanical). Several of these methods use water withdrawals that could entrain benthic larvae (MMS 2009). Due to the limited duration and area involved, BOEM does not expect population-level impacts. The consequences of increased turbidity caused by this IPF are discussed in Section 3.4.2, *Water Quality*.

Benthic recovery processes are relevant to understanding the likely duration of impacts on benthic resources. Neighboring benthic communities that have similar habitats and assemblages would recolonize disturbed areas. Succession would begin with more mobile, early-colonizer species with progression toward a mature assemblage over time. The restoration of marine soft-sediment habitats occurs through a range of physical (e.g., currents, wave action) and biological (e.g., bioturbation, tube building) processes (Dernie et al. 2003). Impacts and recovery times would vary depending on habitat types, which can generally be separated into the high-energy oceanic environment versus the low-energy estuarine environment. In general, physical processes are more important in high-energy environments, while biological processes dominate in low-energy environments. In high-energy environments, repopulation can often be largely attributed to bedload transport of adult and juvenile organisms. Recovery of invertebrate communities in low-energy environments is more dependent upon larval settlement and recruitment and adult migration. Therefore, rates of recolonization and succession can vary considerably among benthic communities. Recovery of the benthic species would likely require several months to a year or more (Dernie et al. 2003; Lewis et al. 2002). Recovery to a preconstruction state may take 2 to 4 years or more (Van Dalfsen and Essink 2001; Boyd et al. 2005). Fauna in dynamic environments are prone to natural sediment movement and deposition due to strong tidal currents and waves. Therefore, they are able to recover from disturbances more rapidly. Benthic meiofauna are known to recover from sediment disturbances more rapidly than the macrobenthos; recolonization up to pre-disturbance densities has occurred within weeks or less, and entire assemblages have recovered within 90 days (MMS 2009). Within the Offshore Project area, benthic communities are expected to recolonize post construction activities within months to years following disturbances (Mayflower Wind 2022). Benthos in coarse sediment and hardbottom areas of the ECCs are expected to recover slower than the flatter, noncomplex areas in the Lease Area and soft bottom portions of the ECCs. Therefore, recolonization of benthic organisms in the complex habitat area of the northern Falmouth ECC (beginning in the Muskeget channel) is expected to occur over a longer period of time. Similarly, the complex glacial moraine habitat within the Rhode Island Sound portion of the Brayton Point ECC will likely be recolonized more slowly than the soft bottom areas of the northern Brayton Point ECC and Lease Area.

During construction, seabed profile alterations resulting from the Proposed Action could lead to short-term impacts including habitat alteration, injury, and mortality. Under the Proposed Action alone, the impacts on benthic resources from seabed profile alterations, including injury, mortality, and short-term habitat disturbance, would be negligible. Overall impacts of cable emplacement on benthic habitats are anticipated to be negligible to moderate, depending on the location and the method of cable emplacement. Most adverse impacts would be avoided, and adverse impacts that do occur would be temporary or short term in nature.

Non-routine activities that could affect benthic resources include intensive corrective maintenance that would require exposing the cable or foundations for maintenance or require extensive anchoring. This would require the same tools used in installation and would have similar impacts via disturbance to the seafloor (e.g., mortality, sedimentation). However, the disturbance would not exceed that caused by the initial installation, and the affected area should be substantially smaller.

Noise: The Proposed Action would result in noise from G&G surveys, WTG O&M, pile driving, and cable burial or trenching. The natures of these sub-IPFs and of their impacts on benthic resources are described in Section 3.5.2.3.

The most substantial noise produced from the Proposed Action would be from pile driving during installation of up to 149 foundations. Given that most benthic species in the region are either mobile as adults or planktonic as larvae, disturbed areas (either through injury or mortality) would likely be recolonized naturally. Other sources of noise, including G&G, WTG operation, and cable trenching, would be of lower magnitude and, therefore, less impactful, even if they occur over larger geographic areas. If injury or mortality occurred to benthic organisms, the affected areas would likely be recolonized in the short-term, and no population-level impacts would be expected. Impacts would therefore be localized and short-term, and may be negligible to minor, depending on the duration of activities.

Port utilization: The Proposed Action would not directly result in any port expansion or construction activities and would therefore not have direct impacts on benthic resources from these activities. Likewise, any port improvements are not dependent on the Proposed Action being analyzed in this EIS. However, multiple projects are proposed to increase port capacity that may support the Proposed Action. Impacts on benthic resources from port construction or upgrades would be local to those ports and would support not just the Proposed Action but other offshore wind projects and general maritime activity as well. Any increase in port utilization would be highest during construction, minor during operation, and moderate during decommissioning. Impacts on benthic resources would be localized and minor.

Presence of structures: Under the Proposed Action, the presence of structures could result in various impacts as described in Section 3.5.2.3. The Proposed Action would install up to 147 WTG foundations, resulting in up to 1,845 acres (745 hectares) of temporary and permanent seabed disturbance (combined area of foundation and scour protection), assuming the GBS foundation (largest of the proposed foundation types) is used. The total permanent footprint for two additional GBS monopile foundations (combined area of foundation and scour protection) could result in up to 24.8 acres (10 hectares) of permanent seabed disturbance.

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

Once construction is complete, the presence of the WTG and OSP foundations could result in some alteration of local water currents, which could produce sediment scouring and alter benthic habitat. Local changes in scour and sediment transport close to a foundation may alter sediment grain sizes and benthic community structure (Lefaible et al. 2019), though this impact is expected to be minimal due to the use of scour protection for each foundation. These effects, if present, would exist for the duration of the Proposed Action and would be reversed only after the Project has been decommissioned, although they may be permanent if scour protection is left in place.

The presence of structures would also result in new hard surfaces that could provide new habitat for recruitment of hard-bottom species and structure-oriented communities (Daigle 2011). The addition of new substrate could provide steppingstones for invasive species colonization. Nonnative benthic invertebrates found within the vicinity of the Project area include but are not limited to *Ascidiella aspersa*, *Botrylloides violaceus*, *Diplosoma listerianum*, *Styela clava, Botryllus schlosseri, Bugula neritina, Tricellaria inopinata, Membranipora membranacea, Ostrea edulis,* and *Diadumene lineata* (Agius 2007; Mass.gov 2022). The invasive tunicate *Didemnum vexillum* (*D. vexillum*) has additionally been expanding its presence in New England waters and was identified within the Project area (COP, Appendix M.2; Mayflower Wind 2022). Benthic monitoring at the Block Island Wind Farm has shown that this species is part of a diverse faunal community on morainal deposits and is an early colonizer along the edges of anchor scars left in mixed sandy gravel with cobbles and boulders (Guarinello and Carey 2020). Four years after construction at the Block Island Wind Farm*, D. vexillum* was common on WTG structures (HDR 2020). Studies have shown that activities that cause fragmentation of *D. vexillum* colonies can facilitate its distribution (Lengyel et al. 2009; Morris and Carman 2012). Turbine and cable installation within hard-bottom habitat where *D. vexillum* is present could fragment the invasive colonies (Morris and Carman 2012). The addition of new artificial substrate used for cable and scour protection and the presence of WTG structures may provide habitat for this invasive tunicate.

Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). Studies have found increased diversity and biomass for benthic fish and invertebrates around foundation structures in the offshore environment (LeFaible et al. 2019; Raoux et al. 2017; Pezy et al. 2018). This indicates that offshore wind farms can generate some beneficial impacts on local ecosystems. However, some impacts such as the loss of soft-bottom habitat may be adverse depending on the resource affected. BOEM anticipates that the impacts associated with the presence of structures would be long-term and minor to moderate beneficial. The impacts on benthic resources resulting from the presence of structures would persist as long as the structures remain.

Impacts of Alternative B on ESA-Listed Species

No benthic species in the region are ESA-Listed; therefore, no impacts are expected.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Ongoing and planned non-offshore wind activities that affect benthic resources in the geographic analysis area include dredging, coastal development, offshore construction, submarine cables and pipelines, oil and gas activities, marine minerals extraction, port expansions, and climate change.

The cumulative impacts of accidental releases from ongoing and planned activities on benthic resources would likely range from negligible, localized, and short term (for fuels, hazardous materials, trash/debris) to moderate, possibly widespread, and long term (for invasive species). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely and impacts from small-scale releases would be localized and short term, resulting in little change to benthic resources. Most of the risk of accidental releases of invasive species comes from ongoing activities, and the impacts (mortality, decreased fitness, disease) due to other types of accidental releases are expected to be negligible and short-term.

Anchoring impacts from ongoing and planned activities would be localized, short term, and minor due to the relatively small size of the affected areas compared to the remaining area of the open ocean within the geographic analysis area and short-term nature of the impacts. Additionally, Project-related anchoring activity would be limited, as the construction/decommissioning phases would occur over a relatively short window.

There would be increased potential for discharges from vessels during construction, operations, and decommissioning activities related to the Proposed Action and other offshore wind projects; however, it is expected that these discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Cumulative impacts of discharges resulting from ongoing and planned activities would be short term, local, and minor.

Export and interarray cables from the Proposed Action and other offshore wind development would add an estimated 3,961 miles (6,375 kilometers) of buried cable to the geographic analysis area, of which the Proposed Action represents 42 percent, producing EMF in the immediate vicinity of each cable during operation. EMF effects from these projects on benthic habitats could be behavioral or physiological, and would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). BOEM would require planned submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. Cumulative impacts of EMF from ongoing and planned activities in the geographic analysis area would likely be minor and localized based on current research; however, more research is needed to better understand the effects of EMF on benthic organisms.

Cable emplacement of export and interarray cables would result in mostly short-term impacts from disturbance, injury, and mortality of benthic resources during installation activities. In most locations, the affected areas are expected to recover naturally; for example, seabed scars associated with jet plow cable installation are expected to recover in a matter of weeks, allowing for rapid recolonization (MMS 2009). The Proposed Action in combination with the other offshore wind development within the geographic analysis area is estimated to result in 10,328 acres (4,179 hectares) of seabed disturbance from cable emplacement in the geographic analysis area, of which the Proposed Action represents 38 percent. Simultaneous construction of export and interarray cables from nearby offshore wind projects would have an additive effect, although it is assumed that only a portion of a project's cable system would be undergoing installation or maintenance at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export and interarray cable installation activities for other offshore wind projects. BOEM expects that the cumulative impacts of cable emplacement and maintenance on benthic resources would be minor to moderate.

Other offshore wind activities would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving. The Proposed Action would contribute 149 structures, or 20 percent, of the total 747 foundations that would be installed within the geographic analysis area. If multiple piles are driven simultaneously, the areas of potential injury or mortality may overlap but that is anticipated to be unlikely and, as described for the Proposed Action, benthic organisms are anticipated to recover quickly. Cumulative noise impacts of the Proposed Action in combination with ongoing and planned activities would be localized, short-term and minor.

Cumulative impacts of port utilization associated with offshore wind-related activities would primarily result in water quality and vessel noise impacts but could also result in habitat alteration associated with port expansion activity. The Proposed Action would not contribute to port expansion and would have no appreciable change in port utilization. In context of reasonably foreseeable environmental trends, the cumulative impacts on benthic resources from port utilization would be minor.

The Proposed Action, in combination with the other offshore wind activity, would add up to 747 foundations in the geographic analysis area. The presence of these structures could affect local hydrodynamics, increase the risk of gear entanglement and loss, convert soft-bottom habitat to hard-bottom habitat, and increase the risk of establishment of invasive species. Cumulative impacts on benthic resources from presence of structures would be long term and moderate adverse to moderate beneficial.

Conclusions

Impacts of the Proposed Action: Activities associated with the construction and installation, O&M, and conceptual decommissioning in the Wind Farm Area and ECCs would affect benthic resources by causing temporary habitat disturbance; permanent habitat conversion; and behavioral changes, injury, and mortality of benthic fauna. BOEM anticipates the impacts resulting from the Proposed Action would range from **negligible** to **moderate**, including the presence of structures, which may result in **moderate beneficial** impacts. The most prominent IPFs are expected to be new cable emplacement, noise from pile driving, anchoring (particularly where it may affect SAV), and the presence of structures. In general, the impacts are likely to be local and are not likely to alter the overall character of benthic resources in the geographic analysis area. Despite benthic mortality and temporary or permanent habitat alteration, BOEM expects the long-term impact on benthic communities from construction and installation of the Proposed Action to be **minor**, as the resources would likely recover naturally over time. Mayflower Wind may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario but doing so would not likely result in different impact ratings than those described above.

Cumulative Impacts of the Proposed Action: Cumulative impacts from the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be **moderate** and **moderate beneficial** for benthic resources in the geographic analysis area. The main drivers for this impact rating are bottom disturbance including the emplacement of cables/structures and the long-term presence of structures and scour/cable protection. The Proposed Action would contribute to the cumulative impact rating primarily through temporary impacts due to new cable emplacement and permanent impacts from the presence of structures (i.e., cable protection measures and foundations). BOEM has considered the possibility of a significant impact resulting from invasive species and considers it unlikely; this level of impact could occur if an invasive species were to adversely affect benthic ecosystem health or habitat quality at a regional scale. While it is an impact that should be considered, it is also unlikely to occur, and the incremental increase in this risk due to the Proposed Action is negligible. Although some of the proposed activities and IPFs analyzed could overlap, BOEM does not anticipate that this would alter the overall impact rating. Considering all IPFs together, BOEM anticipates the cumulative impacts on benthic resources from ongoing and planned activities, including the Proposed Action, would be **moderate**, with some **moderate beneficial** impacts.

3.5.2.6 Impacts of Alternative C on Benthic Resources

Impacts of Alternative C: Under Alternative C, the Brayton Point offshore export cable would be routed onshore (through Aquidneck Island, Rhode Island under Alternative C-1 and through Little Compton/Tiverton, Rhode Island under Alternative C-2) to avoid fisheries impacts in the Sakonnet River. Alternative C-1 would reduce the offshore portion of the Brayton Point ECC by 9 miles (14 kilometers).

This 10 percent decrease in offshore cable length would result in approximately 52 fewer acres (21 hectares) of seabed disturbance compared to the Proposed Action (Table 3.5.2-2). Alternative C-2 would reduce the offshore portion of the Brayton Point ECC by approximately 12 miles (19 kilometers). This 12.7 percent decrease in offshore cable mileage would result in 70 fewer acres (28 hectares) of seabed and benthic habitat disturbance compared to the Proposed Action (Table 3.5.2-2).

The Sakonnet River contains a mix of soft bottom and complex substrates, which can be important benthic habitats for fish and invertebrates. In a few locations, live *Crepidula* reefs or *Crepidula* shell hash were found on the sediment surface overlying reduced silt (COP Appendix M.2; Mayflower Wind 2022), which is a biogenic habitat that also adds complexity to the seafloor. Of the Brayton Point ECC within Rhode Island State Waters, of which the majority is within the Sakonnet River and Mount Hope Bay, 62 percent of benthic sediments are sand or finer. *Crepidula* substrate was also mapped exclusively within the Sakonnet River and Mount Hope Bay across 1,305 acres (528 hectares) or 22 percent of all Rhode Island State Waters. This complex habitat along with some boulder fields in Mount Hope Bay are EFH for many species, and Alternatives C-1 and C-2 would reduce impacts on benthic resources by reducing the length of offshore cable and there would be fewer impacted acres. Because the cables would be routed onshore (Chapter 2, Figure 2-6), Alternative C would completely avoid impacts on these habitats in the Sakonnet River. However, the long-term effects of avoiding construction through these habitats is difficult to quantify, and benthic habitats would likely recover within a few years after construction; therefore, impacts would be temporary.

While Alternative C would reduce the total area of benthic habitat disturbance, cable emplacement activity would still occur along the rest of the offshore export cable and result in localized sediment suspension and habitat disturbance. The portions of Alternative C-1 and Alternative C-2 cable corridors that occur outside of the Proposed Action’s cable corridor (approximately 6 miles [9.7 kilometers] under Alternative C-1 and 4 miles [6.4 kilometers] under Alternative C-2) have not been surveyed, and, therefore, the specific benthic resources that would be affected are not known at this time but are anticipated to be similar to the benthic resources found along the Proposed Action’s cable corridor given the proximity of the routes. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternative C would be similar to those described under the Proposed Action.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Impacts of Alternative C on ESA-Listed Species

No benthic species within the region are ESA-Listed; therefore, no impacts are expected.

Conclusions

Impacts of Alternative C: Alternative C-1 and Alternative C-2 would result in a 10 to 12.7 percent reduction in the length of the Brayton Point offshore ECC and fewer acres of disturbed seabed, respectively. However, the construction and installation, O&M, and decommissioning of Alternative C would still result in similar overall impacts as the Proposed Action. Alternative C would result in **negligible** to **moderate** adverse impacts and could include potentially **moderate beneficial** impacts; overall long-term impacts would be **minor**.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative C would be similar to the Proposed Action, and result in **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area. Although a measurable impact is anticipated, benthic resources would likely recover completely following decommissioning.

3.5.2.7 Impacts of Alternative D on Benthic Resources

Impacts of Alternative D: Alternative D would eliminate up to six WTGs in the northeastern portion of the Lease Area to reduce impacts on foraging habitat along the western edge of Nantucket Shoals. This would lead to a reduction of 15.1 acres (6.1 hectares) of total foundation footprint contacting the seabed (combined area of foundation and scour protection) compared to the Proposed Action, assuming monopile foundations. The amount of seabed disturbance from interarray cable installation would also be reduced. The removal of up to six WTGs would proportionally reduce the interarray cable footprint of impact by an estimated 56.7 acres (22.9 hectares) from the total 1,408 acres (570 hectares) of impact from the Proposed Action. This would reduce total long-term benthic habitat impacts (Table 3.5.2-2), but the impact magnitude would be the same as the Proposed Action.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to those described under the Proposed Action, although with a slightly reduced footprint.

Impacts of Alternative D on ESA-Listed Species

No benthic species in the region are ESA-Listed; therefore, no impacts are expected.

Conclusions

Impacts of Alternative D: Impacts of Alternative D would be reduced compared to impacts of the Proposed Action because of reductions in noise impacts and total seabed and benthic habitat disturbance. Construction and installation, O&M, and decommissioning of Alternative D would result in the same **negligible** to **moderate** adverse impacts as the Proposed Action and could include potentially **moderate beneficial** impacts.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative D would be similar to the Proposed Action and result in **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area. Although a measurable impact is anticipated, benthic resources would likely recover completely following decommissioning.

3.5.2.8 Impacts of Alternative E on Benthic Resources

Impacts of Alternative E: Alternative E includes the use of all piled (Alternative E-1), all suction bucket (Alternative E-2), or all GBS (Alternative E-3) foundations for WTGs and OSPs. While each foundation type is already covered under the Proposed Action's PDE, each foundation presents a different impact, as discussed below. Installation activities would not differ between the Proposed Action and Alternative E-1, which assumes pile driving would be used for all foundations with corresponding noise impacts. Under Alternative E-2 and Alternative E-3, no pile driving would occur; therefore, there would be no underwater noise impacts on benthic resources due to pile driving. The avoidance of pile-driving noise impacts would reduce overall construction and installation impacts on benthic resources under Alternative E-2 and Alternative E-3 compared to the Proposed Action.

Of the 149 total foundations, benthic habitat impacts were calculated based on 147 WTGs and two OSPs (Table 3.5.2-2). Under Alternative E-1, 403.3 acres (163.2 hectares) of benthic habitat would be disturbed from 2.6 acres (1.1 hectares) per WTG and 9.8 acres (3.9 hectares) per OSP using piled foundations. Under Alternative E-2, 730.1 acres (295.5 hectares) of benthic habitat would be disturbed from 4.9 acres (2.0 hectares) per WTG and 4.9 acres (2.0 hectares) per OSP using suction bucket foundations. Under Alternative E-3, 1,719.7 acres (695.9 hectares) of benthic habitat would be disturbed from 11.6 acres (4.7 hectares) per WTG and 10.9 acres (4.4 hectares) per OSP using GBS. The maximum total dredging volume of all foundations combined for GBS installation would be 111,973,203 cubic feet (3,170,728 cubic meters).

GBS foundations would lead to the greatest area of habitat conversion from soft sediments to hard vertical structure due to foundation footprint and scour protection. Alternative E-1 would result in a 77 percent reduction in footprint and scour protection, and Alternative E-2 would result in a 58 percent reduction in footprint and scour protection, compared to Alternative E-3. GBS foundations could also increase the risk of spreading invasive species from the increased surface area and scour protection. Mayflower Wind may use GBS made of concrete, which may be more porous and susceptible to being colonized by marine organisms than piled and suction bucket foundations made of steel (BOEM 2021b). GBS and suction bucket foundations may be built in water within ports and then towed to the Wind Farm Area (BOEM 2021b), which presents an increased risk of invasive species spread by transporting marine organisms from port locations to the Lease Area. All alternative foundation types compared to monopile foundations would lead to larger artificial reef effects, where the increased surface area would benefit some benthic species. The increase in structure would also cause more aggregation of fish predator species, which may alter benthic invertebrate species composition. Less than 1 percent of soft-bottom habitat loss in the Lease Area is expected from foundation and scour protection installation; therefore, impact levels are not expected to change under this alternative. Given that Alternative E would result in reductions in both adverse and beneficial impacts, impacts on benthic resources under the alternative are not expected to be measurably different from those anticipated under the Proposed Action.

Cumulative Impacts of Alternative E: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative E would be similar to those described under the Proposed Action.

Impacts of Alternative E on ESA-Listed Species

No benthic species within the region are ESA-Listed; therefore, no impacts are expected.

Conclusions

Impacts of Alternative E: While each foundation type presents a different impact under Alternative E, the impacts of all foundation types are already covered under the Proposed Action's PDE. Therefore, impacts of Alternative E-1 would not be measurably different from the impacts of the Proposed Action. Construction and installation, O&M, and decommissioning of Alternative E-1 would likewise result in **negligible** to **moderate** adverse impacts and could include potentially **moderate beneficial** impacts.

Impacts of Alternative E-2 and Alternative E-3 would be similar to impacts of the Proposed Action with the most notable difference being the avoidance of pile-driving noise impacts and the increased foundation footprints. Construction and installation, O&M, and decommissioning of Alternative E-2 and Alternative E-3 would result in **negligible** to **moderate** adverse impacts and could include potentially **moderate beneficial** impacts.

Cumulative Impacts of Alternative E: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative E would be the same as the Proposed Action, resulting in **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area. Although a measurable impact is anticipated, benthic resources would likely recover completely following decommissioning.

3.5.2.9 Impacts of Alternative F on Benthic Resources

Impacts of Alternative F: Under Alternative F, the Falmouth offshore export cable route would use ±525kV HVDC cables connected to one HVDC converter OSP, instead of HVAC cables connected to one or more HVAC OSPs as proposed under the Proposed Action, to minimize seabed disturbance in the Muskeget Channel. During operation, there would be increased intake and discharge from the additional HVDC converter OSP, which would require continuous cooling water withdrawals and subsequent discharge of heated effluent back into receiving waters. The potential effects on benthic resources may occur during water withdrawals and would include the entrainment of eggs and larval life stages, as well as thermal impacts due to subsequent heated discharge effluent released back into receiving waters. BOEM anticipates that impacts would be similar to the Proposed Action but slightly greater due to the additional HVDC converter OSP.

Additionally, the Falmouth offshore export cable route would include only three HVDC cables compared to up to five HVAC cables under the Proposed Action, which would reduce seafloor and benthic habitat disturbance by approximately 700 acres (284 hectares) (Table 3.5.2-2). In comparison, a total of 1,753 acres (709 hectares) would be disturbed by the Falmouth export cables under the Proposed Action. Impacts from cable emplacement and anchoring may be reduced under Alternative F due to fewer cables installed. The fewer cables would also reduce the potential EMF effects on marine life. The cables would be sited in the same corridor as the Proposed Action so likely the same benthic communities would be affected by cable emplacement, but the total area extent of impacts would be less. For a description of benthic resources that would be affected by cable emplacement under the Proposed Action, see Section 3.5.2.1. The 40 percent reduction in seabed disturbance from installation of the Falmouth offshore export cables would reduce impacts on benthic resources, some of which may comprise complex habitats in the Muskeget Channel.

The same temporary construction impacts and long-term operational impacts from cable installation would still occur in the Muskeget Channel from the other cables placed and there would be no change in impacts from other offshore components (e.g., WTGs) under this alternative. As under the Proposed Action, benthic resources would likely recover naturally over time. The additional HVDC converter OSP would result in slightly increased impacts from the cooling water intake systems and heat effluent, but impacts would remain localized and minor; thus, BOEM expects that there would be no change in the overall impact magnitude to benthic resources under Alternative F as a whole.

Table 3.5.2-2. Benthic resource seabed disturbance from Alternatives C–F compared to the Proposed Action

Alternative	Difference in Area of Benthic Disturbance
C-1: Onshore Aquidneck Island Route	52 acres less
C-2: Onshore Little Compton/Tiverton Route	70 acres less
D: Nantucket Shoals (Removal of up to six WTGs)	72 acres less
E-1: All Piled Foundation Structures	Same as Proposed Action
E-2: All Suction Bucket Foundation Structures	336 acres more
E-3: All Gravity-Based Foundation Structures	1,317 acres more
F: Muskeget Channel Cable Modification	700 acres less

Note: Alternatives E-1, E-2, and E-3 are all within Mayflower Wind's PDE. Differences in this table are based on an assumed use of all pin pile foundation for the Proposed Action for purposes of comparison. Physical seabed disturbance is compared within the geographic analysis area.

Cumulative Impacts of Alternative F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative F would be similar to those described under the Proposed Action.

Impacts of Alternative F on ESA-Listed Species

No benthic species within the region are ESA-Listed; therefore, no impacts are expected.

Conclusions

Impacts of Alternative F: By reducing the number of Falmouth offshore export cables, Alternative F would reduce impacts on benthic resources compared to the Proposed Action, but the overall impact level would remain the same. Construction and installation, O&M, and decommissioning of Alternative F would likewise result in **negligible** to **moderate** adverse impacts and could include potentially **moderate beneficial** impacts.

Cumulative Impacts of Alternative F: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative F would be similar to the Proposed Action and result in **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area. Although a measurable impact is anticipated, benthic resources would likely recover completely following decommissioning.

3.5.2.10 Proposed Mitigation Measures

The following mitigation measures are proposed to minimize impacts on benthic resources (Appendix G, Table G-2). If the measures analyzed below are adopted by BOEM, some adverse impacts on benthic resources could be further reduced.

- **Pile-driven foundations only.** Only monopile or piled jacket foundations may be used in the enhanced mitigation area (Appendix G, Figure G-1) to minimize the overall structure impact on benthic species. The foundation footprint, including scour protection, on the seabed would be reduced by a minimum of 8.94 acres (3.62 hectares) per foundation in comparison to using GBS foundations. This would mean a total reduction in seabed footprint of at least 206 acres (83 hectares) for the 23 WTGs located in the enhanced mitigation area.
- **Sand Wave Leveling and Boulder Clearance.** Sand wave leveling and boulder clearance would be limited to the extent practicable, which would minimize impacts on benthic habitat.
- **Fisheries and Benthic Habitat Monitoring Surveys.** Mayflower Wind would be required to develop monitoring plans and conduct fisheries research and monitoring surveys, including a benthic survey, which would provide additional information about impacts from the Project on benthic resources and effectiveness of mitigation.

If these mitigation measures are adopted, they would minimize potential impacts on benthic resources but would not change the impact rating.

3.5 Biological Resources

3.5.3 Birds

This section discusses potential impacts on bird resources from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for birds. The geographic analysis area for birds, as shown on Figure 3.5.3-1, includes the United States coastline from Maine to Florida; the offshore limit is 100 miles (161 kilometers) from the Atlantic shore and the onshore limit is 0.5 mile (0.8 kilometer) inland. The geographic analysis area was established to capture resident species and migratory species that winter as far south as South America and the Caribbean, and those that breed in the Arctic or along the Atlantic Coast that travel through the area. The offshore limit was established to cover the migratory movement of most species in this group. The onshore limit was established to cover onshore habitats used by the species that may be affected by onshore and offshore components of the proposed Project.

3.5.3.1 Description of the Affected Environment and Future Baseline Conditions

This section discusses bird species that use onshore and offshore habitats, including both resident bird species that use the proposed Project area during all (or portions of) the year and migrating bird species with the potential to pass through the proposed Project area during fall migration, spring migration, or both. Detailed information regarding habitats and bird species potentially present can be found in COP Volume 2, Section 6.1 and Appendix J (Mayflower Wind 2022). Given the differences in life history characteristics and habitat use between offshore and onshore bird species, the following provides a separate discussion of each group. This section also discusses bald and golden eagles. This section addresses federally listed threatened and endangered birds; BOEM is also preparing a BA for USFWS to analyze the effects of the Project on these species per ESA Section 7 requirements. Results of ESA consultation with USFWS will be included in the Final EIS.

The Atlantic Coast plays an important role in the ecology of many bird species. The Atlantic Flyway is a major route for migratory birds in the eastern United States and Canada, which are protected under the Migratory Bird Treaty Act of 1918. Chapter 4.2.4 of the Atlantic OCS Proposed Geological and Geophysical Activities Programmatic EIS (BOEM 2014a) discusses the use of Atlantic Coast habitats by migratory birds. Birds in the geographic analysis area are subject to pressure from ongoing activities, such as onshore construction, marine minerals extraction, port expansions, and installation of new structures in the OCS, but particularly from accidental releases; new cable, transmission line, and pipeline emplacement; interactions with fisheries and fishing gear; and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions of birds in the geographic analysis area.

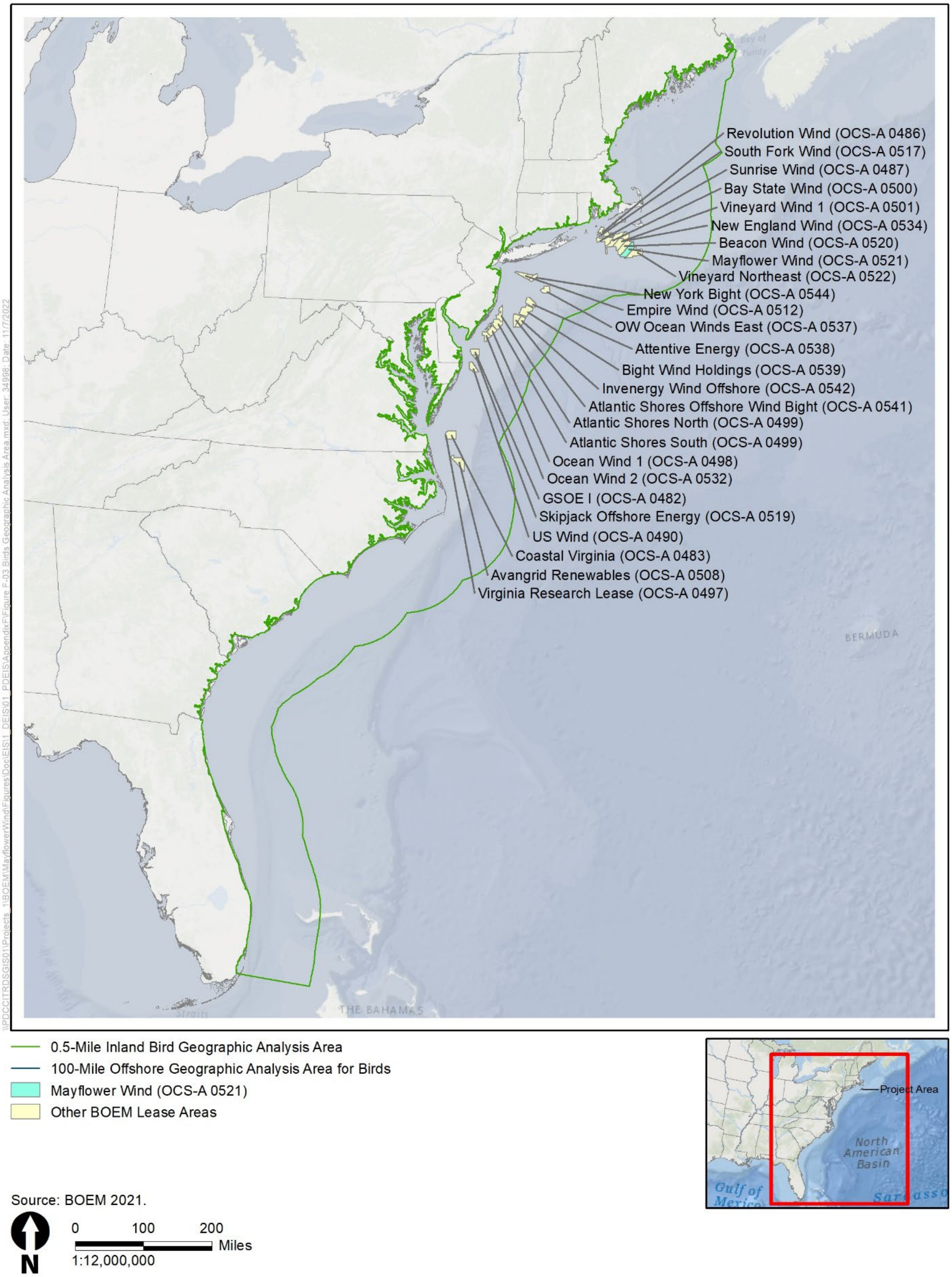

Figure 3.5.3-1. Birds geographic analysis area

Species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including hunting pressure (approximately 86,000 seaducks are harvested annually [Roberts 2019]), commercial fisheries by-catch (approximately 2,600 seabirds are killed annually on the Atlantic [Hatch 2017; Sigourney et al. 2019]), and climate change, which has the potential for adverse impacts on birds.

According to the North American Bird Conservation Initiative (NABCI), more than half of the offshore bird species (57 percent, 31 species) have been placed on the NABCI watch list as a result of small ranges, small and declining populations, and threats to required habitats. This watch list identified species of high conservation concern based upon high vulnerability to a variety of factors, including population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015) including those that forage, breed, and migrate over the Atlantic OCS. Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch list. Many of these coastal species have a small population size or restricted distributions, making them especially vulnerable to habitat loss or degradation and other stressors (NABCI 2016). Models of vulnerability to climate change estimate that, throughout Massachusetts, 42 percent of Massachusetts' 252 bird species and, throughout Rhode Island, 28 percent of Rhode Island's 197 bird species are vulnerable to climate change across seasons (Audubon 2019), some of which occur in the geographic analysis area. These ongoing impacts on birds would continue regardless of the offshore wind industry.

A broad group of avian species may pass through the Project area, including migrants (such as raptors and songbirds), coastal birds (such as shorebirds, waterfowl, and waders), and marine birds (such as seabirds and seaducks). Approximately 106 species of birds that are federally or state-listed or are species of conservation concern (i.e., federal Birds of Conservation Concern or state Species of Greatest Conservation Need) were identified as potentially occurring in the Project area based on literature reviews, review of public databases, and results of surveys conducted in and around the Project area, including long-term local or regional survey efforts in the Massachusetts/Rhode Island offshore wind lease area (refer to COP Volume 2, Section 6.1.1; Mayflower Wind 2022). Of these 106 species, 2 are federally listed as threatened, 1 is federally listed as endangered, 1 is protected under the Bald and Golden Eagle Protection Act (BGEPA), 27 are state-listed under the Massachusetts Endangered Species Act (MESA), 61 are listed as MESA Species of Greatest Conservation Need (SGCN), 25 are state-listed in Rhode Island, 51 are SGCN in Rhode Island, and 34 are listed as USFWS Birds of Conservation Concern (BCC) species. There is high diversity of marine birds that may use the Wind Farm Area because it is in the Mid-Atlantic Bight, which overlaps with the ranges of both the northern and southern species and falls within the Atlantic Flyway. Migrant terrestrial species may follow the coastline on their annual trips or choose more direct flight routes over expanses of open water. Many marine birds also make annual migrations up and down the eastern seaboard (e.g., gannets, loons, and seaducks), taking them directly through the Atlantic region in spring and fall. This results in a complex ecosystem where the community composition shifts regularly, and temporal and geographic patterns are highly variable. The mid-Atlantic supports large populations of birds in summer, some of which breed in the area, such as coastal gulls and terns. Other summer residents, such as shearwaters and storm-petrels, visit from the Southern Hemisphere (where they breed during the austral summer). In the fall, many of the summer residents leave the area and migrate south to warmer climates and are replaced by species that breed farther north and winter in the mid-Atlantic. Table 3.5.3-1 summarizes the bird presence in the Offshore Project area by bird type.

Table 3.5.3-1. Bird presence in the Offshore Project area by bird type

Bird Type	Potential Bird Presence in the Offshore Project Area
Non-Marine Migratory Birds	
Shorebirds	Shorebirds are coastal breeders and foragers and avoid straying out over deep waters during breeding. Of the shorebirds, red phalarope (*Phalaropus fulicarius*) and red-necked phalarope (*Phalaropus lobatus*) have a greater potential to occur in the marine environment as they forage over the open ocean during both non-breeding and breeding seasons. Phalarope species were observed during Aerial HD surveys in the spring and fall. MDAT abundance models and MCEC surveys indicate red phalarope occurrence is uncommon in spring and that red-necked phalarope occurrence is rare in spring in the Lease Area. Overall, exposure of shorebirds to the offshore infrastructure will be limited to migration, and, apart from phalaropes, the offshore marine environment does not provide habitat for shorebirds.
Wading birds	Most long-legged wading birds breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are coastal breeders and foragers and generally avoid straying out over deep waters, but may traverse the Wind Farm Area during spring and fall migration periods. No wading birds were recorded in the Lease Area during offshore surveys (Veit et al. 2016) including the 2019–2020 Aerial HD surveys. The USFWS IPaC database identified five bird species that are listed as BCC, and two great blue herons (*Ardea herodia*) were observed during the October–November 2019 boat-based G&G surveys (RPS Group 2020, 2019).
Raptors	Except for falcons, most raptors do not fly in the offshore marine environment due to their wing morphology, which requires thermal column formation to support their gliding flight. Falcons are encountered offshore because they can make large water crossings. Merlins (*Falco sparverius*) and peregrine falcons (*Falco peregrinus*) are commonly observed offshore, fly offshore during migration, and have been observed on offshore oil platforms. Therefore, falcons may pass through the Wind Farm Area during migration. Ospreys fly over open water crossings; however, satellite telemetry data from ospreys in New England and the mid-Atlantic suggest these birds generally follow coastal or inland migration routes. No peregrine falcons were observed in the Lease Area during offshore surveys (Veit et al. 2016) including the 2019–2020 Aerial HD surveys. However, one peregrine falcon was observed during the October–November 2019 boat-based G&G surveys (RPS Group 2020, 2019).

Bird Type	Potential Bird Presence in the Offshore Project Area
Songbirds	Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine system except during migration. Songbirds regularly cross large bodies of water, and there is some evidence that species migrate over the northern Atlantic. Some birds may briefly fly over the water while others, like the blackpoll warbler (*Setophaga striata*), can migrate over vast expanses of ocean (DeLuca et al. 2015; Faaborg et al. 2010). Evidence for a variety of species suggests that overwater migration in the Atlantic is much more common in fall (than in spring), when the frequency of overwater flights increases perhaps due to consistent tailwinds from the northwest. Overall, the exposure of songbirds to the Wind Farm Area will be limited to migration. Common songbirds that were observed during G&G surveys included mourning dove (*Zenaida macroura*), northern cardinal (*Cardinalis cardinalis*), northern flicker (*Colaptes auratus*), and golden-crowned kinglet (*Regulus satrapa*), among others (RPS Group 2020, 2019). Additionally, during the October–November 2019 G&G surveys, a marsh wren (*Cistothorus palustris*) was observed.
Coastal waterbirds	Coastal waterbirds (including waterfowl) use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. The species in this group are generally restricted to freshwater or use saltmarshes, beaches, and other strictly coastal habitats and are unlikely to pass through the Wind Farm Area. Seaducks are discussed below in the marine bird section.
Marine Birds	
Loons and grebes	Common loons (*Gavia immer*) and red-throated loons (*Gavia stellate*) use the Atlantic OCS in winter. Analysis of satellite-tracked red-throated loons, captured and tagged in the mid-Atlantic area, found their winter distributions to be largely inshore of the mid-Atlantic, and this species is known to use the Nantucket Shoals located northeast of the Lease Area (Gray et al. 2017). The red-throated loon was observed in the Lease Area during spring MCEC surveys and observed in the fall and several observed in spring during Aerial HD surveys. Additionally, portions of the 75% and 95% isopleths overlap the Lease Area. The common loon was observed during the October–November 2019 boat-based G&G surveys. The MDAT abundance models and MCEC surveys indicate that red-throated loons are generally concentrated closer to shore and in the Nantucket Shoals during fall and winter. Grebes occur in nearshore marine environments during the winter in Massachusetts. MDAT models, MCEC surveys, and site-specific surveys indicate the occurrence of horned grebe (*Podiceps auratus*) is expected to be rare and limited to winter.
Seaducks	The seaducks use the Atlantic OCS heavily in winter. Most seaducks forage on mussels and other benthic invertebrates, and generally winter in shallower inshore waters or out over large offshore shoals, where they can access benthic prey. Regional MDAT abundance models and MCEC surveys indicate sea ducks are concentrated close to shore and in the Nantucket Shoals, which is recognized as an important wintering area (Veit et al. 2016; Silverman et al. 2013). Exposure to the Lease Area varies from rare to common with most seaducks occurring in winter and early spring. During Aerial HD surveys, black scoter, common eider, long-tailed duck, surf scooter, and white-winged scooter were observed (COP, Appendix I1, Figure 3-45; Mayflower Wind 2022).

Bird Type	Potential Bird Presence in the Offshore Project Area
Petrel group	Shearwaters, petrels, and storm-petrels are pelagic seabirds that only occur on land during the breeding season. These species use the Atlantic OCS region heavily, including in the Massachusetts/Rhode Island offshore wind lease area in the summer (Veit et al. 2016; Veit et al. 2015; Nisbet et al. 2013). However, the northern fulmar (*Fulmarus glacialis*) is primarily observed during the winter, and the black-capped petrel *(Pterodroma hasitata)* and band-rumped storm-petrel (*Oceanodroma castro*) are rare visitors in the winter. The regional MDAT models and MCEC surveys indicate that the occurrences in the Lease Area for shearwaters, petrels, and storm-petrels range from rare to common, and Cory's shearwater (*Calonectris borealis*), great shearwater (*Ardenna gravis*), and northern fulmar (*Fulmaris glacialis*) occurrence is common. Shearwaters, storm-petrel, and fulmar species were observed during the Aerial HD surveys and included Cory's shearwater, greater shearwater, sooty shearwater, and northern fulmar. Additionally, during G&G vessel surveys completed in the Lease Area from October–November, the great shearwater was observed (92 observations representing 199 individuals).
Gannets and cormorants	Northern gannets use the Atlantic OCS primarily during winter. They breed in southeastern Canada and winter along the U.S. Atlantic Coast, with concentration observed near the OCS of Massachusetts. The northern gannet was observed in the Lease Area in all seasons during MCEC surveys, and in the spring, winter, and fall during Aerial HD surveys. During the October–November G&G surveys, over 400 individuals were observed in the Lease Area and six were observed during the Project G&G surveys in September 2019. GPS tracking data of the northern gannet did not indicate that core use areas occur in the Lease Area; however, portions of the 75% and 95% isopleths overlap the Lease Area. Based on MDAT abundance models, MCEC surveys, and site-specific surveys, northern gannet occurrence in the Lease Area is common during spring, fall, and winter, and rare in summer. Additionally, unidentified cormorants were observed during Aerial HD surveys in the spring and fall. The double-crested cormorant is commonly observed year-round on coastlines in Massachusetts and Rhode Island, and regional MDAT abundance models and MCEC surveys further corroborate this, indicating that cormorants are concentrated closer to shore and not commonly encountered well offshore.
Gulls, skuas, and jaegers	Several species in this group were observed during Aerial HD surveys and could potentially pass through the Wind Farm Area (COP Appendix I1, Figure 3-48; Mayflower Winds 2022). Gulls are primarily coastal species but may occur offshore. MCEC surveys documented large gulls such as the herring gulls (*Larus argentatus*) and great-black-backed gull (*Larus marinus*) offshore outside of breeding season (Veit et al. 2016), and G&G vessel surveys completed in the Lease Area during October–November were dominated by the herring gull; (59 observations representing 572 individuals). Jaegers and skuas reside in the marine environment outside of breeding season. The parasite jaeger (*Stercorarius parasiticus*) and pomarine jaeger (*Stercorarius pomarinus*) migrate through the North Atlantic region and breed in the arctic. Both jaegers and skuas in the Lease Area is rare in spring, summer, and fall.

Bird Type	Potential Bird Presence in the Offshore Project Area
Terns	Terns generally restrict themselves to coastal waters during breeding, although they may pass through the Wind Farm Area infrequently to forage and during migration. The MDAT abundance models and MCEC surveys indicate that terns are primarily concentrated close to shore. Conventional aerial surveys identified hotspots of roseate tern abundance on the western side of the Nantucket Shoals and in the Muskeget Channel between Martha's Vineyard and Muskeget during the spring (Veit et al. 2016). Migration routes of roseate terns are not well known but are believed to be largely or exclusively pelagic in both spring and fall; therefore, roseate terns may pass through the Lease Area during this period (Veit et al. 2016; Normandeau Associates Inc. 2011). Common terns (*Sterna hirundo*) were observed in the Lease Area during Aerial HD surveys in spring only (Mayflower Wind 2022) and in two BOEM blocks adjacent to the Lease Area during MCEC surveys. The roseate tern (*Sterna dougalli*) was observed in the Lease Area during Aerial HD surveys in spring only (Mayflower Wind 2022) and in one BOEM block during summer MCEC surveys. Based on MDAT abundance models, MCEC surveys, and Aerial HD surveys, the occurrence of roseate tern in the Lease Area is expected to be rare in the spring and fall.
Auks	Four species in this group were observed during Aerial HD surveys and could potentially pass through the Wind Farm Area (COP Appendix I1, Figure 3-43; Mayflower Winds 2022). Auk species present in the region are generally northern or Arctic breeders and are marine species outside of their breeding seasons. Auks may occur in the Lease Area during any season; however, most species are primarily observed during the spring and winter.

Source: Mayflower Wind 2022.
G&G = geological and geophysical; IPaC = Information for Planning and Consultation; MDAT = Marine-life Data and Analysis Team; MCEC = Massachusetts Clean Energy Center.

Due to the variety of upland, wetland, and coastal habitats in the Falmouth and Brayton Point Onshore Project areas (COP Appendix J, Figures 4-2 through 4-8; Mayflower Wind 2022) and their location in the Atlantic Flyway, a broad group of avian species utilize these onshore habitats during breeding, wintering, and migration periods. The avian groups found in these habitats include songbirds, shorebirds, raptors, waterfowl, waders, and seabirds. These birds include 55 species that are federally listed as threatened and endangered, USFWS-designated BCC, state-listed threatened and endangered, and state Special Concern birds (COP Appendix J, Table 4-10; Mayflower Wind 2022). The Onshore Project areas are in Bird Conservation Region 30, which is an area defined by the USFWS to facilitate use and interpretation of USFWS-designated BCC. The JBCC, which is located in proximity to Falmouth Onshore Project features, is designated as a National Audubon Society Important Bird Area (IBA). The Brayton Point Onshore Project area is directly adjacent to the Lee and Cole Rivers IBA, which serves as habitat for a significant population of waterfowl and covers 2,569 acres (1,040 hectares) (National Audubon Society n.d.).

The Falmouth Onshore Project area is located in the USEPA Atlantic Coastal Pine Barren Level III Ecoregion and intersects Massachusetts's Natural Heritage and Endangered Species Program Priority Habitat 945 and Estimated Habitat 756 (MassWildlife 2020). Priority Habitat is based on the known geographical extent of habitat for all state-listed rare species and Estimated Habitats are subsets of the Priority Habitats based on the geographical extent of habitat of state-listed rare wetlands wildlife. See COP Appendix J, Table 4-8 (Mayflower Wind 2022) for a list of species, including birds, identified in the National Heritage and Endangered Species Program Priority Habitat and Estimated Habitat for the

Falmouth Onshore Project area. The Brayton Point Onshore Project area is located within the USEPA Northeastern Coastal Zone. The Onshore Project area in Brayton Point, or portion thereof, is located within Priority Habitat 387 and Estimated Habitat 353 (COP Appendix J; Mayflower Wind 2022). See COP Appendix J, Table 4-9 (Mayflower Wind 2022) for a list of Rhode Island Species of Concern identified near the Brayton Point Onshore Project area.

Bald eagles (*Haliaeetus leucocephalus*), which are listed as Threatened under MESA, and as SGCN in Massachusetts and Rhode Island, are federally protected by the BGEPA, 16 USC 668 et seq., as are golden eagles (*Aquila chrysaetos*). Bald eagles are broadly distributed across North America and generally nest and perch in areas associated with water (lakes, rivers, bays) in both freshwater and marine habitats, often remaining largely within roughly 1,640 feet (500 meters) of the shoreline. Bald eagles are present year-round in Massachusetts and can primarily be found in terrestrial environments near water and overwinter along the coast of Cape Cod, Martha's Vineyard, and Nantucket (MassWildlife 2019). The general morphology of bald eagles dissuades long-distance movements in offshore settings, as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, bald eagles are unlikely to fly through the Wind Farm Area. The bald eagle may be present in the Onshore Project areas and immediate vicinity. The statewide breeding population is increasing (MassWildlife 2020), and, in Spring 2020, a new bald eagle nest was observed on Cape Cod in Barnstable. However, no known bald eagle nesting sites have been observed in the Onshore Project areas (MassWildlife 2020). In Rhode Island, populations of bald eagles have increased since the 1960s with 100 sightings reported during 2018, 19 of which occurred on Aquidneck Island (Avenego 2018). Although populations of bald eagles in Rhode Island have increased, Project activities are not expected to interfere with the species.

Golden eagles are found throughout the United States but are rare on the East Coast (Faherty 2016). In Massachusetts, golden eagles are very uncommon to rare fall migrants and winter visitors and are not known to breed within the state (MassAudubon 2022). As with bald eagles, the general morphology of golden eagle dissuades long-distance movements in offshore settings (Kerlinger 1985), as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, golden eagles are unlikely to fly through the Wind Farm Area.

Three species of birds listed as threatened or endangered under the ESA may occur in the Onshore and Offshore Project areas: the threatened piping plover (*Charadrius m. melodus*), endangered roseate tern (*Sterna d. dougallii*), and threatened Rufa subspecies of the red knot (*Calidris canutus rufa*) (Mayflower Wind 2022).

Impacts from reasonably foreseeable offshore wind activities on ESA-listed species will be discussed in detail in subsequent project-specific analysis documents. As is the case with the proposed Mayflower Wind Project, each proposed project will be required to address ESA-listed species at the individual project scale and cumulatively. Additionally, BOEM is currently working on a programmatic framework for ESA consultation with USFWS to address the potential impacts of the anticipated development of Atlantic offshore wind energy facilities on ESA-listed species.

3.5.3.2 Impact Level Definitions for Birds

Impact level definitions for birds are provided in Table 3.5.3-2.

Table 3.5.3-2. Definitions of impact levels for birds

Impact Level	Type of Impact	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
	Beneficial	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
	Beneficial	Impacts would be localized to a small area but with some measurable effect on one or a few individuals or habitat.
Moderate	Adverse	Impacts would be unavoidable but would not result in population-level effects or threaten overall habitat function.
	Beneficial	Impacts would affect more than a few individuals in a broad area but not regionally, and would not result in population-level effects.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level effects on species.
	Beneficial	Long-term beneficial population-level effects would occur.

3.5.3.3 Impacts of Alternative A – No Action on Birds

When analyzing the impacts of the No Action Alternative on birds, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for birds. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for birds described in Section 3.5.3.1, *Description of the Affected Environment and Future Baseline Conditions,* 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 birds are generally associated with onshore impacts (including onshore construction and coastal lighting), activities in the offshore environment (e.g., vessel traffic, commercial fisheries), and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bird species through temporary and permanent habitat removal or conversion, temporary noise impacts related to construction, collisions (e.g., presence of structures), and lighting effects, which could cause avoidance behavior and displacement, as well as injury or mortality to individual birds. However, population-level effects would not be anticipated. Activities in the offshore environment could result in bird avoidance behavior and displacement, but population-level effects would not be anticipated. Impacts associated with climate change have the potential to result in habitat degradation and loss, and shifting of species distribution.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on birds include the following.

- Continued O&M of the Block Island project (5 WTGs) installed in State waters.
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance. Ongoing offshore wind activities would have the same type of impacts that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect birds include installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Appendix D, *Planned Activities Scenario,* Section D.2 for a complete description of planned activities). Similar to ongoing activities, planned non-offshore wind activities may result in temporary and permanent impacts on birds including disturbance, displacement, injury, mortality, habitat degradation, and habitat conversion.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on birds during construction, O&M, and decommissioning of the projects. Planned offshore wind activities include offshore wind energy development activities on the Atlantic OCS other than the Proposed Action determined by BOEM to be reasonably foreseeable (see Appendix D, *Planned Activities Scenario*, Section D.2, for a complete description of planned offshore wind activities).

BOEM expects offshore wind activities may affect birds through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids, other contaminants, and trash and debris could occur as a result of offshore wind activities. The risk of any type of accidental release would be increased primarily during construction but may also be present during operations and decommissioning of offshore wind facilities. Hazardous materials that could be released include coolant fluids, oils and lubricants, and diesel fuels and other petroleum products. Ingestion of fuel and other hazardous contaminants has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feathers can lead to sublethal effects that include changes in flight efficiencies and increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). Based on the volumes potentially involved (refer to Table D2-3 in Appendix D), the likely amount of releases associated with offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities, and would represent a negligible impact on birds.

Vessel compliance with USCG regulations would minimize trash or other debris; therefore, BOEM expects accidental trash releases from offshore wind vessels to be rare and localized in nature. In the unlikely event of a release, lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019). Given that accidental releases are anticipated to be rare and localized, BOEM expects that accidental releases of trash and debris would not appreciably contribute to overall impacts on birds.

Light: Nighttime lighting associated with offshore wind structures and vessels could represent a source of bird attraction. Up to 2,945 offshore WTGs and OSPs would have hazard and aviation lighting that would be incrementally added beginning in 2023 and continuing through 2030. Vessel lighting would result in localized and temporary impacts on birds; structure lighting may pose an increased collision or predation risk (Hüppop et al. 2006), although this risk would be localized in extent and minimized through the use of BOEM lighting guidelines (BOEM 2021; Kerlinger et al. 2010). Overall, BOEM anticipates lighting impacts related to offshore wind structures and vessels would be negligible.

Cable emplacement and maintenance: Generally, emplacement of submarine cables would result in increased suspended sediments that may affect diving birds, result in displacement of foraging individuals, or decreased foraging success, and have impacts on some prey species (e.g., benthic assemblages) (Cook and Burton 2010). Impacts associated with cable emplacement would be temporary and localized, and birds would be able to successfully forage in adjacent areas not affected by increased suspended sediments. Any dredging necessary prior to cable installation could contribute to additional impacts. Disturbed seafloor from construction of offshore wind projects may affect some bird prey species; however, assuming future projects use installation procedures similar to those proposed in the Mayflower Wind COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance. Section 3.5.2, *Benthic Resources*, and Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, provide more information. Impacts would be negligible because increased suspended sediments would be temporary and generally localized to the emplacement corridor, and no individual fitness or population-level effects on birds would be expected.

Noise: Anthropogenic noise on the OCS associated with offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to result in impacts on birds on the OCS. Additionally, onshore construction noise has the potential to result in impacts on birds. BOEM anticipates that noise impacts would be negligible because noise would be localized and temporary. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

Aircraft flying at low altitudes may cause birds to flush, resulting in increased energy expenditure. Disturbance to birds, if any, would be temporary and localized, with impacts dissipating once the aircraft has left the area. No individual or population-level effects would be expected.

Construction of up to 2,945 offshore structures would create noise and may temporarily affect diving birds. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise transmitted through water has the potential to result in temporary displacement of diving birds in a limited space around each pile and can cause short-term stress and behavioral changes ranging from mild annoyance to escape behavior (BOEM 2014b, 2016). Additionally, noise impacts on prey species may affect bird foraging success. Similar to pile driving, G&G site characterization surveys for offshore wind facilities would create high-intensity impulsive noise around sites of investigation, leading to similar impacts on birds.

Onshore noise associated with intermittent construction of required offshore wind development infrastructure may also result in localized and temporary impacts, including avoidance and displacement, although no individual fitness or population-level effects would be expected to occur.

Noise associated with project vessels could disturb some individual diving birds, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). However, brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level effects would be expected.

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on birds through fish aggregation and associated increase in foraging opportunities, as well as entanglement and gear loss or damage, migration disturbances, and WTG strikes and displacement. These impacts may arise from buoys, meteorological towers, foundations, scour and cable protections, and transmission cable infrastructure.

The primary threat to birds from the presence of structures would be from collision with WTGs. The Atlantic Flyway is an important migratory pathway for as many as 164 species of waterbirds, and a similar number of land birds, with the greatest volume of birds using the Atlantic Flyway during annual migrations between wintering and breeding grounds (Watts 2010). Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). While both groups may occur over land or water within the flyway and may extend considerable distances from shore, the highest diversity and density are centered on the shoreline. Building on this information, Robinson Wilmott et al. (2013) evaluated the sensitivity of bird resources to collision and displacement due to offshore wind development on the Atlantic OCS and included the 164 species selected by Watts (2010) plus an additional 13 species, for a total of 177 species that may occur on the Atlantic OCS from Maine to Florida during all or some portion of the year. As discussed in Robinson Willmott et al. (2013) and consistent with Garthe and Hüppop (2004), Furness and Wade (2012), and Furness et al. (2013), species with high scores for sensitivity for collision include gulls, jaegers, and the northern gannet (*Morus bassanus*). In many cases, high collision sensitivity was driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the RSZ. Many of the species addressed in Robinson Willmott et al. (2013) had low collision sensitivity including passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ. As discussed by Watts (2010), 55 bird species occur on the Atlantic OCS at a distance from shore where WTGs could be operating. However, generally the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure 3.5.3-2). Of the 55 bird species, 47 marine bird species have sufficient survey data to calculate the modeled percentage of a species population that would overlap with the anticipated offshore wind development on the Atlantic OCS (Winship et al. 2018); the relative seasonal exposure is generally very low, ranging from 0.0 to 5.2 percent (Table 3.5.3-3). BOEM assumes that the 47 species (85 percent) with sufficient data to model the relative distribution and abundance on the Atlantic OCS are representative of the 55 species that may overlap with offshore wind development on the Atlantic OCS.

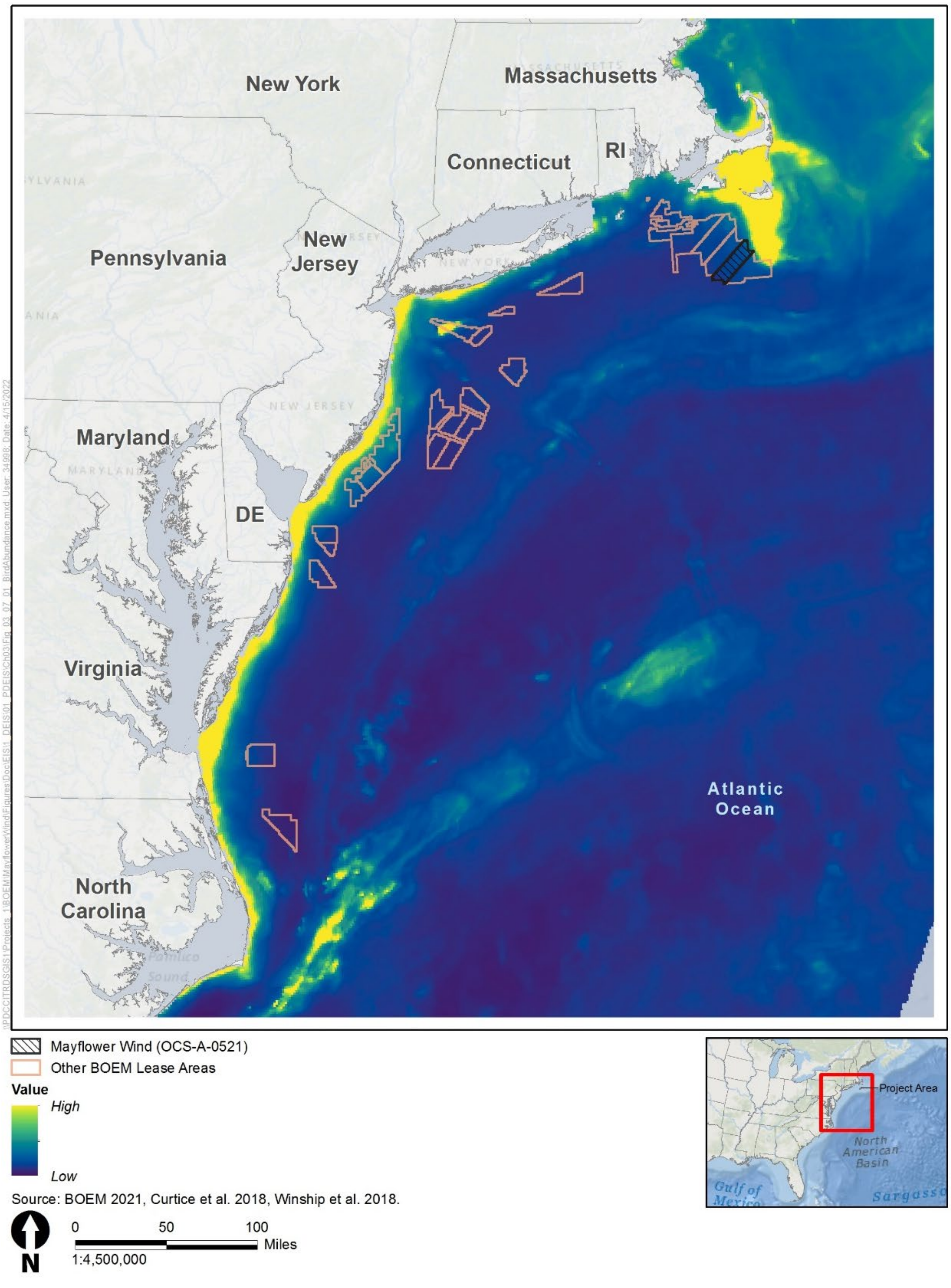

Figure 3.5.3-2. Total avian relative abundance distribution map

Table 3.5.3-3. Percentage of each Atlantic seabird population that overlaps with anticipated offshore wind energy development on the OCS by season

Species	Spring	Summer	Fall	Winter
Artic tern (*Sterna paradisaea*)	NA	0.2	NA	NA
Atlantic puffin (*Fratercula arctica*) [a]	0.2	0.1	0.1	0.2
Audubon shearwater (*Puffinus lherminieri*) [b]	0.0	0.0	0.0	0.0
Black-capped petrel (*Pterodroma hasitata*) [b]	0.0	0.0	0.0	0.0
Black guillemot (*Cepphus grille*)	NA	0.3	NA	NA
Black-legged kittiwake (*Rissa tridactyla*) [a]	0.7	NA	0.7	0.5
Black scoter (*Melanitta americana*)	0.2	NA	0.4	0.5
Bonaparte's gull (*Chroicocephalus philadelphia*)	0.5	NA	0.4	0.3
Brown pelican (*Pelecanus occidentalis*)	0.1	0.0	0.0	0.0
Band-rumped storm-petrel (*Oceanodroma castro*) [b]	NA	0.0	NA	NA
Bridled tern (*Onychoprion anaethetus*)	NA	0.1	0.1	NA
Common eider (*Somateria mollissima*) [a]	0.3	0.1	0.5	0.6
Common loon (*Gavia immer*)	3.9	1.0	1.3	2.1
Common murre (*Uria aalge*)	0.4	NA	NA	1.9
Common tern (*Sterna hirundo*) [a]	2.1	3.0	0.5	NA
Cory's shearwater (*Calonectris borealis*) [b]	0.1	0.9	0.3	NA
Double-crested cormorant (*Phalacrocorax auritus*)	0.7	0.6	0.5	0.4
Dovekie (*Alle alle*)	0.1	0.1	0.3	0.2
Great black-backed gull (*Larus marinus*) [a]	1.3	0.5	0.7	0.6
Great shearwater (*Puffinus gravis*)	0.1	0.3	0.3	0.1
Great skua (*Stercorarius skua*)	NA	NA	0.1	NA
Herring gull (*Larus argentatus*) [a]	1.0	1.3	0.9	0.5
Horned grebe (*Podiceps auritus*)	NA	NA	NA	0.3
Laughing gull (*Leucophaeus atricilla*)	1.0	3.6	0.9	0.1
Leach's storm-petrel (*Oceanodroma leucorhoa*)	0.1	0.0	0.0	NA
Least tern (*Sternula antillarum*)	NA	0.3	0.0	NA
Long-tailed ducks (*Clangula hyemalis*)	0.6	0.0	0.4	0.5
Manx shearwater (*Puffinus puffinus*) [a, b]	0.0	0.5	0.1	NA
Northern fulmar (*Fulmarus glacialis*) [a]	0.1	0.2	0.1	0.2
Northern gannet (*Morus bassanus*) [a]	1.5	0.4	1.4	1.4
Parasitic jaeger (*Stercorarius parasiticus*)	0.4	0.5	0.4	NA
Pomarine jaeger (*Stercorarius pomarinus*)	0.1	0.3	0.2	NA
Razorbill (*Alca torda*) [a]	5.2	0.2	0.4	2.1
Ring-billed gull (*Larus delawarensis*)	0.5	0.5	0.9	0.5
Red-breasted merganser (*Mergus serrator*)	0.5	NA	NA	0.7
Red phalarope (*Phalaropus fulicarius*)	0.4	0.4	0.2	NA

Species	Spring	Summer	Fall	Winter
Red-necked phalarope (*Phalaropus lobatus*)	0.3	0.3	0.2	NA
Roseate tern (*Sterna dougallii*)	0.6	0.0	0.5	NA
Royal tern (*Thalasseus maximus*)	0.0	0.2	0.1	NA
Red-throated loon (*Gavia stellate*) [a]	1.6	NA	0.5	1.0
Sooty shearwater (*Ardenna grisea*)	0.3	0.4	0.2	NA
Sooty tern (*Onychoprion fuscatus*)	0.0	0.0	NA	NA
South polar skua (*Stercorarius maccormicki*)	NA	0.2	0.1	NA
Surf scoter (*Melanitta perspicillata*)	1.2	NA	0.4	0.5
Thick-billed murre (*Uria lomvia*)	0.1	NA	NA	0.1
Wilson's storm-petrel (*Oceanites oceanicus*)	0.2	0.9	0.2	NA
White-winged scoter (*Melanitta deglandi*)	0.7	NA	0.2	1.3

Source: Winship et al. 2018.
[a] Species used in collision risk modeling.
[b] Species considered Birds of Conservation Concern by the USFWS (USFWS 2021a).
NA = not applicable.

The greatest risk to birds associated with offshore wind development would be collision with operating WTGs. Offshore wind development would add up to 2,884 WTGs in the bird geographic analysis area. In the contiguous United States, bird collisions with operating WTGs are relatively rare events, with an estimated 140,000 to 500,000 (mean = 320,000) birds killed annually from about 49,000 onshore wind turbines in 39 states (USFWS 2018). Bird collisions with turbines in the eastern United States is estimated at 6.86 birds per turbine per year (USFWS 2018). Based on this mortality rate, an estimated 19,784 birds could be killed annually from the 2,884 WTGs that would be added for offshore wind development. This represents a worst-case scenario and does not consider mitigating factors, such as landscape and weather patterns, or bird species that are expected to occur. Given that the relative density of birds in the OCS is low, relatively few birds are likely to encounter WTGs (Figure 3.5.3-2). Potential annual bird kills from WTGs would be relatively low compared to other causes of migratory bird deaths in the United States; feral cats are the primary cause of migratory bird deaths in the United States (2.4 billion per year), followed by collisions with building glass (599 million per year), collisions with vehicles (214.5 million per year), poison (72 million per year), collisions with electrical lines (25.5 million per year), collisions with communication towers (6.6 million per year), and electrocutions (5.6 million per year) (USFWS 2021b). Not all individuals that occur or migrate along the Atlantic Coast are expected to encounter the RSZ of one or more operating WTGs associated with offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table 3.5.3-2). The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. However, a recent study of long-term data collected in the North Sea found that despite the extensive observed displacement of loons in response to the development of 20 wind farms, there was no decline in the region's loon population (Vilela et al. 2021). Furthermore, substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas. Impacts on birds due to the presence of operating WTGs would likely be minor; however, no individual fitness or population-level impacts would be expected to occur.

Because most structures would be spaced 0.6 to 1 nautical mile (1.1 to 1.9 kilometers) apart, ample space between WTGs should allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. The effects of offshore wind farms on bird movement ultimately depend on the bird species, size of the offshore wind farm, spacing of the turbines, and extent of extra energy cost incurred by the displacement of flying birds (relative to normal flight costs pre-construction) and their ability to compensate for this degree of added energy expenditure. Little quantitative information is available on how offshore wind farms may act as a barrier to movement, but Madsen et al. (2012) modeled bird movement through offshore wind farms using bird (common eider) movement data collected at the Nysted offshore wind farm in the western Baltic Sea just south of Denmark. After running several hundred thousand simulations for different layouts/configurations for a 100 WTG offshore wind farm, the proportion of birds traveling between turbines increased as distance between turbines increased. With eight WTG columns at 200 meter (0.1 nm) spacing, no birds passed between the turbines. However, increasing inter-turbine distance to 500 meters (0.27 nm) increase the percentage of birds to more than 20 percent, while a spacing of 1,000 meters (0.54 nm) increased this further to 99 percent. The 0.6 to 1 nm spacing estimated for most structures that will be proposed on the Atlantic OCS is greater than the distance at which 99 percent of the birds passed through in the model. As such, adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of offshore wind lease areas would not be expected to be biologically significant. Any additional flight distances would likely be small for most migrating birds when compared with the overall migratory distances traveled, and no individual fitness or population-level effects would be expected to occur.

In the Northeast and Atlantic waters, there are 2,570 seabird fatalities through interaction with commercial fishing gear each year; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2017). Abandoned or lost fishing nets from commercial fishing may get tangled with foundations, reducing the chance that abandoned gear would cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013). In contrast, the presence of structures may also lead to an increase in recreational fishing and thus expose individual birds to harm from fishing line and hooks.

The presence of new structures could result in increased prey items for some marine bird species. Offshore wind foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017; Dorrell et al. 2022). Additionally, the new structures may create habitat for structure-oriented and hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind energy facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for individuals of some marine bird species. BOEM anticipates that the presence of structures may result in long-term moderate beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs.

Traffic (aircraft): General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Because aircraft flights associated with offshore wind development are expected to be minimal in comparison to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic impacts would be negligible and not expected to appreciably contribute to overall impacts on birds.

Land disturbance: Onshore construction of offshore wind development infrastructure has the potential to result in some impacts due to habitat loss or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities. Furthermore, construction would be expected to generally occur in previously disturbed habitats, and no individual fitness- or population-level impacts on birds would be expected to occur. As such, onshore construction impacts associated with offshore wind development would be negligible and would not be expected to appreciably contribute to overall impacts on birds.

Impacts of Alternative A on ESA-Listed Species

Three bird species in the geographic analysis area are either threatened or endangered and protected by the ESA. Impacts of Alternative A on ESA-listed birds are represented in the IPF discussion under *Offshore Wind Activities*. Any future federal activities that could affect federally listed birds in the geographic analysis area would need to comply with ESA Section 7 to ensure that the proposed activities would not jeopardize the continued existence of the species.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, birds would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on birds primarily through construction and climate change. Given that the amount of bird species that overlap with ongoing wind energy facilities on the Atlantic OCS is relatively small, ongoing wind activities would not appreciably contribute to impacts on birds. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects in the geographic analysis area. The No Action Alternative would result in **minor** impacts on birds.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and birds would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on birds due to habitat loss from increased onshore construction and interactions with offshore developments. BOEM anticipates that the impacts associated with offshore wind activities in the geographic analysis area would result in adverse impacts but could potentially include beneficial impacts because of the presence of structures. The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind development. Migratory birds that use the offshore wind lease areas during all or parts of the year would either be exposed to new collision risk or experience long-term functional habitat loss due to behavioral avoidance and displacement from wind lease areas on the OCS. The offshore wind development would also be responsible for the majority of impacts related to new cable emplacement and pile-driving noise, but effects on birds resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant. Cumulative impacts of the no Action Alternative would have a **moderate** adverse impact on birds but could also include **moderate beneficial** impacts because of the presence of offshore structures.

3.5.3.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on birds.

- The onshore substation/converter stations, which could require limited tree clearing.
- The number, size, and location of the WTGs.
- The routing variants within the selected onshore export cable system, which could require removal of trees on the edge of the construction corridor.
- The time of year during which construction occurs.

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

- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to birds.
- Onshore export cable routes and substation/converter station footprints: the route chosen (including variants within the general route) and substation/converter station footprint would determine the amount of habitat affected.
- Season of construction: The activity and distribution of birds exhibit distinct seasonal changes. For instance, summer and fall months (generally May through October) constitute the most active season for birds in the Project area, and the months on either side coincide with major migration events. Therefore, construction during months in which birds are not present, not breeding, or less active would have a lesser impact on birds than construction during more active times.

Mayflower Wind has committed to measures to minimize impacts on birds. These measures include, but are not limited to, siting the proposed Project to avoid locating Project components in or near areas of known important or high bird use, incorporating the use of HDD at landfall locations to avoid disturbance to shorelines and coastal habitats, using lighting technology to minimize impacts on avian species, ensuring that lighting on WTGs will be executed in accordance with FAA regulations, and developing and implementing a Post-Construction Monitoring Plan to evaluate and mitigate for potential collision risk for bird species (Appendix G, *Mitigation and Monitoring*).

3.5.3.5 Impacts of Alternative B – Proposed Action on Birds

The following summarizes the potential impacts of the Proposed Action on birds during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*.

Accidental releases: Some potential exists for mortality, decreased fitness, and health effects due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with the Proposed Action. Vessels associated with the Proposed Action may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Proposed Action would comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). In addition, Mayflower Wind will abide by the Bureau of Safety and Environmental Enforcement's regulations (30 CFR 250.300) concerning marine pollution prevention and control in OCS waters. In the case of an accidental spill within the proposed Project area, Mayflower Wind will use an approved OSRP mitigation measures to prevent birds from going to affected areas including hazing, chumming, and relocating to unaffected areas (COP Volume 2, Table 16-1; Mayflower Wind 2022). These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and temporary and negligible impacts on birds.

Light: Under the Proposed Action, up to 149 WTG/OSP positions in the OCS would be lit with navigational and FAA hazard lighting; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). Birds may be less attracted to longer-wavelength lighting such as red and yellow lights (Zhao et al. 2020; Rebke et al. 2019) and steady burning lights pose a higher risk than pulsing strobe lights (Rebke et al. 2019; Patterson 2012; Kerlinger et al. 2010). In accordance with BOEM (2021) lighting guidelines and as outlined in Mayflower Wind COP Volume 1, Section 3.3.12 (Mayflower Wind 2022), each WTG and OSP would be lit and marked in accordance with FAA and USCG lighting standards and consistent with BOEM best practices. Lighting would be placed on all structures and would be visible throughout a 360-degree arc from the surface of the water. Mayflower Wind would implement an ADLS to only activate WTG lighting when aircraft enter a predefined airspace. The short-duration synchronized flashing of the ADLS would have less impact on birds at night than the standard continuous, medium-intensity red strobe light aircraft warning systems. ADLS for the Proposed Action is anticipated to be activated for less than 5 hours per year, or 0.1 percent of nighttime hours, compared to standard continuous FAA hazard lighting (COP, Appendix T, Section 5.1.3; Mayflower Wind 2022). This would reduce impacts already associated with WTG lighting. Vessel lights during construction, O&M, and decommissioning would be minimal and likely limited to vessels transiting to and from construction areas. To further reduce impacts on birds, Mayflower Wind proposes to minimize lighting, to the extent practicable. As such, BOEM expects impacts, if any, to be long term but negligible from lighting.

Cable emplacement and maintenance: The Proposed Action would disturb up to 3,888 acres (1,573 hectares) of seafloor associated with the installation of interarray cable and offshore cable, which would result in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species including the sand lance (*Ammodytes* sp.; Staudinger et al. 2020). These impacts are expected to be temporary, with sediments settling quickly to the seabed and potential plumes generally confined to just above the seabed. The maximum TSS level would drop below 10 mg/l (0.00008 lb/gal) within 2 hours for all simulated scenarios and drop below 1 mg/l (0.000008 lb/gal) within 4 hours for any scenario except for nearshore areas of the Brayton Point corridor where 100 mg/L and 10 mg/L concentrations would last for less than 5 hours and a little over 2 days, respectively (Mayflower Wind 2022). Dredging, which may also occur along the proposed cable routes in locations where sand waves (naturally mobile slopes on the seabed) are encountered or when crossing federal and state navigation channels, would produce similar effects, but with plumes likely to last longer and extend farther out. As BOEM (2018) notes, while turbidity would likely be high in the areas affected by dredging, the sediment would not affect water quality after it settles, and the period of sediment suspension would be very short term and localized. Individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement, and only non-measurable negligible impacts, if any, on individuals or populations would be expected given the localized and temporary nature of the potential impacts.

Noise: The expected impacts of aircraft, G&G surveys, and pile-driving noise associated with Proposed Action alone would not increase the impacts of noise beyond those described under the No Action Alternative. Effects on offshore bird species could occur during the construction phase of the Proposed Action due to equipment noise, primarily through sound generated from pile driving. The pile-driving noise impacts would be short term (2 hours per pin pile with a maximum of eight per day or 4 hours per monopile with a maximum of two per day) and soft starts will be used to mitigate impacts (COP Volume 2, Table 9-11; Mayflower Wind 2022). Additionally, prey species for marine birds would likely be temporarily displaced from the active construction noise, which would likely cause avian species to forage elsewhere. Potential disturbances from pile-driving noise are expected to be temporary and limited to the areas where the activity occurs.

Vessel and construction noise from seabed preparation, substructure installation, WTG and OSP installation, cable laying, and placement of scour protection could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). During construction, multiple vessels may operate concurrently throughout the Lease Area or offshore export cable corridor with dynamic positioning vessels generating noise from cavitation on the propeller blades of the thrusters. However, marine life, including diving birds, within the region is regularly subjected to vessel activity and would be habituated to the underwater noise (BOEM 2014b). BOEM anticipates the temporary impacts, if any, related to construction and installation of the offshore components would be negligible.

Normal operation of the substation and converter station would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises near the proposed sites. Noise from onshore construction would be mitigated to the extent practicable and is also considered negligible in context of other short-term commercial and industrial noises near the proposed substation.

Presence of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, entanglement and fishing gear loss or damage, migration disturbances, and WTG strikes and displacement, are described in detail Section 3.5.3.3. The impacts of the Proposed Action alone as a result of presence of structures would be long term but minor and may include some minor beneficial impacts.

As previously described and depicted for the offshore wind lease areas on Figure 3.5.3-3 and Figure 3.5.3-4, the locations of the OCS offshore wind lease areas were selected to minimize impacts on all resources, including birds. Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). However, operation of the Proposed Action would result in impacts on some individuals of offshore bird species and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Millman 2016). The predicted activity of bird populations that have a higher sensitivity to collision (as defined by Robinson Willmott et al. 2013) is relatively low in the OCS during all seasons of the year (Figure 3.5.3-3), suggesting that bird fatalities due to collision are likely to be low.

When WTGs are present, many birds would avoid the WTG site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid WTGs by flying above, below, or between them (e.g., Desholm and Kahlert 2005; Plonczikier and Simms 2012; Skov et al. 2018). Several species have very high avoidance rates; for example, the northern gannet, black-legged kittiwake, herring gull, and great black-backed gull have measured avoidance rates of at least 99.6 percent (Skov et al. 2018).

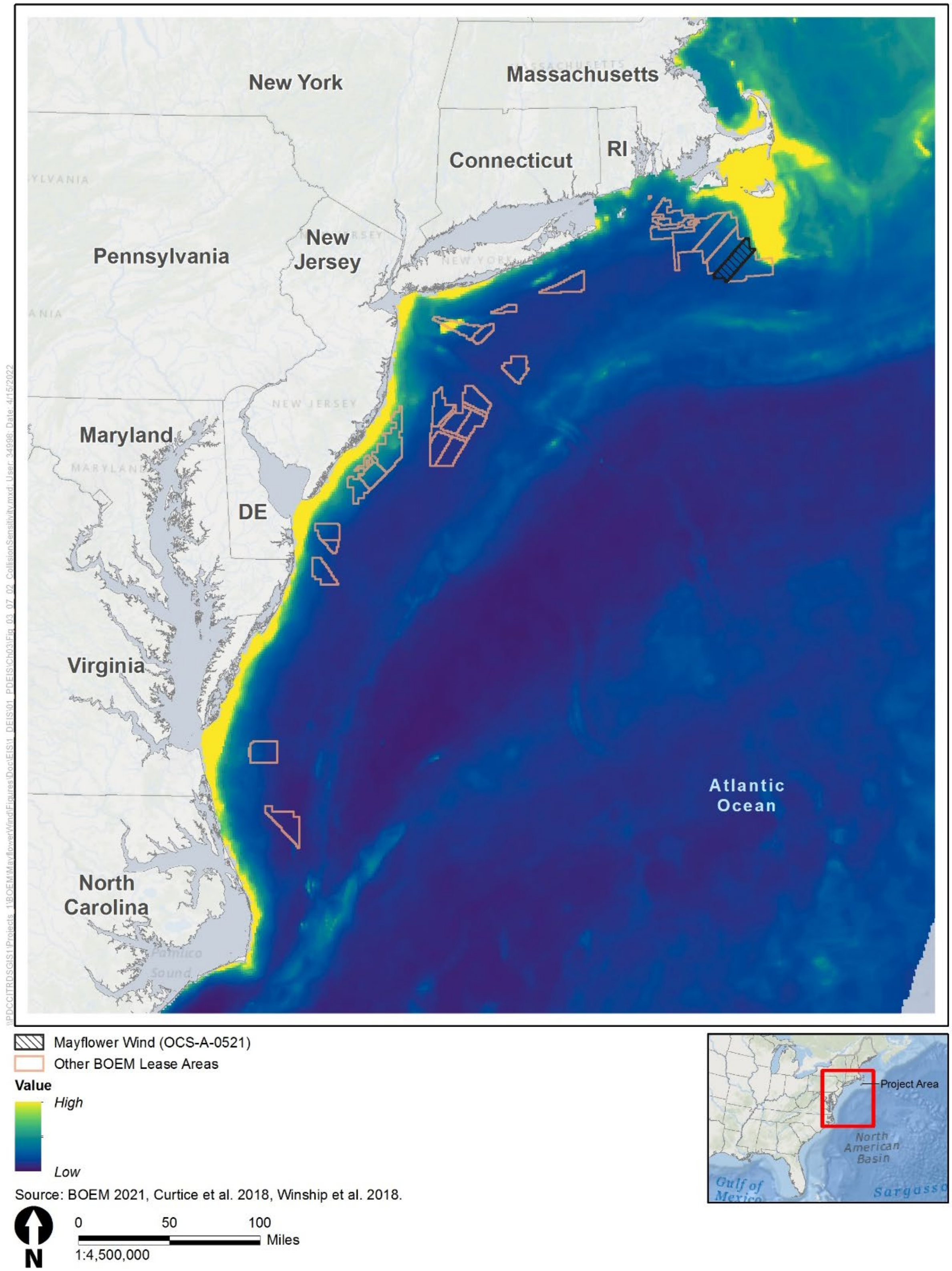

Figure 3.5.3-3. Total avian relative abundance distribution map for the higher collision sensitivity species group

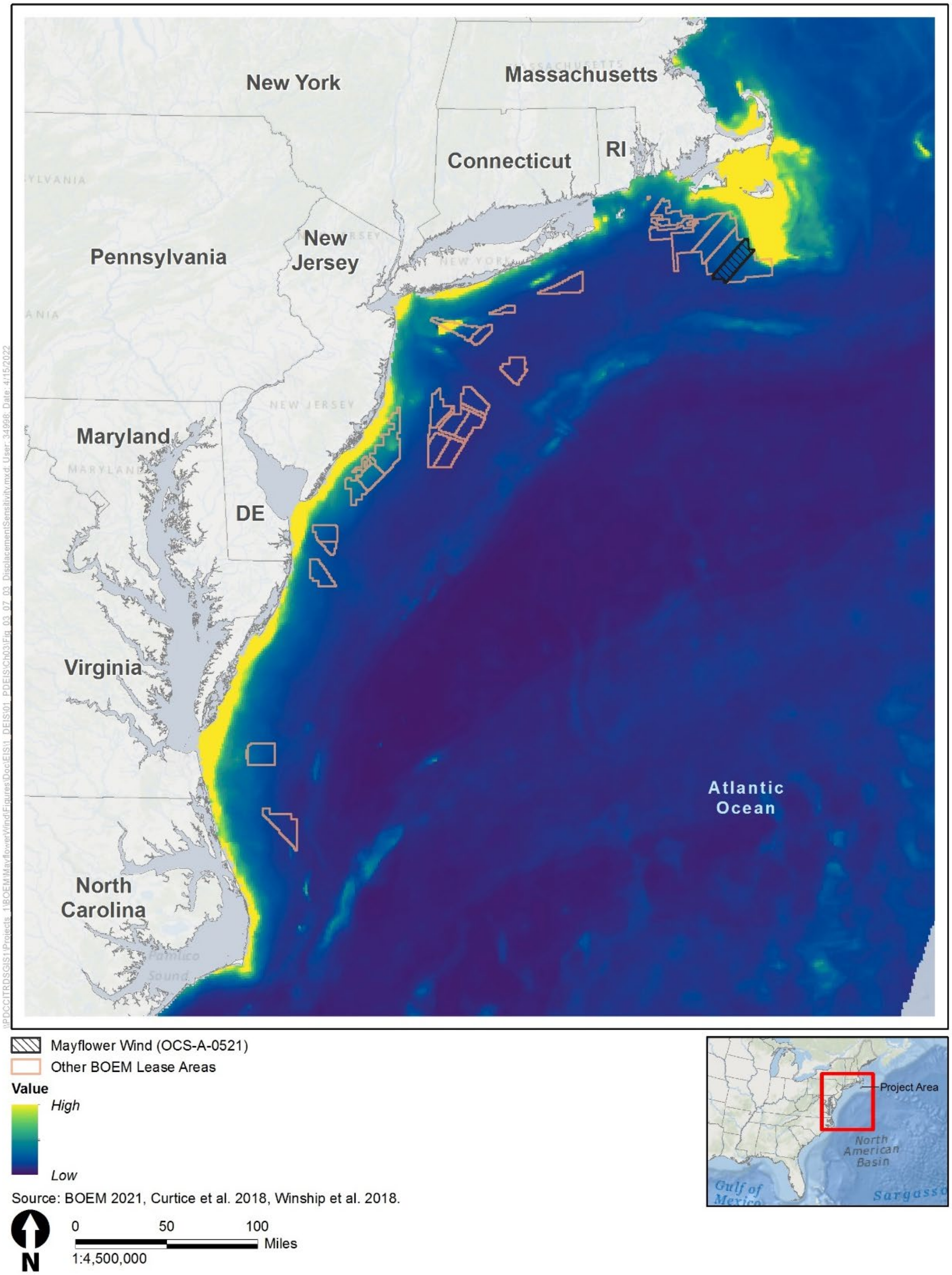

Figure 3.5.3-4. Total avian relative abundance distribution map for the higher displacement sensitivity species group

Mayflower Wind performed an avian exposure risk assessment to estimate the risk of various offshore bird species encountering the Wind Farm Area (Mayflower Wind 2022). The Lease Area is not likely to contain areas where high relative abundances of collision risk species may collide with the operational turbines. However, some collision-sensitive species—including the razorbill, northern gannet, gull, and seaducks—may frequent northern portions of the Lease Area during the winter and spring. Displacement-sensitive species densities including the razorbill, northern gannet and some seaduck species are likely to be low relative to regional and local waters with a small pocket of the moderately high activity recorded in the northern portion of the Lease Area during the winter and spring. While some non-marine birds have the potential to be exposed to the Wind Farm Area, it is far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. Of the species considered to have a higher overall exposure risk, the northern gannet and long-tailed duck are listed as SGCNs in Massachusetts; the razorbill, black scoter, red-breasted merganser, and surf scoter are listed as SGCNs in Rhode Island; and the common eider is listed as an SGCN in both Massachusetts and Rhode Island.

During migration, many bird species, including songbirds, likely fly at heights well above or below the RSZ (54 to 1,066.4 feet [16.5 to 325 meters] above MLLW) (COP Appendix I1; Mayflower Wind 2022). As shown in Robinson Willmott et al. (2013), species with low sensitivity scores include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ. Other bird species such as seaducks have been observed increasing their altitude to avoid WTGs during the night (Desholm and Kahlert 2005). However, bird species such as gulls are ranked as vulnerable to collisions as they fly at RSZ heights (Johnston et al. 2014; Cook et al. 2012) but may exhibit avoidance behavior (Cook et al. 2012).

It is generally assumed that inclement weather and reduced visibility cause changes to migration altitudes (Ainley et al. 2015) and could potentially lead to large-scale mortality events. However, this has not been shown to be the case in studies of offshore wind facilities in Europe, with oversea migration completely, or nearly so, ceasing during inclement weather (Fox et al. 2006; Pettersson 2005; Hüppop et al. 2006), and with migrating birds avoiding flying through fog and low clouds (Panuccio et al. 2019). Furthermore, many of these passerine species, while detected on the OCS during migration as part of BOEM's Acoustic/Thermographic Offshore Monitoring project (Robinson Willmott and Forcey 2014), were documented in relatively low numbers. While several studies documenting bird flight and wind speeds over terrestrial environments have shown birds to fly at variable wind speeds, including above the typical cut-in speeds of wind turbines (Abdulle and Fraser 2018; Bloch and Bruderer 1982; Bruderer and Boldt 2001; Chapman et al. 2016), Robinson Willmott and Forcey (2014) found that most of the bird activity (including blackpoll warblers) in the offshore environment on the OCS occurred during windspeeds less than 6 miles per hour (10 kilometers per hour) (see Figure 109 in Robinson Willmott and Forcey 2014). The cut-in speed for the Mayflower Wind WTGs is 5.6 to 8.9 miles per hour (9 to 14.4 kilometers per hour); therefore, based on the Robinson Willmott and Forcey (2014) offshore study, passerines would likely be migrating when the turbine blades are more often idle. Furthermore, most carcasses of small migratory songbirds found at land-based wind energy facilities in the Northeast were within 6.6 feet (2 meters) of the turbine towers, suggesting that they are colliding with towers rather than with moving turbine blades (Choi et al. 2020). Although it is possible that migrating passerines could collide with offshore structures, migrating passerines are also occasionally found dead on boats, presumably from exhaustion (e.g., Stabile et al. 2017).

Some marine bird species might avoid the Wind Farm Area during its operation, leading to an effective loss of habitat. For example, loons (Dierschke et al. 2016; Drewitt and Langston 2006; Lindeboom et al. 2011; Percival 2010; Petersen et al. 2006), grebes (Dierschke et al. 2016; Leopold et al. 2011; Leopold et al. 2013), seaducks (Drewitt and Langston 2006; Petersen et al. 2006), and northern gannets (Drewitt and Langston 2006; Lindeboom et al. 2011; Petersen et al. 2006) typically avoid offshore wind developments. The proposed Project would no longer provide foraging opportunities to those species with high displacement sensitivity, but suitable foraging habitat exists in the immediate vicinity of the proposed Project and throughout the region. However, as depicted on Figure 3.5.3-4, modeled use of the Wind Farm Area by bird species with high displacement sensitivity is low. A complete list of species included in the higher displacement sensitivity group can be found in Robinson Willmott et al. (2013). Because the Wind Farm Area is not likely to contain important foraging habitat for the species susceptible to displacement, BOEM expects this loss of habitat to be insignificant. Mayflower Wind proposes to develop and implement a Post-Construction Monitoring Plan to evaluate and mitigate for potential collision risk for bird species (COP Volume 2, Table 16-1; Mayflower Wind 2022). Population-level, long-term impacts resulting from habitat loss would likely be negligible.

Generally, onshore operation is not expected to pose any significant IPFs (i.e., hazards) to birds because activities would disturb little if any habitat. The onshore Project components are mostly within existing, highly disturbed, industrial areas that are unlikely to provide important bird habitat.

Traffic (aircraft): The expected impacts of aircraft traffic associated with the Proposed Action would be negligible and would not increase impacts beyond those described for the No Action Alternative.

Land disturbance: The expected impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond those described under the No Action Alternative. Mayflower Wind proposes to use HDD technology for cable installation at landfall locations, which will primarily go under beaches and would avoid beach habitat for nesting shorebirds (COP Volume 2, Table 16-1; Mayflower Wind 2022); as such, temporary impacts on birds, particularly nesting shorebirds, resulting from the landfall location would be negligible. Collisions between birds and vehicles or construction equipment have limited potential to cause mortality. However, these temporary impacts, if any, would be negligible, as most individuals would avoid noisy construction areas (Bayne et al. 2008; Goodwin and Shriver 2010; McLaughlin and Kunc 2013).

Overall, impacts on bird habitat from onshore construction activities would be limited because, whenever possible, facilities (including overhead transmission lines) would be co-located with existing developed areas to limit disturbance. Vegetation clearing would likely be minimal for the sites in Falmouth and the converter station site and onshore Project components in Somerset. If tree clearing is required, Mayflower Wind has proposed to conduct habitat assessments and presence/absence surveys and would coordinate with MassWildlife, RIDEM, and USFWS as appropriate. Clearing during construction within temporary workspaces would result in temporary loss of forage and cover for birds within the area. Construction of the onshore substation and converter station would result in temporary and permanent impacts on habitat from construction of the permanent substation facility and use of temporary construction workspace. However, the existing habitat at the proposed onshore substation sites and converter site is in previously disturbed areas and the Project would result in no further additional habitat fragmentation, significant new open spaces, or open corridors (Mayflower Wind 2022). Due to the short duration of the activities and AMMs (COP Volume 2, Table 16-1; Mayflower Wind 2022) that Mayflower Wind has committed to implementing to reduce impacts, population-level impacts on birds from habitat modification and impacts are unlikely. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the impacts on birds are expected to be negligible.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Ongoing and planned non-offshore wind activities related to installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures would contribute to impacts on birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the same IPFs. Given that the abundance of bird species that overlap with wind energy facilities on the Atlantic OCS is relatively small, offshore wind activities would not appreciably contribute to impacts on bird populations. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. Ongoing and planned offshore wind activities in combination with the proposed Action would result in an estimated 3,031 WTGs, of which the Proposed Action would contribute 147 or about 5 percent.

The cumulative impacts on birds would likely be moderate because, although bird abundance on the OCS is low, there could be unavoidable impacts offshore and onshore; however, BOEM does not anticipate the impacts to result in population-level effects or threaten overall habitat function. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative impacts on birds.

Impacts of Alternative B on ESA-Listed Species

Three bird species in the geographic analysis area are either threatened or endangered and protected by ESA. Impacts of the Proposed Action on ESA-listed birds are represented in the IPFs discussed previously as all impact types and mechanisms for birds also apply to ESA-listed birds. BOEM is preparing a BA for the potential effects on USFWS federally listed species. There are no critical habitats designated for these species in the action area defined in the BA. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing and results of the consultation will be included in the Final EIS.

Conclusions

Impacts of the Proposed Action: Construction, installation, O&M, and eventual decommissioning of the Proposed Action would have **minor** impacts on birds, depending on the location, timing, and species affected by an activity. The primary factors of the Proposed Action affecting birds are habitat loss and collision-induced mortality from rotating WTGs and permanent habitat loss and conversion from onshore construction. The Proposed Action would also result in potential **minor beneficial** impacts associated with foraging opportunities for marine birds.

Cumulative Impacts of the Proposed Action: BOEM anticipates that the cumulative impacts from the Proposed Action on birds in the geographic analysis area would be **moderate**, as well as **moderate beneficial**. The incremental impacts contributed by the Proposed Action to the cumulative impacts on birds would be undetectable. The Proposed Action would contribute to the cumulative impacts primarily through the permanent impacts from the presence of structures.

3.5.3.6 Impacts of Alternative C on Birds

Impacts of Alternative C: Under Alternative C, the export cable route to Brayton Point would be rerouted onshore to avoid sensitive fish habitat in the Sakonnet River. The new overland portions of Alternative C-1 and Alternative C-2 would largely be sited in public road ROWs to the extent possible. Both the eastern and western variations of Alternative C-1 and Alternative C-2 overlap four separate Natural Heritage areas. Prior to traveling along Route 138, the eastern variation additionally abuts Gardiner Pond and the Norman Bird Sanctuary and is 1 mile (1.7 kilometers) northwest of the Sahucest Point National Wildlife Refuge (NWR). Both the Norman Bird Sanctuary and the Sahucest Point NWR provide stopover and wintering habitat that support federally and state-listed migratory birds.

The only IPFs that would be meaningfully different under Alternative C compared to the Proposed Action are land disturbance and new cable emplacement/maintenance. The primary impacts of Alternative C affecting birds would be habitat loss from tree and brushland disturbance, which would result in both temporary and permanent impacts. In addition to the forest and brushland area disturbed under the Proposed Action, 4.95 acres (2.00 hectares), 2.59 acres (1.04 hectares), and 15.46 acres (6.26 hectares) of forest habitat could be disturbed under Alternative C-1 (eastern variation), Alternative C-1 (western variation), and Alternative C-2, respectively. In addition, 1.51 acres (0.61 hectare), 1.07 acres (0.43 hectare), and 1.31 acres (0.53 hectare) of brushland under Alternative C-1 (eastern variation), Alternative C-1 (western variation), and Alternative C-2, respectively, would be disturbed in addition to the Proposed Action disturbance (refer to Section 3.5.4, *Coastal Habitat and Fauna*). These impacts may affect bird foraging and nesting located along the edges of the road ROWs. While the area of tree and brushland disturbance would be greater than the Proposed Action, the potential impact on birds would remain minor.

In the aquatic environment, Alternative C-1 and Alternative C-2 would reduce the total offshore export cable route by 9 miles (14 kilometers) and 12 miles (19 kilometers), respectively. However, cable emplacement activity would still occur and result in short-term and localized sediment suspension. Individual birds would be expected to successfully forage in nearby areas and impacts would remain negligible.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Impacts of Alternative C on ESA-Listed Species

BOEM anticipates that Mayflower Wind would use HDD technology for cable installation at the Alternative C-1 landfall location. Cables would be installed primarily under beaches and would avoid beach habitat for nesting shorebirds, which would include the three ESA-listed species in the Project area. As such, impacts on these species' habitat would be avoided and other construction impacts (e.g., noise) would be temporary and negligible. There is no beach habitat for the three ESA-listed bird species at the Alternative C-2 landfall.

Conclusions

Impacts of Alternative C: Impacts of Alternative C would be similar to the impacts of the Proposed Action. While Alternative C would result in a greater area of onshore habitat impacts along the onshore export cable routes than the Proposed Action, the overall affected area would be small and the same construction, O&M, and decommissioning impacts would still occur. Therefore, Alternative C would result in **minor** adverse impacts on birds and could include **minor beneficial** impacts.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts on birds associated with Alternative C would be similar to the Proposed Action and result in **moderate** adverse impacts and may include **moderate beneficial** impacts.

3.5.3.7 Impacts of Alternatives D, E, and F on Birds

Impacts of Alternatives D, E, and F: Impacts on birds associated with construction and installation, O&M, and decommissioning of the Project under Alternatives D, E, and F would be similar to those described under the Proposed Action. Under Alternative D, potential impacts on birds from the presence of structures, noise, and light could be reduced with the removal of up to six WTGs in the northern portion of the Lease Area that are nearest to Nantucket Shoals. Nantucket Shoals provides foraging habitat for various avian species including seabirds and seaducks and has high year-round avian abundance (Figure 3.5.3-2). As shown in Chapter 2*, Alternatives*, Figure 2-7, Nantucket Shoals is a persistent hotspot of *gammarid* amphipod abundance, which is a persistent food source for seaducks, including the long-tailed duck (*Clangula hyemalis*) and potentially white-winged scoters (*Melanitta deglandi*) (White et al. 2009; Veit et al. 2016). In addition to these species, the northern portions of the Lease Area may be frequented by other collision-sensitive and displacement-sensitive species including the northern gannet, razorbill, and gull in winter and spring (Figure 3.5.3-3 and Figure 3.5.3-4), and a reduction in offshore wind development in this area may lessen the impacts on these species. The red-throated loon may also frequent the northern portion of the Lease Area. The removal of six WTGs in this area may lessen the impacts on birds by providing more area of open ocean nearest to Nantucket Shoals foraging habitat. However, this 4 percent reduction in WTGs represents only a small portion of the overall Project, and impacts associated with the remaining 141 WTGs would still occur. Overall impacts are not anticipated to be materially different than the Proposed Action.

None of the differences between Alternatives E and F and the Proposed Action would have the potential to significantly reduce or increase impacts on birds from the analyzed IPFs. Alternative E-1 would require all piled foundations, resulting in similar impacts from noise as the Proposed Action. Under Alternative E-2 and Alternative E-3, foundations would be used that require no impact pile driving (suction-bucket and GBS), eliminating impacts on diving birds due to underwater noise. Foundations with larger seabed footprints (Alternative E-3) may present increased foraging opportunities due to increased aggregations of fish near structures due to the presence of artificial reefs. BOEM anticipates that the impacts on birds under Alternatives E-1, E-2, and E-3 would not be measurably different from those anticipated under the Proposed Action. Under Alternative F, the Falmouth offshore export cable route would still be within the Proposed Action's PDE but would include only three HVDC cables compared to five HVAC cables under the Proposed Action, which would reduce seafloor disturbance by approximately 700 acres. The reduction in seafloor disturbance would not have a meaningful difference on bird foraging opportunities.

Cumulative Impacts of Alternatives D, E, and F: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives D, E, and F would be similar to those described under the Proposed Action.

Impacts of Alternatives D, E, and F on ESA-Listed Species

Impacts on ESA-listed species resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Project under Alternatives D, E, and F would be similar to those described under the Proposed Action for the reasons described above for all birds. Coastal shorebirds including the *rufa* red knot and piping plover may travel through the Lease Area, but available data do not indicate that such movements are common. Tern species, including the roseate tern, may occur in the Lease Area in low to moderate levels relative to regional and local occurrences. Concentrations of terns are not expected in the Lease Area based on sand lance distribution data. None of the differences between Alternatives E and F and the Proposed Action would have the potential to significantly reduce or increase impacts on ESA-listed birds from the analyzed IPFs. BOEM does not anticipate impacts to be measurably different than those described under the Proposed Action.

Conclusions

Impacts of Alternatives D, E, and F: The expected **minor** impacts and **potential minor beneficial** impacts associated with the Proposed Action alone would not change under Alternatives D, E, and F. Alternative D would reduce the number of WTGs compared to the Proposed Action in the northern Lease Area but would have similar overall impacts on birds. Alternative E would reduce impacts on diving birds due to underwater noise under Alternatives E-2 and E-3 but, along with Alternative F, would have the same WTG number and overall Wind Farm Area footprint as the Proposed Action and, therefore, would have similar impacts on birds.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts on birds associated with Alternatives D, E, and F would be similar to the Proposed Action and result in **moderate** adverse impacts and may include **moderate beneficial** impacts.

3.5.3.8 Proposed Mitigation Measures

The following mitigation measures are proposed to minimize impacts on birds (Appendix G, Table G-2). If the measures analyzed below are adopted by BOEM, some adverse impacts on birds could be further reduced.

If the reported post-construction bird monitoring results (generated as part Mayflower Wind’s bird and bat Post-Construction Monitoring Plan [COP Volume 2, Table 16-1; Mayflower Wind 2022]) indicate bird impacts deviate substantially from the impact analysis included in this EIS, then Mayflower Wind must make recommendations for new mitigation measures or monitoring methods. In addition, an Annual Bird and Bat Mortality Report would be required. Mayflower Wind must submit an annual report covering each calendar year, due by January 31 of the following year, documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning.

3.5 Biological Resources

3.5.4 Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the Proposed Action, alternatives, and ongoing and planned activities in the coastal habitat and fauna geographic analysis area. Coastal habitat includes flora and fauna within state waters (which extend 3 nautical miles [5.6 kilometers] from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The coastal habitat and fauna geographic analysis area, as shown in Figure 3.5.4-1, includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the offshore export cable corridors, the landfall locations under consideration, the overhead transmission lines, underground transmission lines, substation, converter station, and points of interconnection in Falmouth, Massachusetts, and at Brayton Point, in Somerset, Massachusetts.

This section analyzes the affected environment and environmental consequences of the Proposed Action and alternatives on coastal flora and fauna, including special-status species. The affected environment and environmental consequences of Project activities that are in the geographic analysis area and extend into state waters (i.e., HDD for cable landfalls and cable laying within 1.0 mile [1.6 kilometers] of cable landfalls) are presented in Sections 3.5.2, *Benthic Resources*; 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.5.6, *Marine Mammals*; 3.5.7, *Sea Turtles*; and 3.4.2, *Water Quality*. Additional information on birds, bats, and wetlands is presented in Section 3.5.3, *Birds*; Section 3.5.1, *Bats*; and Section 3.5.8, *Wetlands*, respectively, and will not be addressed in this section.

3.5.4.1 Description of the Affected Environment and Future Baseline Conditions

This section describes vegetation communities and associated fauna in the upland portions of the geographic analysis area and includes information on special-status species and habitats in the onshore geographic analysis area. Vegetation communities occurring in wetlands are described in Section 3.5.8, *Wetlands*, while aquatic vegetation and estuarine habitats are described in Section 3.5.2, *Benthic Resources*.

The geographic analysis area encompasses the Falmouth and Brayton Point Onshore Project areas. The Falmouth Onshore Project area falls in the Cape Cod Coastal Lowland and Islands Ecoregion of the Atlantic Coastal Pine Barrens (Griffith et al. 2009). The Brayton Point Onshore Project area is in the Narragansett-Bristol Lowland and Island Ecoregion of the Northeastern Coastal Zone (Griffith et al. 2009; Swain 2020).

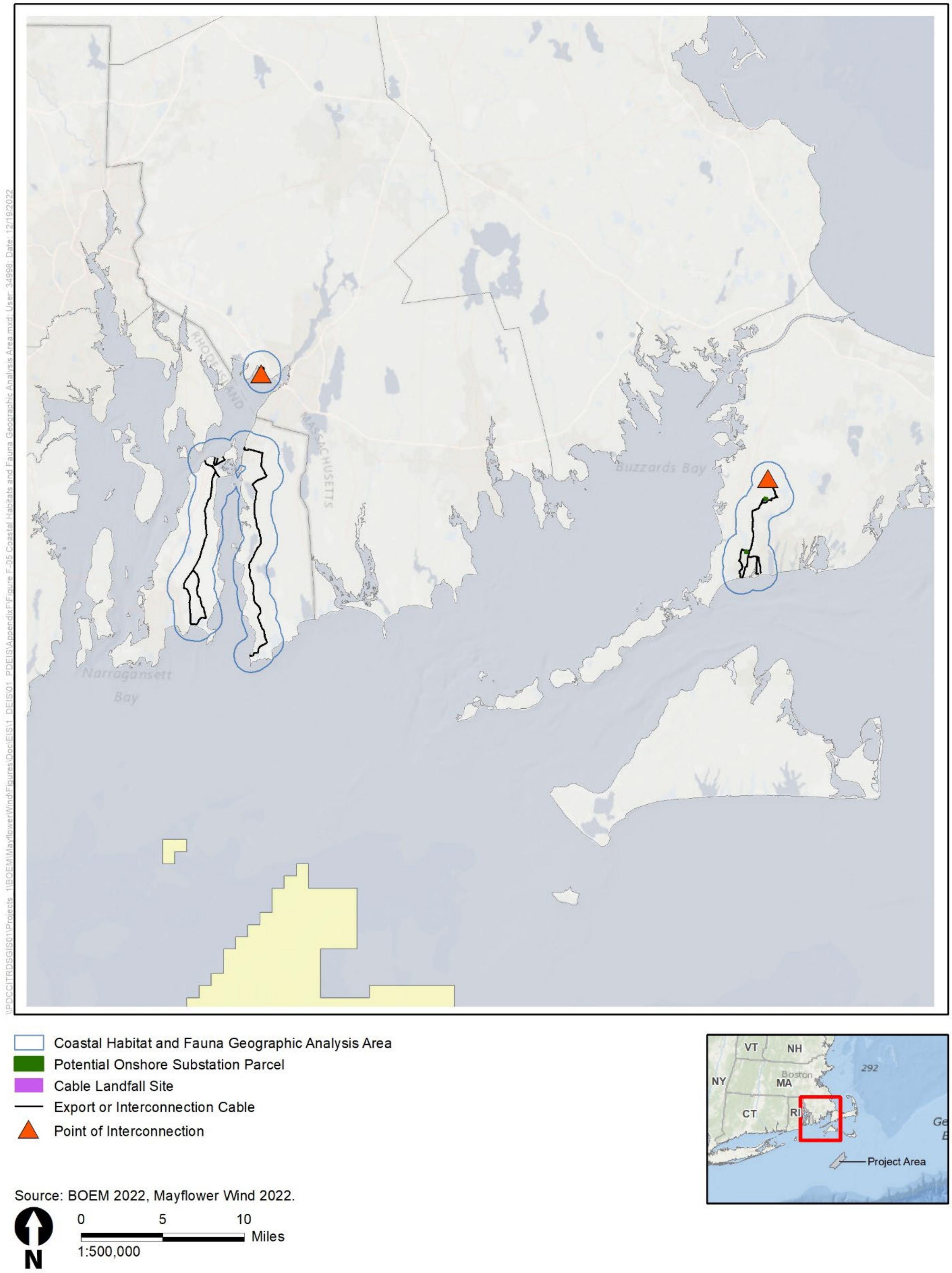

Figure 3.5.4-1. Coastal Habitat and Fauna geographic analysis area

Cape Cod Coastal Lowland and Island Ecoregion (Falmouth Onshore Project Area): Characteristics of the Cape Cod Coastal Lowland and Island Ecoregion include terminal moraines and outwash plains left by receding glaciers that include habitats such as forests, wetlands, grasslands, scrub-shrub, and fragmented vegetated areas. Most of the land in the Falmouth Onshore Project area is disturbed or developed, with portions of relatively undisturbed land. Desktop studies, wetland delineations, and windshield surveys are summarized in COP, Appendix J (Mayflower Wind 2022). The most likely species to occur in the area include 8 mammals, 11 birds, 6 reptiles, 7 amphibians, and 6 fish species (Mayflower Wind 2022). Forest and open woodlots serve as the primary habitat for many mammal species, such as Virginia opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), Eastern coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), and white-tailed deer (*Odocoileus virginianus*). Meadow vole (*Microtus pennsylvanicus*) and white-footed mouse (*Peromyscus leucopus*) use the grasslands (Mayflower Wind 2022). Forests are also used by many bird species: dark-eyed junco (*Junco hyemalis*), blue jay (*Cyanocitta cristata*), and black-capped chickadee (*Poecile atricapillus*). Open woodlots are used by the American robin (*Turdus migratorius*), American crow (*Corvus brachyrhynchos*), mourning dove (*Zenaida macroura*), American goldfinch (*Spinus tristis*), and chipping sparrow (*Spizella passerine*). Ponds, lakes, and wetland are where the red-winged blackbird (*Agelaius phoeniceus*) and the swallow (*Tachycineta bicolor*) are found. The European starling (*Sturnus vulgaris*) is found in developed areas and is an invasive species throughout the United States (Homan et al. 2017). Birds are discussed further in Section 3.5.3, *Birds*.

Many species of reptiles, amphibians, and perennial freshwater fish reside in and around ponds and lakes: painted turtle (*Chrysemys picta)*, spotted turtle (*Clemmys guttata*), spring peeper (*Pseudacris crucifer*), American bullfrog (*Lithobates catesbeianus*), yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) (Mayflower Wind 2022). Wetlands provide habitat for other reptiles, amphibians, and freshwater fish species: grey treefrog (*Hyla versicolor*), green frog (*Rana clamitans*), spotted salamander (*Ambystoma maculatum*), Eastern red-backed salamander (*Plethodon cinereus*), Eastern ribbon snake (*Thamnophis sauritus*), and Northern water snake (*Nerodia sipedon*). The Northern ring-necked snake (*Diadophis punctatus*), black racer (*Coluber contrictor*), and fowler’s toad (*Anaxyrus fowleri*) inhabit open woodlots.

Narragansett-Bristol Lowland and Islands Ecoregion (Brayton Point Onshore Project Area): The Narragansett-Bristol Lowland and Islands Ecoregion is relatively flat with gently rolling irregular plains. This ecoregion contains many wetlands, low-gradient streams, and oak and oak-pine forests with combinations of central hardwood species (Swain 2020). Similar species to those found in the Falmouth Onshore Project area are expected to occur in the Project area for the Brayton Point landfall site and export cable routes and substation, in Somerset, Massachusetts. Many migratory birds visit Narraganset Bay in the spring and fall. A significant population of waterfowl are found in the Lee and Cole Rivers IBA, directly adjacent to the Brayton Point landfall site. Other avian species expected to be present include those that inhabit coastal terrestrial habitats, like shore birds, wading birds, raptors, gulls, and seaducks (Mayflower Wind 2022) and are discussed in Section 3.5.3, *Birds*.

The intermediate landfall site on Aquidneck Island is highly urbanized and, therefore, the species inhabiting that environment have likely adapted to living in urban environments.

The onshore cable routes under Alternative C-1, which traverses Aquidneck Island for approximately 12 miles (19 kilometers), and Alternative C-2, which extends for nearly 16 miles (26 kilometers) through Little Compton and Tiverton, also occur in the Narragansett-Bristol Lowland and Islands Ecoregion. Species inhabiting these areas would be similar to those described for the other Brayton Point Onshore Project facilities.

Coastal Flora Special-Status Species and Habitats

Protected terrestrial species identified by the United States Fish and Wildlife Service (USFWS), Natural Heritage & Endangered Species Program (NHESP), and RIDEM as potentially occurring in the vicinity of the Project area are provided in this section. The MESA also offers further protection for the state-listed species. The USFWS IPaC tool (USFWS 2022) and MassWildlife (NHESP data (MassWildlife 2022) were used to determine the potential presence of special-status floral species in the geographic analysis area. Personal communications with NHESP were used to confirm the online data include the most recent list of state-protected species (Maier 2022). Additionally, personal communications with RIDEM were used to provide information on protected species in Rhode Island (Jordan 2022). Table 3.5.4-1 provides all threatened or endangered species, besides birds and bats, that may potentially occur in the geographic analysis area.

There are two federally listed plant species that may occur in the geographic analysis area: American chaffseed (*Schwalbea american*) and sandplain gerardia (*Agalinis acuta*). American chaffseed is an herbaceous perennial found on the sandy glacial outwash plains in nutrient-poor coils and are often observed with the sandplain gerardia. It is a fire-dependent species and requires open habitats often shaded out by rapidly growing pitch pines and invasives (MassWildlife 2020a). It reaches heights of 12 to 18 inches (30.5–46 centimeters) and blooms in early July. Though it was last observed on Cape Cod in 1965, a population was found in Barnstable County in 2018 (MassWildlife 2020a). Sandplain gerardia is an annual species that averages 4 to 8 inches (10–20 centimeters) but can reach heights up to 16 inches (41 centimeters; MassWildlife 2020b). It grows in dry, sandy soils along roadsides and grasslands and pine-oak forests often where lichens are present Flowering occurs from late August through later September, and the blooms only last a single day (MassWildlife 2020b). The shortnose sturgeon (*Acipenser brevirostrum*) is also listed as federally endangered and may occur in the Onshore Project area. Shortnose sturgeon is an anadromous fish that mainly lives in large freshwater rivers and coastal estuaries. Impacts on shortnose sturgeon are addressed in Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*.

Table 3.5.4-1. Federally and state-listed endangered and threatened species that may potentially occur in the geographic analysis area

Common Name	Scientific Name	Federal Status [a]	MESA Status [b]	RIDEM Status [c]
Amphibians				
Eastern spadefoot	*Scaphiopus holbrookii*	--	T	--
Fish				
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	--
Invertebrates				
Melsheimer's sack bearer	*Cicinnus melsheimeri*	--	T	--
Collared cycnia	*Cycnia collaris*	--	T	--
The pink streak	*Dargida rubripennis*	--	T	--
Imperial moth	*Eacles imperialis*	--	T	--
Scarlet bluet	*Enallagma pictum*	--	T	--
Pine barrens bluet	*Enallagma recurvatum*	--	T	--
Agassiz's clam shrimp	*Eulimnadia agassizii*	--	E	--
Water-willow borer Moth	*Papaipema sulphurata*	--	T	--
Salt marsh tiger beetle	*Ellipsoptera marginata*	--	--	T
Plants				
American chaffseed	*Schwalbea american*	E	--	--
Sandplain gerardia	*Agalinis acuta*	E	E	--
Purple needlegrass	*Aristida purpurascens*	--	T	--
Purple milkweed	*Asclepias purpurascens*	--	E	--
Whorled milkweed	*Asclepias verticillata*	--	T	--
Mattamuskeet rosette-grass	*Dichanthelium mattamuskeetense*	--	E	--
Purple cudweed	*Gamochaeta purpurea*	--	E	--
Saltpond pennywort	*Hydrocotyle verticillata*	--	T	--
Saltpond grass	*Leptochloa fusca* ssp. *fascicularis*	--	T	--
Stiff yellow flax	*Linum medium* var. *texanum*	--	T	--
Dwarf bulrush	*Lipocarpha micrantha*	--	T	--
Adder's tongue fern	*Ophioglossum pusillum*	--	T	--
Eastern prickly pear	*Opuntia humifusa*	--	E	--
Short-beaked beaksedge	*Rhynchospora nitens*	--	T	--
Papillose nut sedge	*Scleria pauciflora*	--	E	--
Grass-leaved ladies'-tresses	*Spiranthes vernalis*	--	T	--
Resupinate bladderwort	*Utricularia resupinata*	--	T	--

[a] USFWS 2022.
[b] MassWildlife 2022.
[c] Jordan 2022.
E= Endangered, T= Threatened

Falmouth Onshore Project Area

Six state-listed endangered plant species may occur in the Falmouth Onshore Project area (Table 3.5.4-1). Examples include the purple milkweed (*Asclepias purpurascens*), papillose nutsedge (*Scleria pauciflora*), and prickly pear (*Opuntia humifusa*). Purple milkweed is found in shrub thickets, open woodlands, pine oak forests, roadsides, and dry fields. They can also be found occasionally in wetlands (Native Plant Trust 2022a). Papillose nutsedge can be found in wetland and non-wetland environments. Prickly pear is the only native cactus in New England and is found on sandy coastal beaches, dunes, grasslands, meadows, and ridges (Native Plant Trust 2022c).

Ten plant species are state listed as threatened and may occur in the Falmouth Onshore Project area (Table 3.5.4-1). Examples include the saltpond pennywort (*Hydrocotyle verticillata*) found along the margins of ponds or in wetland marshes and meadows. The short-beaked bald-sedge (*Rhynchospora nitens*) remains dormant on the banks of sandy or muddy rivers and lakes until water levels are unusually low (Native Plant Trust 2022d), while resupinate bladderwort (*Utricularia resupinate*) is found submerged in shallow water of lakes and ponds (Native Plant Trust 2022e). Adder's tongue fern (*Ophioglossum pusillum*) inhabit marshes and meadows. Saltpond grass (*Leptochloa fusca* ssp. *fascicularis*) does not have a classified wetland status and can inhabit disturbed areas, as well as beaches and marshes (Native Plant Trust 2022b).

Plant species of special concern in the Falmouth Onshore Project area include Wright's rosette-grass (*Dichanthelium wrightianum*), redroot (*Lachnanthes caroliniana*), New England blazing star (*Liatris novae-angliae*), pinnate water-milfoil (*Myriophyllum pinnatum*), pondshore smartweed (*Persicaria puritanorum*), sea-beach knotweed (*Polygonum glaucum*), long-beaked beaksedge (*Rhynchospora scirpoides*), Plymouth gentian (*Sabatia kennedyana*), teretea arrowhead (*Sagittaria teres*), and bristly foxtail (*Setaria parviflora*).

Brayton Point Onshore Project Area

There are no state-listed plant species, or species of special concern that occur in the Brayton Point Onshore Project area, specifically in the area of the intermediate landfall in Aquidneck Island (Jordan 2022).

Coastal Fauna Special-Status Species

Falmouth Onshore Project Area

The USFWS IPaC database did not identify any federally listed threatened or endangered faunal species (non-bird or bat) under the jurisdiction of USFWS in the geographic analysis area; however, the monarch butterfly (*Danaus plexippus*) has a candidate species status (USFWS 2022).

There are no state-listed endangered or threatened reptile species that occur in the Falmouth Onshore Project area (MassWildlife 2022; Maier 2022). Eastern spadefoot (*Scaphiopus holbrookii* – state listed as threatened) is the only listed amphibian potentially occurring in the Falmouth Onshore Project area (Table 3.5.4-1); the species is found burrowing in dry sandy, loamy soils associated with pitch pine barrens, coastal oak woodlands, and sparse shrubs with vernal pools and leaf litter (MassWildlife 2015). Shortnose sturgeon (*Acipenser brevirostrum*) is the only fish species listed as endangered under MESA. Eight state-listed invertebrate species may also potentially occur in the Falmouth Onshore Project area, with Agassiz's clam shrimp (*Eulimnadia agassizii*) being the only state-endangered species listed (Table 3.5.4-1). The other seven invertebrate species—Melsheimer's sack-bearer (*Cicinnus melsheimeri*), collared cycnia (*Cycnia collaris*), pink-streak (*Dargida rubripennis*), imperial moth (*Eacles imperialis*), scarlet bluet (*Enallagma pictum*), pine barrens bluet (*Enallagma recurvatum*), and water-willow stem borer moth (*Papaipema sulphurate*)—are listed as threatened.

Species of special concern in the Falmouth Onshore Project area include Eastern box turtle (*Terrapene Carolina*), Eastern hog-nosed snake (*Heterodon platirhinos*), bridle shiner (*Notropis bifrenatus*), coastal heathland cutworm (*Abargrotis nefascia*), frosted elfin (*Callophrys irus*), Herodias underwing moth (*Catocala herodias*), purple tiger beetle (*Cicindela purpurea*), chain dot geometer (*Cingilia catenaria*), buck moth (*Hemileuca maia*), tidewater mucket (*Leptodea ochracea*), American clam shrimp (*Limnadia lenticularis*), pink sallow moth (*Psectraglaea carnosa*), pine barrens speranza (*Speranza exonerate*), and pine barrens zale (*Zale lunifera*).

Brayton Point Onshore Project Area

The Brayton Point Onshore Project area includes Aquidneck Island as well as Little Compton, and Tiverton (as part of Alternative C) in Rhode Island and Brayton Point in Massachusetts. The USFWS IPaC database did not identify any federally listed threatened or endangered faunal species (non-bird or bat) under the jurisdiction of USFWS in the Brayton Point Onshore Project area; however, the monarch butterfly (*Danaus plexippus*) has a candidate species status (USFWS 2022).

The only state-listed species that may occur in the Rhode Island section is the salt marsh tiger beetle (*Ellipsoptera marginata*), listed as threatened (Jordan 2022). Adult tiger beetles emerge in the fall to feed until the cold winter months. They burrow underground until the spring when they emerge to feed, mate and lay eggs, burrow underground, and hibernate the winter. Habitat loss, disturbance, sea-level rise, and tidal erosion all pose threats for these beetles (Mayflower Wind 2022).

Terrestrial Habitats and Wildlife

Falmouth Onshore Project Area

The Falmouth Onshore Project area consists of three landfall sites, onshore export cable routes, and two potential substation sites. Most of the Onshore Project area is highly developed with areas of dense residential, commercial and industrial development, although there are areas of open space and rural residential development that provide higher quality habitat. COP Volume 2, Section 6.3.1.1.2, Figure 6-7 shows the land use in the Falmouth Onshore Project area (Mayflower Wind 2022). Only species adapted to urban environments are anticipated to be in the Falmouth Onshore Project area.

The three landfall sites considered—Central Park, Shore Street, and Worcester Avenue—consist of coastal beach community habitat adjacent to developed areas. The Worcester Avenue and Central Park landfall locations are of low ecological value, largely consisting of mowed lawns and other areas common to human disturbance and presence. The Shore Road landfall location is largely developed and devoid of natural communities (Mayflower Wind 2022).

From the coastline, the Falmouth onshore export cable routes would traverse mostly developed areas of Falmouth, Massachusetts. Natural communities present along the Falmouth onshore export cable routes and underground transmission route include bare land, deciduous forest, developed open space, evergreen forest, grassland, impervious, wetlands, scrub/shrub, and unconsolidated shore. Some export cable route segments would traverse natural pockets of undisturbed environments. Species that thrive in edge environments are likely to be found in these areas (COP, Appendix J; Mayflower Wind 2022).

The two sites being considered for the onshore substation, the Lawrence Lynch site and the Cape Cod Aggregates site, primarily consist of disturbed and developed land currently used for sand and gravel mining and processing. At the Lawrence Lynch site, there are several constructed stormwater ponds on the site but these features are not considered a valuable resource for wildlife, fish, or other aquatic life due to their highly altered nature and function as a stormwater management facility (COP, Appendix J; Mayflower Wind 2022).

Brayton Point Onshore Project Area

The Brayton Point Onshore Project area consists of several potential landfall sites, onshore export cable routes, and a converter station. The Brayton Point Onshore Project area is situated in an ecoregion that is relatively flat with most elevations under 200 feet (61 meters) (Griffith et al. 2009). Terrestrial habitats for wildlife in the Onshore Project areas and the immediate vicinity of the proposed Project include forested land, disturbed or developed land, wetland areas, grasslands, scrub-shrub areas, fragmented vegetated habitats, and coastal habitats. These habitats are predominately composed of disturbed or developed lands (Mayflower Wind 2022).

Intermediate Landfalls and Export Cable Routes

The natural communities at the intermediate landfalls and along the export cable routes on Aquidneck Island include developed land, developed recreation, impervious surfaces, and wetlands (Mayflower Wind 2022).

The onshore export cable route under Alternative C-1 would make landfall at the southern end of Aquidneck Island and then traverse the island for approximately 12 miles (19 kilometers). Terrestrial habitats along the export cable route are mainly developed or agricultural lands. Other natural communities include deciduous forest, brushland, mixed forest, and wetlands. The onshore export cable route under Alternative C-2 would pass through Little Compton and Tiverton, Rhode Island for approximately 16 miles (26 kilometers). Terrestrial habitats along the route include developed or agricultural lands, with some deciduous forest, brushland, and wetlands.

Brayton Point Landfall, Export Cable Routes, and Converter Station

Two landfall sites were investigated and are being considered at Brayton Point: Western, from the Lee River on the western side of Brayton Point, and Eastern from the Taunton River on the eastern side of

Brayton Point. Both landfall locations are generally devoid of natural communities as they consist of roads and former industrial facilities (Mayflower Wind 2022). The proposed onshore export cable route would be installed within and below existing developed land to the HVDC converter station. The converter station at Brayton Point would be constructed at the former Brayton Point Power Station in Somerset, Massachusetts (Mayflower Wind 2022). The site is largely developed with limited habitat resources available.

3.5.4.2 Impact Level Definitions for Coastal Habitat and Fauna

Impact level definitions for coastal habitat and fauna are provided in Table 3.5.4-2.

Table 3.5.4-2. Definitions of impact levels for coastal habitat and fauna

Impact Level	Type of Impact	Definition
Negligible	Adverse	No effect or no measurable impact on coastal habitats or fauna.
Minor	Adverse	Impacts from which coastal habitats or fauna would recover completely without mitigating action.
Moderate	Adverse	Notable and measurable impacts from which coastal habitats or fauna would recover completely with mitigating action.
Major	Adverse	Regional or population-level impacts from which coastal habitats or fauna would not recover.

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

When analyzing the impacts of the No Action Alternative on coastal habitat and fauna, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for coastal habitat and fauna. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for coastal habitat and fauna Section 3.5.4.1, *Description of the Affected Environment and Future Baseline Conditions* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on coastal habitat and fauna are generally associated with onshore impacts, including onshore coastal development (e.g., residential, commercial, industrial) and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect coastal flora and fauna through temporary and permanent habitat removal or conversion, temporary noise impacts during construction, and lighting, which could cause avoidance behavior and displacement of animals, as well as injury or mortality to individual animals or loss and alteration of vegetation and individual plants. However, population-level effects would not be anticipated. Ongoing climate change can increase storm frequency and severity, disturbing the established coastal community. Sea-level rise has also resulted in habitat loss due to coastal flooding and rising water tables (Sacatelli et al. 2020). The wetlands, dunes, and beaches are inherently vulnerable and erode in the storms, creating moving shorelines that fluctuate seasonally (USEPA 2016). Climate change may also affect coastal habitats through the earlier arrival of spring bringing more precipitation, heavier rainstorms, and summer temperatures that are hotter and drier (USEPA 2016). These shifting rainfall patterns increase the intensity of both floods and droughts, which may affect populations of terrestrial and coastal plants and animals. For instance, vernal pools, such as those found in the Falmouth Onshore Project area, are typically filled with water in the fall or winter due to rainfall and seasonal high groundwater levels and remain ponded through the spring and into summer. However, often vernal pools dry up completely by the middle or end of the summer, or at least every few years, preventing fish populations from becoming established in the pool. Invasive species emerge earlier in the year, expand their range into new ecosystems, become more competitive, and can take advantage of the already stressed species more effectively as a result of higher concentrations of carbon dioxide from warming temperatures (Beaury et al. 2020). The increase of deer populations from these warmer temperatures earlier in the year leads to the loss of forest underbrush, leaving other species more vulnerable (USEPA 2016). The effects of climate change on other animals will likely include loss of habitat (Sacatelli et al. 2020), population declines, increased risk of extinction, decreased reproductive productivity, and changes in species distribution.

There are no ongoing offshore wind activities in the geographic analysis area for coastal habitat and fauna.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with the other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect coastal habitat and fauna primarily include increasing onshore development activities (see Appendix D, Section D.2, for a description of planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on animals and vegetation, including disturbance, displacement, injury, mortality, habitat and plant degradation and loss, and habitat conversion.

Within the Massachusetts and Rhode Island lease areas, there are several approved and proposed offshore wind projects adjacent to the Mayflower Wind Lease Area. However, at this time BOEM is not aware of any onshore components of other offshore wind projects that would co-occur or overlap with the geographic analysis area for coastal habitat and fauna for the Proposed Action. If any offshore wind activities are identified that would occur in the geographic analysis area, impacts would be similar to those under the Proposed Action, and any adverse impacts on coastal habitats and fauna would be minimal.

BOEM expects other offshore wind activities (without the Proposed Action) to affect coastal habitat and fauna through the following primary IPFs.

Noise: Onshore noise associated with intermittent construction of required offshore wind development infrastructure may result in localized and temporary impacts on coastal fauna, including avoidance and displacement, although no individual fitness or population-level effects would be expected to occur. Displaced wildlife could use adjacent habitats and would repopulate these areas once construction ceases. Onshore construction noise associated with other offshore wind activities (without the Proposed Action) is expected to result in temporary, localized, and negligible impacts.

Land disturbance: Onshore construction of offshore wind development infrastructure has the potential to result in some impacts due to habitat loss or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities. Furthermore, construction would be expected to generally occur in previously disturbed habitats, and no individual fitness- or population-level impacts on coastal habitat and fauna would be expected to occur. As such, onshore construction impacts associated with offshore wind development (without the Proposed Action) would be minor, short-term, and would not be expected to appreciably contribute to overall impacts on coastal habitat and fauna.

Presence of structures: Additional structures and cables that are anticipated to be constructed in association with future offshore wind activities would not be expected to affect coastal fauna at the individual or population level considering the anticipated placement of most onshore wind components in developed areas. Impacts would be long-term but negligible.

Traffic: If the use of construction equipment or vehicles from other offshore wind developments overlapped the geographic analysis area, collisions with coastal wildlife could occur. However, those collisions are expected to be rare because most of the wildlife are expected to avoid construction areas or have the mobility to avoid construction equipment. Therefore, impacts on coastal fauna from traffic resulting from other offshore wind developments (without the Proposed Action) would be expected to be short-term, temporary during the construction period, and negligible.

Impacts of Alternative A on ESA-Listed Species

Two ESA-listed plant species occur or potentially occur in the geographic analysis area. Any future federal or private activities that could affect federally listed species in the geographic analysis area would need to comply with ESA Section 7 or Section 10, respectively, to ensure that the proposed activities would not jeopardize the continued existence of the species.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, coastal habitats and fauna would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, habitat loss, displacement, injury, and mortality) on coastal habitat and fauna, primarily through onshore coastal construction and climate change. BOEM anticipates that the potential impacts of ongoing construction activities on coastal habitat and fauna would be minor, but impacts from climate change could be moderate. Therefore, the No Action Alternative would result in **moderate** impacts on coastal habitats, primarily driven by climate change.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and coastal habitat and fauna would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on coastal habitat and fauna through construction-related activities that affect habitat, vegetation, and wildlife. Currently, there are no future offshore wind activities proposed in the geographic analysis area. If any were to occur, they would have some potential to result in temporary disturbance and permanent loss of onshore habitat. However, habitat removal is anticipated to be minimal due to the developed and urbanized landscape of the geographic analysis area. Any impacts resulting from habitat loss or disturbance would not be expected to result in population-level effects on species in the geographic analysis area. BOEM anticipates the cumulative impacts of the No Action Alternative would be **moderate**, primarily driven by ongoing construction activities and climate change.

3.5.4.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on coastal habitat and fauna.

- The onshore export cable routes, including routing variants, and extent of land disturbance for new onshore substations, which could require the removal of vegetation.

Variability of the proposed Project design exists as outlined in Appendix C. The following summarizes potential variances in impacts.

- Onshore export cable routes and substation footprints: The route chosen (including variations of the general route) and substation footprints would determine the amount of habitat affected.

Mayflower Wind has committed to measures to minimize impacts on coastal habitat and fauna, including avoiding areas of unique or protected habitat or known habitat for threatened or endangered and candidate species to the extent practicable and conducting maintenance and repair activities in a manner to avoid or minimize impacts on sensitive species and habitat. Onshore export cables would be buried beneath existing roadways and Mayflower Wind would implement construction best management practices such as erosion and sediment control measures where needed. Mayflower Wind would train construction staff on biodiversity management and environmental compliance requirements and implement a Vegetation Management Plan (COP Volume 2, Section 16, Table 16-1; Mayflower Wind 2022).

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

The following summarizes the potential impacts of the Proposed Action on coastal habitat and fauna and special-status species during the various phases of the Project. Routine activities would include construction, O&M, and decommissioning of the Project, as described in Chapter 2, *Alternatives*.

Noise: Construction noise is anticipated at the landfall sites (primarily associated with HDD activities), along the onshore export cable routes, and at substation and converter station locations. Impacts, if any, are expected to be limited to behavioral avoidance of construction activity and noise. Construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise. Displaced individuals would likely return to the affected areas once the noise has ended, and BOEM anticipates temporary and negligible impacts from construction noise. Normal operation of the substation and converter station would generate continuous noise. Terrestrial fauna may habituate to noise so that it has little to no effect on their behavior or biology (Kight and Swaddle 2011). For this reason, BOEM expects minimal impacts on coastal fauna from onshore O&M, especially given that terrestrial fauna in this area is likely to be already subject and habituated to anthropogenic noise from other nearby sources in the developed landscape surrounding the substation and converter station locations. Onshore O&M noise is expected to result in long-term, localized, and minor impacts.

Land disturbance: Construction of the onshore export cables, substation, and converter station at Falmouth and Brayton Point would result in land disturbance of various coastal vegetation communities, which are quantified in COP, Appendix J, Table 4-1 and Table 4-2 (Mayflower Wind 2022). Impacts on habitat from onshore construction activities would be limited because facilities would be located mostly in existing developed areas. The onshore Project components are sited in existing paved areas, public road ROW, and developed industrial areas to the maximum extent practicable.

In the Falmouth Onshore Project area, offshore export cables would make landfall in Falmouth and connect to one of two substation sites. None of the onshore export cable routes would affect substantial areas of natural habitat or vegetation communities. The onshore cable routes would be installed to the greatest extent feasible in the disturbed road ROW, with the result that most impacts on natural communities would be avoided. Tree and vegetation clearing would be less than 0.5 acre (0.2 hectare) for each of the onshore export cables route options (COP Volume 2, Section 6.3.1.1.2; Mayflower Wind 2022). The maximum footprint of the substation would be up to 26 acres (10.5 hectares), mostly comprised of disturbed land that provides minimal habitat value.

Depending on the specific landfalls, cable routes, and substation sites selected, there would be between 43 and 151 acres (17 and 61 hectares) of natural communities in the Falmouth Onshore Project area with the potential to be affected by construction, operation, and decommissioning activities of the

Proposed Action (COP, Appendix J, Table 4-1; Mayflower Wind 2022). Of these affected areas, 76 percent and 52 percent, respectively, consist of impervious surface, bare land, and developed open space, where there would be no to minimal vegetation affected. The remaining 10 to 72 acres (4 to 29 hectares) of affected vegetation communities include coastal beach, unconsolidated shore, deciduous forest, wetlands, scrub, evergreen forest, grasslands, water, and wetlands, depending on the specific Project component. It is anticipated that direct effects on sensitive environmental resources, such as wetlands, would be avoided to the maximum extent practicable during the detailed design and construction of the Project. As such, the area of natural community types ultimately altered by the route is anticipated to be less than the acreages identified above (COP, Appendix J; Mayflower Wind 2022).

Within the Brayton Point export cable corridor, export cables would come ashore for the intermediate landfall on Aquidneck Island. HDD would be used to enter and exit Aquidneck Island to avoid potential impacts on nearby tidal zones, eelgrass zones, coastal dunes, and public beaches. A 3-mile (4.8-kilometer) underground onshore export cable, using one of three potential routes, would cross the island using existing roadways where feasible, which would minimize the potential impacts on vegetation communities. At Brayton Point, the export cables would connect to the 7.5-acre site of the HVDC converter station, which is mostly comprised of developed and disturbed land with minimal habitat value.

Depending on the routes selected, there would be between 62 and 69 acres (25 and 28 hectares) of natural communities within the Brayton Point Onshore Project area with the potential to be affected by construction, O&M, and decommissioning activities of the Proposed Action (COP, Appendix J, Table 4-2; Mayflower Wind 2022). Of the total 69 acres, approximately 84 percent consists of impervious surface, bare/vacant land, and developed open space, where there would be no to minimal vegetation affected. The remaining 11 acres (4 hectares) of affected vegetation communities include beaches, deciduous forest, scrub/shrub, and grassland, depending on the specific Project component.

To limit land disturbance whenever possible, Mayflower Wind would co-locate facilities and onshore export cables with existing developed areas (i.e., roads and existing transmission ROWs). By using the HDD to transition onshore, the impacts on beaches and nearshore vegetated natural habitats would be avoided for all options. Due to the very small area needed for HDD operations, compared to the amount of suitable habitat available in Falmouth and in the vicinity of Brayton Point, species in the area are not expected to be meaningfully affected by the short-term and temporary construction activity. Some previously disturbed areas of maintained roadside vegetation may be affected during construction, dependent upon workspace requirements for equipment. Additional ground disturbance and the introduction of new impervious surface would be required at the onshore substation and converter station sites.

Mayflower Wind has committed to implementing various measures to avoid and minimize impacts on coastal habitat and fauna. These including contacting appropriate federal or state agencies should tree clearing be required, implementing a Vegetation Management Plan and installing sediment erosion controls near waterbodies to minimize impacts on these resources, and training construction staff on biodiversity management and environmental compliance requirements. To the greatest extent practicable, construction would take place away from significant fish and wildlife habitats and during times when highly sensitive species are not likely to be present. Overall, land disturbance under the Proposed Action is anticipated to have short-term and long-term minor impacts on coastal flora and fauna habitats.

Presence of structures: Because most of the area where onshore Project components would be constructed and operated is developed and urbanized, the wildlife communities are composed of disturbance-tolerant species inhabiting an area with existing structures, cables, and other infrastructure. Export cables would be buried and therefore, following construction and reclamation, would not contribute to impacts on coastal habitat and fauna. Additional structures and cables from the onshore Project components would not alter the characteristics of the existing environment to an extent that would alter wildlife species composition, population sizes, or individual fitness, leading to long-term, negligible impacts.

Traffic: Collisions between wildlife and vehicles or construction equipment would be rare because most wildlife are expected to avoid construction areas or have the mobility to avoid construction equipment. The species likely to be present in the Project area are also acclimated to urban environments and are less vulnerable to development and traffic. However, individuals that are not able to move away from disturbed areas (e.g., juveniles in nests) or those that occupy a single tree being removed (e.g., invertebrates) could be more vulnerable to this impact, particularly during land clearing and ground excavation. To the extent practicable, construction activities would take place outside of periods when highly sensitive species are likely to be present. Mayflower Wind has identified a preliminary list of timing restrictions it would adhere to, including illuminating equipment at night, clearing trees in colder months, and avoiding known raptor nests during nesting periods (COP, Appendix J, Section 5.4.2.4; Mayflower Wind 2022). While these restrictions are intended to minimize impacts on birds and bats, they may also benefit other species. Routine O&M activities are likely to have less potential for direct injury or fatality for wildlife than the construction phase. Mayflower Wind would develop a Vegetation Management Plan and implement best management practices to minimize potential impacts on vegetation communities during construction. In addition, vehicle speed limits would be enforced at all Project sites. Population-level effects are not expected to occur. Impacts would be short term, temporary during the construction period, and negligible.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on coastal habitat and fauna through the primary IPFs of noise, presence of structures, land disturbance, and traffic. The construction, O&M, and decommissioning of onshore infrastructure for the Proposed Action would contribute to impacts primarily associated with temporary disturbance and permanent loss of habitat onshore. BOEM is not aware of any offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna. But if habitat removal is anticipated, it would be minimal and any related impacts would not be expected to result in individual fitness or population-level effects in the geographic analysis area.

The cumulative impact on coastal habitat and fauna would likely be moderate, mostly driven by climate change. The Proposed Action onshore cable routes and substation/converter station sites are located in developed areas where there is limited natural habitat and wildlife is habituated to human activity and noise. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative impacts on coastal habitat and fauna.

Impacts of Alternative B on ESA-Listed Species

Impacts of the Proposed Action on ESA-listed birds, bats, and fish are represented in the IPF text in Section 3.5.3, *Birds*, Section 3.5.1, *Bats*, and Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*. Two ESA-listed plant species occur or potentially occur in the geographic analysis area. BOEM is preparing a BA for the potential effects on USFWS federally listed species. A preliminary draft found that the Proposed Action was *not likely to adversely affect*, or would have *no effect*, on listed species. There are no critical habitats designated for these species in the action area defined in the BA. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing and results of consultation will be presented in the Final EIS.

Conclusions

Impacts of the Proposed Action: Construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have **minor** impacts on coastal habitat and fauna because most potential effects would be localized and short-term and could be minimized with mitigation measures and other best management practices.

Cumulative Impacts of the Proposed Action: BOEM anticipates that the cumulative impacts on coastal habitat and fauna in the geographic analysis area would be **moderate**, mostly driven by climate change. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on coastal habitat and fauna would be undetectable. The Proposed Action would contribute to the cumulative impacts primarily through the permanent impacts from habitat loss from onshore construction.

3.5.4.6 Impacts of Alternative C on Coastal Habitat and Fauna

Impacts of Alternative C: The export cable route to Brayton Point under Alternative C-1 and Alternative C-2 would be rerouted onshore to avoid sensitive fish habitat in the Sakonnet River, which would increase impacts on coastal habitat and fauna compared to the Proposed Action. The Alternative C-1 onshore export cable route would be installed largely within existing road ROWs on Aquidneck Island, increasing the total length of the onshore cable route by approximately 9 miles (14 kilometers). The Alternative C-2 onshore export cable route would be installed largely within existing road ROWs in Little Compton and Tiverton, increasing the total length of the onshore cable route by approximately 13 miles (21 kilometers).

The types of impacts under Alternative C-1 and Alternative C-2 would be similar to those described for the Proposed Action, but slightly greater due to the larger area of land disturbance in coastal habitats. Approximately 68 percent and 56 percent of Alternative C-1 and Alternative C-2, respectively, consist of developed land cover types, with the remaining area consisting of natural vegetation land cover. Table 3.5.4-3 summarizes the vegetation communities within the Alternative C-1 and C-2 onshore export cable routes that could be directly affected by installation of the cables. Alternative C-2 would result in the greatest impact on coastal habitat and fauna because more acres of natural vegetation would be affected than under Alternative C-1. The vegetated areas presented in Table 3.5.4-3 are in addition to the areas affected by the Proposed Action because the export cable routes under this alternative would effectively replace an offshore segment of the Proposed Action's overall export cable route. The onshore cable routes under both Alternative C-1 and Alternative C-2 would be installed within existing road ROWs to the extent feasible; however, the alternate routes may require pathways in road shoulder, median, and off-road, including private property, transmission ROWs, stream/wetland crossings, and railroad ROWs due to the narrower roads lined with historic stonewalls and structures in the southern portions of the alternate routes. Despite this, impacts on coastal habitat and fauna under either alternative would be limited to the immediate vicinity of the roadway where there is already limited habitat.

Table 3.5.4-3. Vegetation potentially affected by Alternatives C-1 and C-2 onshore export cables (acres)

Vegetation Community	Alternative C-1 East	Alternative C-1 West	Alternative C-2
Brushland	1.51	1.07	1.31
Agriculture [a]	8.99	8.84	15.08
Mixed Forest	1.34	0.80	0.31
Softwood Forest	0	0	0.09
Deciduous Forest	3.61	1.79	15.06
Sandy Areas [b]	0.20	0.20	0.51
Wetlands [c]	0.92	3.31	1.27
Total	**16.57**	**16.01**	**33.63**

Source: RIGIS 2011

[a] Agriculture includes cropland (tillable), abandoned fields/orchards, pastures, orchards, groves, and nurseries.

[b] Sandy Areas include beach and non-beach sandy areas. Note, Alternative C-2 does not have any beach sandy areas, and each sandy area for Alternative C-1 would be avoided with HDD.

[c] The wetland areas presented in this table are based on a broad land cover GIS dataset and do not substitute for the more accurate wetlands GIS data used to generate wetland impacts in Section 3.5.8, *Wetlands*.

Cumulative Impacts of Alternative C: The cumulative impacts on coastal habitat and fauna would be moderate for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the cumulative impacts on coastal habitat and fauna would be slightly greater than the Proposed Action but would still represent an undetectable increment.

Impacts of Alternative C on ESA-Listed Species

Impacts on ESA-listed species would be similar to the Proposed Action, with proportionally more land disturbance due to the longer onshore cable component of Alternative C-1 and Alternative C-2 compared to the Proposed Action.

Conclusions

Impacts of Alternative C: Activities associated with the construction, installation, O&M, and eventual decommissioning of Alternative C would have **minor** short-term impacts on coastal habitat and fauna, depending on the location, timing, and species affected by an activity. The primary impacts of Alternative C affecting coastal habitat and fauna would be habitat loss.

Cumulative Impacts of Alternative C: In context of other reasonably foreseeable environmental trends, the cumulative impacts of Alternative C on coastal habitat and fauna would be similar to the Proposed Action and result in a **moderate** impact.

3.5.4.7 Impacts of Alternatives D, E, and F on Coastal Habitat and Fauna

Impacts of Alternatives D, E, and F: Because Alternatives D, E, and F would involve modifications only to offshore components, impacts on coastal habitat and fauna from Alternatives D, E, and F would be the same as those under the Proposed Action.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives D, E, and F would be the same as those described for the Proposed Action.

Impacts of Alternatives D, E, and F on ESA-Listed Species

Impacts on ESA-listed species would be the same as the Proposed Action.

Conclusions

Impacts of Alternatives D, E, and F: As discussed above, the anticipated **minor** impacts under the Proposed Action would not change under Alternatives D, E, and F.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives D, E, and F would be the same as those described for the Proposed Action and result in **moderate** impacts.

3.5.4.8 Proposed Mitigation Measures

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

3.5 Biological Resources

3.5.5 Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH from the proposed Project, alternatives, and ongoing and planned activities in the finfish, invertebrates, and EFH geographic analysis area. The geographic analysis area, as shown on Figure 3.5.5-1., includes the Northeast Continental Shelf Large Marine Ecosystem (LME),[1] which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, likely encompassing the majority of movement ranges for most invertebrates and finfish species. The entirety of the geographic analysis area includes only U.S. waters. Due to the size of the geographic analysis area, the analysis in this EIS focuses on finfish and invertebrates that would be likely to occur in the Project area and be affected by Project activities.

This section provides a qualitative assessment of the impacts of each alternative on finfish, invertebrates, and EFH, which has been designated under the Magnuson-Stevens Fishery Conservation and Management Act as “essential” for the conservation and promotion of specific fish and invertebrate species. A discussion of benthic species is provided in Section 3.5.2, *Benthic Resources*, and a discussion of commercial fisheries and for-hire recreational fishing is provided in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.5.5.1 Description of the Affected Environment and Future Baseline Conditions

Finfish

The geographic analysis area is the LME, which was selected based on the likelihood of capturing the majority of movement range for most finfish species that would be expected to pass through the Project area. This area is large and has very diverse and abundant fish assemblages that can be generally categorized based on life history and preferred habitat associations (e.g., pelagic, demersal, resident, and highly migratory species). In this region, fish distribution is largely influenced by seasonal temperature fluctuation. Various species use the geographic analysis area for feeding, development, reproduction, and nursery habitat (NEFSC 2020).

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

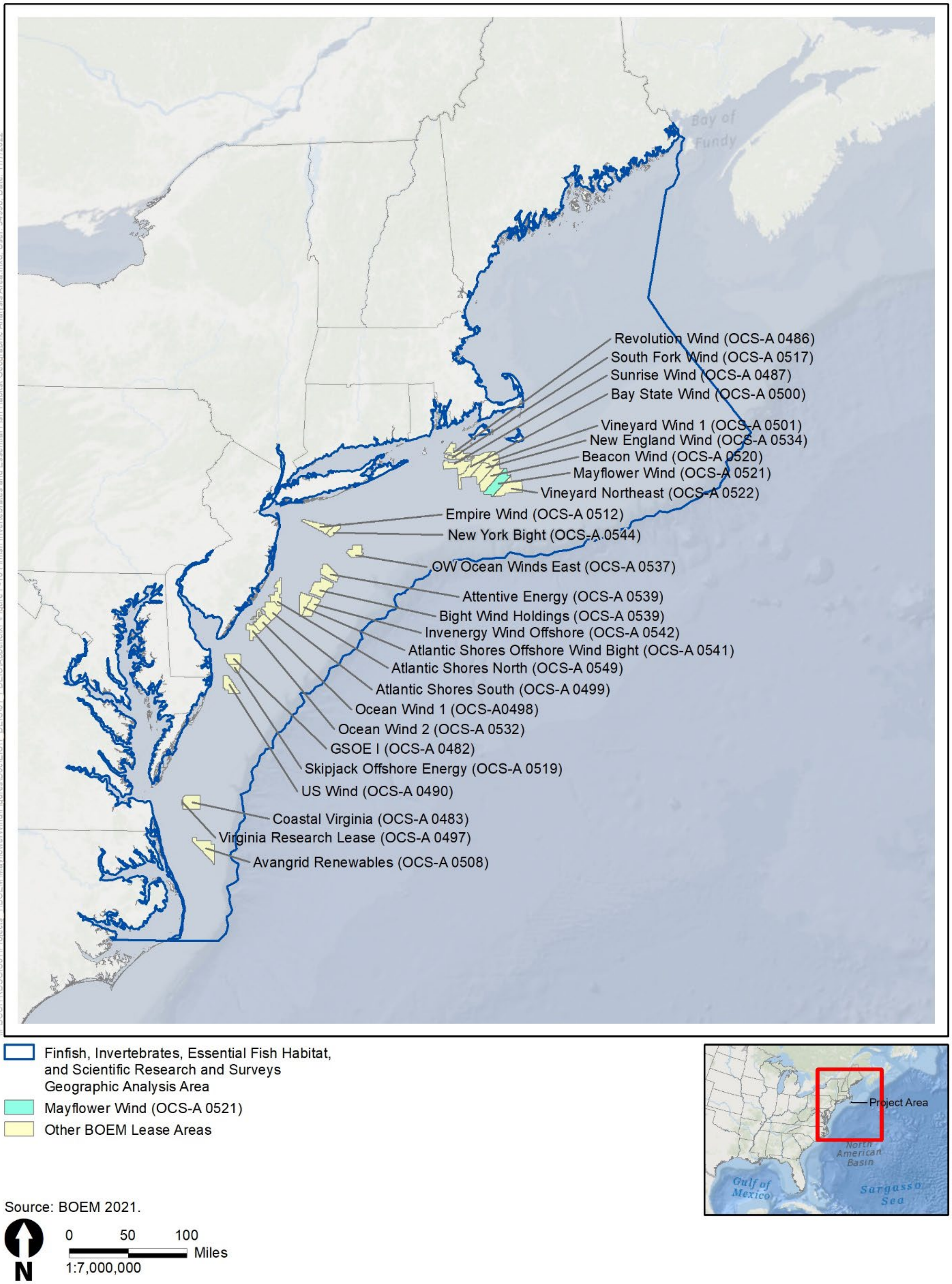

Figure 3.5.5-1. Finfish, invertebrates, and essential fish habitat geographic analysis area

Many species of finfish belonging to pelagic, demersal, shark, resident, or highly migratory assemblages occur in the geographic analysis area, suggesting that these species could potentially occur in or pass through the Project area. Moreover, a number of the species with potential to occur in the Project area have designated EFH either in or in the vicinity of the Project area (COP Appendix N; Mayflower Wind 2022). For a list of species with EFH designations, see Appendix B, *Supplemental Information and Additional Figures and Tables*, of this EIS. In addition to those species with designated EFH, several species of commercial and recreational importance would be expected to occur in the geographic analysis area and Project area, which are discussed in further detail in Section 3.6.1.

Pelagic finfish species spend most of their lives swimming in the water column rather than occurring on or near the seafloor (NEFSC 2020). Pelagic species migrate north and south along the Atlantic Coast, depending on sea surface temperatures. They use the highly productive coastal waters during the summer months for feeding and then move to waters that are deeper, more distant, or both for the remainder of the year. Common species of this assemblage include Atlantic herring and Atlantic mackerel. Coastal pelagic species also rely on coastal wetlands, seagrass habitats, and estuaries to provide habitat for their early life stages. Demersal fish, or groundfish, are finfish species that inhabit benthic or benthopelagic (near-benthic) habitats. Common species of this assemblage include skates, summer flounder, and black sea bass. Many demersal finfish species have either pelagic eggs or larvae that are carried long distances by oceanic surface currents or eggs that adhere to the various benthic substrates. Highly migratory finfish species often migrate from southern portions of the Atlantic Ocean to as far north as the Gulf of Maine and are expected to be present in the Offshore Project area during the warmer summer months. Common species of this assemblage include tunas, sharks, and billfishes. Based on bottom trawl surveys conducted by NMFS NEFSC, the Massachusetts/Rhode Island offshore wind lease areas have low finfish biomass but high species richness when compared to neighboring waters around Cape Cod (COP Volume 2, Section 6.7.2, Figure 6-34 through Figure 6-37; Mayflower Wind 2022).

Finfish species are also characterized as estuarine, marine, or anadromous species. Estuarine species generally reside in nearshore areas where waters have lower salinity levels than ocean waters (e.g., where rivers meet the ocean) and include species such as white perch (*Morone americana*). Marine finfish species are found offshore in deeper waters and utilize the open water column; examples of marine finfish include Atlantic menhaden (*Brevoortia tyrannus*) and Atlantic herring (*Clupea harengus*). Anadromous fish species prefer both nearshore and offshore waters but annually migrate up rivers to lower-salinity environments for spawning. Juvenile anadromous species leave coastal rivers and estuaries to enter the ocean, where they grow to sexual maturity prior to returning to freshwater environments for spawning. Several species of anadromous fish are present in the geographic analysis area and thus could occur in the Project area, including American shad, alewife, and striped bass. In addition to estuarine, marine, and anadromous fish species, the less-common catadromous species, which are fish species that behave in the opposite fashion of anadromous fish, with adults migrating from fresh water to spawn in the sea, such as the American eel (*Anguilla rostrata*), are known to occur in coastal river systems in southern New England and make their way to the Atlantic Ocean to spawn.

BOEM has funded several studies of finfish species occurrence in the northeast wind lease areas, which are summarized by Guida et al. (2017). The Mid-Atlantic Bight region contains some of the most productive fishing areas along the East Coast of the United States, largely due to the diversity and density of finfish that occur in the region (NJDEP 2010). The NMFS, Massachusetts Division of Marine Fisheries, Rhode Island Department of Environmental Management, and Northeast Area Monitoring and Assessment Program all have seasonal trawl surveys that sample finfish in the Project area. Data from these surveys are considered for use in stock assessments of state- and federally managed species. Stock assessments for federally managed species potentially affected by the Project can be found on NMFS' Stock Status, Management, Assessment, and Resource Trends website (NMFS 2022a) and NMFS' NEFSC Stock Assessment Review Index website (NEFSC 2022), and summaries are provided in the EFH Assessment (COP Appendix N; Mayflower Wind 2022). Stock assessments for each Atlantic States Marine Fisheries Commission (ASMFC)–managed species can be found on ASMFC's website (ASMFC 2022). State- and federally managed fishes in the LME that have EFH in the Project area (COP Volume 2, Section 6.7.2.2.1, Table 6-49 through Table 6-51) or recorded catch in (COP Appendix V, Section 2.2, Table 2-5; Mayflower Wind 2022) or in and around (COP Appendix V, Section 2.1, Table 2-1; Mayflower Wind 2022) the Project area are listed in in Appendix B, *Supplemental Information and Additional Figures and Tables*. Many of these species can be found in the Project area throughout multiple life stages (i.e., eggs, larvae, juvenile, adult). The commercial importance of species is discussed in Section 3.6.1, and a record of species catch in the Project area is in COP Appendix V, Section 2.2, Table 2-5 (Mayflower Wind 2022).

The outlook for finfish species throughout the geographic analysis area includes presumed increased anthropogenic pressure as human population size along the northeastern seaboard increases (NEFSC Ecosystem Assessment Program 2012), continued commercial and recreational fishing, and changing climate. Species-selective harvesting has led to shifts in fish community composition, with dominant populations comprising larger proportions of small pelagic fish, skates, and small sharks, which are of relatively low economic value (NOAA 2009). Currently, at the ecosystem level, the Georges Bank and the Mid-Atlantic Bight ecosystems that the Project area overlaps are not experiencing overfishing (NMFS 2021a, 2021b). Warming of coastal and shelf waters is resulting in a northward shift in the distributions of some fish species that prefer cooler waters; based on future increases in surface water temperatures, it is expected that this trend will continue (Morley et al. 2018; NEFSC Ecosystem Assessment Program 2012). Distributions are expected to contract in some species, while other species are expected to see range expansions under warmer conditions. A small number of species, such as longfin inshore squid, butterfish (*Peprilus triacanthus*), and black sea bass (*Centropristis striata*), have seen positive impacts on their productivity and distribution due to warming conditions, and Atlantic croaker (*Micropogonias undulates*) is one of the species expected to expand its range into the region. While these species stand to gain from warming temperatures, a greater number of species in the region are expected to see negative impacts on their productivity and distribution. Species such as the yellowtail flounder (*Limanda ferruginea*) have already experienced declines in productivity due to environmental changes, and species such as the Atlantic mackerel (*Scomber scombrus*) are expected to have their distribution shift out of the region (Hare et al. 2016). Trends of fish populations shifting toward the northeast and generally into deeper waters alter both species interactions and fishery interactions (Hare et al. 2016;

NMFS 2021a, 2021b). Recent habitat climate vulnerability analyses link black sea bass, scup, and summer flounder to several highly vulnerable nearshore habitats, including estuarine systems, suggesting that populations are facing additional pressures that could lead to further population decline (Hare et al. 2016; NMFS 2021a, 2021b). Multiple drivers interact with each fish species differently; however, underlying climate change is likely linked to these changes. Most notably, fishes such as striped bass and flounder species may be affected due to increased predation levels at early life stages, where warmer than average winters may be affecting fishery resources during critical life stages. Striped bass surveys suggest recruitment success has decreased dramatically relative to the long-term average. Low recruitment could be caused by a mismatch in striped bass larval and prey abundance as a result of warm winter conditions, leading to decreased larval survival rates (NMFS 2021a). Moreover, warm winters trigger early phytoplankton and zooplankton blooms, resulting in timing mismatches between juvenile striped bass and key prey species (NMFS 2021a).

The Project area includes a portion of Nantucket and Rhode Island Sounds, which serve as a nursery habitat for some juvenile fishes, and Narragansett Bay, which is a regionally important estuary providing unique and diverse habitats, especially for early life stage development and survival. In the Sakonnet River/Mount Hope Bay portion of the Narragansett Bay, there has been a recent community shift from year-round resident species to summer migrants (e.g., summer flounder, black sea bass, scup, and butterfish) (Mayflower Wind 2022). The phenology of finfish assemblages in Narragansett Bay has been driven by climate change with warm-water species residing longer as warm seasons have expanded (Langan et al. 2021). This pattern is expected to continue with further climate change.

Several ESA-listed species may occur in the geographic analysis area, including all five distinct population segments (DPS) (The Gulf of Maine, the New York Bight, the Chesapeake Bay, The Carolinas, and the South Atlantic DPS) of Atlantic sturgeon (*Acipenser oxyrinchus*) (NMFS 2022b), shortnose sturgeon (*Acipenser brevirostrum*) (SSSRT 2010), giant manta ray (*Manta briostris*) (NMFS 2017a), Gulf of Maine distinct population segment of Atlantic salmon (*Salmo salar*) (NMFS 2020), and oceanic whitetip shark (*Carcharhinus longimanus*) (NMFS 2017b).

The species with the greatest probability of occurring in the Offshore Project area, which includes the Lease Area and offshore and inshore ECCs, is the Atlantic sturgeon; however, occurrence would be rare, especially in the Lease Area (Stein et al. 2004; Eyler et al. 2009; Dunton et al. 2010; Erickson et al. 2011). The greatest probability of occurrence would be along the ECCs, particularly the Brayton Point ECC, and along the Sakonnet River (Stein et al. 2004). Otherwise, Atlantic sturgeon may be encountered by vessels transiting to and from ports, with potential port locations for the Proposed Action extending from Nova Scotia to Virginia. Juvenile and adult Atlantic sturgeon occur in the offshore marine environment during fall, winter, and summer (Stein et al. 2004). Atlantic sturgeon have not been documented to spawn in tributaries between the Delaware and Hudson Rivers (Hilton et al. 2016). Atlantic sturgeon enter Chesapeake Bay in July and continue migrating into the James, York, and Pamunkey Rivers in Virginia to spawn in September (Hager et al. 2020; Hager et al. 2014; Kahn et al. 2014; Balazik et al. 2012). Ports proposed to be used by the Proposed Action include the Port of Virginia in Newport News and Portsmouth, Virginia along the James River where Atlantic sturgeon may occur.

The shortnose sturgeon (*Acipenser brevirostrum*) is found mainly in large freshwater rivers and coastal estuaries located along the east coast of North America, from New Brunswick to Florida. Based on its habitat preferences, shortnose sturgeon may occur in the nearshore ECCs and landfall locations (Mayflower Wind 2022). However, shortnose sturgeon rarely leave their natal rivers (Bemis and Kynard 1997; Zydlewski et al. 2011). The Hudson River population is almost exclusively confined to the river (Kynard et al. 2016; Pendleton et al. 2018), differing from other populations that may use coastal waters to move into smaller coastal rivers nearby. None of the primary ports being considered for Proposed Action are along the Hudson River.

Atlantic salmon are unlikely to occur in the Offshore Project area. Endangered Atlantic salmon from the Maine DPS, are not expected to occur south of central New England and the natural spawning population in North America occurs primarily between West Greenland and the Labrador Sea (Rikardsen 2021; USASAC 2020). However, the DPS of Atlantic salmon could be affected by vessels transiting from the Port of Sheet Harbour in Nova Scotia, Canada; while it is noted that vessel strikes are not an identified threat to the species (74 FR 29344) or their recovery (USFWS and NMFS 2019), accidental releases or vessel noise could temporarily affect Atlantic salmon.

The giant manta ray (*Manta birostris*) is listed as threatened throughout its range (NMFS 2018a). This highly migratory species is found in temperate, subtropical, and tropical oceans worldwide. Sightings of giant manta rays in New England are rare, though individuals have been documented as far north as New Jersey and Block Island (BOEM 2021 citing Gudger 1922; BOEM 2021 citing Miller and Klimovich 2017; Farmer et al 2021). In sightings compiled from 1925 to 2020 by Farmer et al. (2021), all sightings of giant manta rays, north of New Jersey, occurred along the boundary of the Atlantic OCS. Giant manta rays may overlap in areas traversed by vessels from New Jersey and farther south, however, interactions between transiting vessels and giant manta ray would be unlikely.

The oceanic whitetip shark (*Carcharhinus longimanus*) is listed as threatened throughout its range (NMFS 2018). This species is generally found in tropical and subtropical oceans worldwide, inhabiting deep, offshore waters on the outer edge of the OCS (Young and Carlson 2020). In the western Atlantic, oceanic whitetips occur as far north as Maine (NMFS 2016). Given the species' preference for deep, offshore waters, it is possible, but unlikely that they would transit through the Offshore Project area. Similar to the other listed species, Oceanic whitetips may be affected by vessels transiting to and from ports. However, vessel strikes have not been identified as a threat to the species (NMFS 2016), and there is no information to indicate that vessels have adverse effects on this species (BOEM 2021).

Invertebrates

The geographic analysis area for invertebrates is the LME, which was selected based on the likelihood of encompassing most of the spatial range for most invertebrate species that would be expected to occur in the Project area. In this region, mobile invertebrate distribution is largely influenced by seasonal temperature fluctuation. Many species of invertebrates belonging to pelagic, demersal, and resident assemblages occur in the geographic analysis area, suggesting that these species could occur in or pass through the Project area. Moreover, a number of the species with potential to occur in the Project area have designated EFH either in or in the vicinity of the Project area (COP Appendix N; Mayflower Wind 2022). In addition, several species of commercial and recreational importance would be expected to occur in the geographic analysis area and Project area, which is discussed in further detail in Section 3.6.1.

Invertebrate resources assessed in this section include the invertebrate zooplankton community and important megafauna species that have benthic, demersal, or planktonic life stages. Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.5.2. The description of invertebrate resources is supported by studies conducted by Mayflower Wind (COP Appendix M; Mayflower 2022) as well as other studies reviewed in the literature. Benthic invertebrates in the geographic analysis area include polychaetes, crustaceans (e.g., amphipods, crabs, lobsters), mollusks (e.g., gastropods, bivalves), echinoderms (e.g., sand dollars, brittle stars, sea cucumbers), and various other groups (e.g., sea squirts, burrowing anemones) (Guida et al. 2017).

Zooplankton

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

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

Narragansett Bay also has seasonal zooplankton abundance trends with peak abundance during spring and summer (Beaulieu et al. 2013). Predator-prey dynamics also influence zooplankton abundances in Narragansett Bay. Monitoring has observed changes in predator-prey overlap for two species of zooplankton in response to climate change (Costello et al. 2006).

Megafaunal Invertebrates

Stock assessments for each ASMFC-managed invertebrate species can be found on ASMFC's website (ASMFC 2022). State- and federally managed invertebrates in the LME that have EFH in the Project area (COP Volume 2, Section 6.7.3.1, Table 6-52; Mayflower Wind 2022) or recorded catch in (COP Appendix V, Section 2.2, Table 2-5; Mayflower Wind 2022) or in and around (COP Appendix V, Section 2.1, Table 2-1; Mayflower Wind 2022) the Project area include: American lobster (*Homarus americanus*), Atlantic sea scallop (*Placopecten magellanicus*), Atlantic surfclam (*Spisula solidissima*), horseshoe crab (*Limulus polyphemus*), Jonah crab (*Cancer borealis*), longfin inshore squid (*Loligo pealeii*), northern shortfin squid (*Illex illecebrosus*), northern shrimp (*Pandalus borealis*), ocean quahog (*Arctica islandica*), and Atlantic deep-sea red crab (*Chaceon quinquedens*).

Notable seasonal temperature changes in the Northeast Continental Shelf LME influence the distribution and movement of invertebrates with latitudinal (north–south) seasonal migrations and longitudinal (inshore–offshore) seasonal migrations (NJDEP 2010). Some megafaunal invertebrates found in the geographic analysis area are migratory (e.g., American lobster, Jonah crab, longfin inshore squid, and northern shortfin squid). Highly mobile invertebrates with broad habitat requirements have more flexibility to respond to disturbance and anthropogenic impacts compared to other invertebrates that are more sensitive because they have limited mobility or require specific habitats during one or more life stages. Species that are sessile or have more limited mobility, meaning they would be expected to reside in the Project area, include species such as Atlantic sea scallop, Atlantic surfclam, and ocean quahog, which were identified as shellfish species of concern for the Massachusetts offshore wind lease area by Guida et al. (2017). NEFSC seasonal trawl survey catches in the Massachusetts offshore wind lease area between 2003 and 2016 found that longfin squid were one of the dominant species in the warm season, along with some finfish species. In the cold season, no invertebrate species were dominant (Guida et al. 2017).

The Lease Area and the southern sections of the export cable corridors are predominantly characterized by soft-sediment habitats (NBEP 2017; COP Appendix M; Mayflower Wind 2022). Economically and ecologically important species associated with soft sediments in the vicinity of the Project area include Atlantic sea scallop, bay scallop (*Argopecten irradians*), horseshoe crab, Atlantic surfclam, squid, Atlantic deep-sea red crab, channeled whelk, razor clam (*Ensis leei*), soft-shelled clam (*Mya arenaria*), northern quahog (*Mercenaria mercenaria*), and ocean quahog (COP Volume 2, Section 6.7.3; Mayflower Wind 2022). Other soft-sediment megafaunal invertebrates include decapod crab species, sand dollars, sea stars, gastropods, and sea urchins (Mayflower Wind 2022).

The northern section of the Falmouth export cable corridor and the glacial moraines in the offshore portion of the Brayton Point export cable corridor contain hard, complex habitats with attached epifauna and mobile epifauna such as whelk. Hard substrates provide important nursery habitat for juvenile lobster and areas where squid species can attach egg masses, called mops (NJDEP 2010). Both squid and American lobster are of economic importance. The commercial importance of other species, such as Jonah crab (*Cancer borealis*), has increased with the decline of the American lobster fishery. Jonah crabs are typically associated with rocky habitats and soft sediment, while lobsters prefer hard-bottom habitats. Invertebrates associated with the presence of SAV occur in the northern portion of both export cable corridors (COP Appendix K; Mayflower Wind 2022). The hard substrates, along with SAV, are EFH for the spat (i.e., free-moving larvae) life stage of Atlantic sea scallop, which attach to these surfaces for survival (NEFMC and NMFS 2017), as do bay scallops.

The outlook for invertebrate species throughout the geographic analysis area includes presumed increased anthropogenic pressure as human population size along the northeastern seaboard increases (NEFSC Ecosystem Assessment Program 2012), continued commercial and recreational fishing, and changing climate. Warming of coastal and shelf waters is resulting in a northward shift in the distributions of some invertebrate species that prefer cooler waters; based on future increases in surface water temperatures, it is expected that this trend will continue (NEFSC Ecosystem Assessment Program 2012). American lobster distributions are a dramatic example of invertebrate distributions shifting toward the northeast and generally into deeper waters with more than a 70 percent decline in landings in southern New England between 1996 and 2014 and evidence of receding nursery habitat in Narragansett Bay (NOAA 2021; Wahle et al. 2015).

The Project area includes a portion of Nantucket and Rhode Island Sounds and Narragansett Bay, which provide unique and diverse habitats, especially for early life stage development and survival. The phenology of longfin squid in Narragansett Bay has been driven by climate change with this warm-water species residing longer as warm seasons have expanded (Langan et al. 2021). This pattern is expected to continue with further climate change with likely opposite effects for cold-water species (Langan et al. 2021).

Essential Fish Habitat

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

EFH has been designated for 46 species or management groups that occur in the New England and Mid-Atlantic OCS and nearshore coastal waters. Species and their EFH occurrence within the Project area are described in Table 3.5.5-1. The table also shows stock status and trends and spawning stock biomass.

NOAA, Northeast Fisheries Management Council, and Mid-Atlantic Fisheries Management Council also identified HAPC as a component of EFH. HAPCs are high-priority areas for conservation and exhibit one or more of the following characteristics: rare, sensitive, stressed by development, provide important ecological functions for federally managed species, or especially vulnerable to anthropogenic degradation. HAPCs can cover specific localities or cover habitat types that could be found at many locations (NOAA 2004). The only HAPC that could be directly affected by Project activities is specific habitat for both juvenile and adult summer flounder and juvenile Atlantic cod. The summer flounder HAPC includes all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes (i.e., SAV) in any size bed, as well as loose aggregations, in currently designated adult and juvenile summer flounder EFH. Summer flounder HAPC overlaps the Project area at the Falmouth landfall sites (MAFMC 2016). The Atlantic cod HAPC includes inshore areas of the Gulf of Maine and southern New England between 0 to 65 feet (0 to 20 meters), relative to mean high water. Atlantic Cod juvenile HAPC overlaps the Project area in Mount Hope Bay, the Sakonnet River, and Nantucket Sound (NEFMC and NMFS 2017). Larval and young-of-the-year Atlantic cod have both been observed overlapping with the Project area in the Sakonnet River and Mount Hope Bay (Langan et al. 2019).

In October 2017, the New England Fishery Management Council established a new juvenile Atlantic cod HAPC for the New England coastline out to a depth of 66 feet (20 meters). NMFS implemented this HAPC on April 9, 2018. This HAPC for juvenile Atlantic cod is a subset of EFH for juvenile Atlantic cod, which consists of structurally complex habitats, including eelgrass, mixed sand and gravel, rocky habitats, and emergent epifauna (NEFMC and NMFS 2017). The HAPC for juvenile Atlantic cod includes all hard-bottom habitats within both ECCs and within 20 nautical miles of shore. The total area of juvenile Atlantic cod HAPC present in the ECCs is not known but is assumed to occur along the entire length of the ECCs from the 65.6-foot (20-meter) depth contour to shore. Overall, the proportion of juvenile cod HAPC within the ECCs is small considering the entire HAPC extends from the Canadian border to southern New England (map 245 in NEFMC and NMFS 2017).

Table 3.5.5-1. EFH in Project area and stock status for species in the New England and Mid-Atlantic OCS and nearshore coastal water

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Albacore Tuna	• EFH for juvenile and adult life stages in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor • EFH for juvenile life stage only in Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Not overfished	Not subject to overfishing	Increasing	NA	2020
American Plaice	• Larval life stage EFH in the Lease Area	Not overfished	Not subject to overfishing	Decreasing	17,748	2019
Atlantic Butterfish	• EFH for all life stages in the Lease Area, Falmouth export cable corridor, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for juvenile and adult life stages only at the Falmouth landfalls	Not overfished	Not subject to overfishing	Increasing	66,566	2022
Atlantic Cod	• EFH for all life stages in the Lease Area, Falmouth export cable corridor, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for egg, larval, and juvenile life stages only at the Falmouth landfalls	Overfished	Unknown	Decreasing	NA	2021
Atlantic Herring	• EFH for all life stages in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor • EFH for larval, juvenile, and adult life stages only in Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for juvenile life stage only at Falmouth landfalls	Overfished	Not subject to overfishing	Decreasing	39,091	2022

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Atlantic Mackerel	• EFH for all life stages in the Lease Area and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for egg, larval, and juvenile life stages only in Falmouth export cable corridor and offshore portion of the Brayton Point export cable corridor • EFH for juvenile life stage only in Falmouth landfall	Overfished	Overfishing is occurring	No Change	42,862	2021
Atlantic Sea Scallop	• Egg, larval, juvenile, and adult life stage EFH in the Lease Area, Falmouth export cable corridor, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Not overfished	Not subject to overfishing	Increasing	147,073	2020
Atlantic Surfclam	• Juvenile and adult life stage EFH in the offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and near the Falmouth landfalls	Not overfished	Not subject to overfishing	No Change	46,355,000	2016
Atlantic Wolffish	• EFH for all life stages in the offshore portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and at Falmouth landfalls	Overfished	Not subject to overfishing	Increasing	676	2020
Barndoor Skate	• Juvenile and adult life stage EFH in the Lease Area	Not overfished	Not subject to overfishing	Increasing	NA	2020
Basking Shark	• EFH for all life stages in the Lease Area, offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, and Falmouth export cable corridor	Unknown	Unknown	NA	NA	NA
Black Sea Bass	• EFH for juvenile and adult life stages in the Falmouth export cable corridor, Falmouth landfall, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for juvenile life stage only in the Lease Area	Not overfished	Not subject to overfishing	Increasing	29,769	2021

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Blue Shark	• Neonate, juvenile, and adult life stage EFH in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor	Not overfished	Not subject to overfishing	NA	NA	2015
Bluefin Tuna	• Juvenile and adult life stage EFH in the Lease Area, Falmouth export cable corridor, Falmouth landfalls, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Unknown	Not subject to overfishing	NA	NA	2017
Bluefish	• EFH for juvenile and adult life stages in the offshore portion of the Brayton Point export cable corridor and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for adult life stage only in the Lease Area and Falmouth export cable corridor	Not overfished	Not subject to overfishing	Decreasing	95,742	2021
Common Thresher Shark	• EFH for all life stages in the Lease Area, offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfalls	Unknown	Unknown	NA	NA	NA
Dusky Shark	• EFH for all life stages in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor	Overfished	Overfishing is occurring	NA	NA	2016
Haddock	• EFH for all life stages in Lease Area • EFH for egg, larval, and juvenile life stages only in the offshore portion of the Brayton Point export cable corridor and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for egg life stage only in the Falmouth export cable corridor	Not overfished	Not subject to overfishing	NA	NA	2019
Little Skate	• Juvenile and adult life stage EFH in the Lease Area, offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfalls	Not overfished	Not subject to overfishing	Decreasing	NA	2020

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Longfin Inshore Squid	• EFH for all life stages in the Lease Area, offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and near the Falmouth landfalls	Not overfished	Unknown	No Change	NA	2017
Monkfish	• EFH for all life stages in the Lease Area and offshore portion of the Brayton Point export cable corridor • EFH for egg and larval life stages only in the Falmouth export cable corridor	Not overfished	Not subject to overfishing	NA	NA	2013
Northern Shortfin Squid	• Adult life stage EFH in the offshore portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and near the Falmouth landfalls	Unknown	Unknown	NA	NA	2022
Ocean Pout	• EFH for egg, juvenile, and adult life stages in the Falmouth export cable corridor, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for egg and adult life stages only in the Lease Area	Overfished	Not subject to overfishing	No Change	NA	2017
Ocean Quahog	• Juvenile and adult life stage EFH in the Lease Area, offshore portion of the Brayton Point export cable corridor, and Falmouth export cable corridor	Not overfished	Not subject to overfishing	Increasing	NA	2017
Offshore Hake	• Larval life stage EFH in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor	Not overfished	Unknown	NA	NA	2010
Pollock	• EFH for egg, larval, and juvenile life stages in the offshore portion of the Brayton Point export cable corridor • EFH for egg and larval life stages only in the Lease Area • EFH for larval life stage only in the Falmouth export cable corridor and Falmouth landfalls • EFH for juvenile life stage only in the Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Not overfished	Not subject to overfishing	NA	NA	2019

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Porbeagle Shark	• EFH for all life stages in the Lease Area	Overfished	Not subject to overfishing	NA	NA	2021
Red Hake	• EFH for all life stages in the Lease Area, Falmouth export cable corridor, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for egg, larval, and juvenile life stages only at the Falmouth landfalls	Overfished	Overfishing is occurring	Increasing	NA	2017
Sand Tiger Shark	• Neonate and juvenile life stage EFH in the Lease Area, offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfalls	Unknown	Unknown	NA	NA	NA
Sandbar Shark	• EFH for juvenile and adult life stages in the Lease Area, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for juvenile life stage only in the Falmouth export cable corridor	Overfished	Not subject to overfishing	No Change	NA	2017
Scup	• EFH for all life stages in the Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for juvenile and adult life stages only in the Lease Area, offshore portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfalls	Not overfished	Not subject to overfishing	Decreasing	176,404	2021
Shortfin Mako Shark	• Neonate, juvenile, and adult life stage EFH in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor	Overfished	Overfishing is occurring	NA	NA	2017

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Silver Hake	• EFH for all life stages in the Lease Area • EFH for egg, larval, and adult life stages only in the offshore portion of the Brayton Point export cable corridor and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for egg and larval life stages only in the Falmouth export cable corridor and Falmouth landfalls	Not overfished	Not subject to overfishing	Increasing	NA	2020
Skipjack Tuna	• EFH for juvenile and adult life stages in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor • EFH for adult life stage only at the Falmouth landfalls and the Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Not overfished	Unknown	NA	NA	2014
Smooth hound Shark Complex	• EFH for all life stages in the Lease Area, offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfalls	Not overfished	Not subject to overfishing	NA	NA	2015
Spiny Dogfish	• Male and female sub-adult and adult life stage EFH in the Lease Area, offshore portion of the Brayton Point export cable corridor, and Falmouth export cable corridor • EFH for sub-adult female and adult male life stages only in the Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Not overfished	Not subject to overfishing	Decreasing	NA	2018
Summer Flounder	• EFH for all life stages in the Lease Area, offshore portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfall • EFH for larval, juvenile, and adult life stages only in the Sakonnet River/Mount Hope Bay portion of the export cable corridor	Not overfished	Not subject to overfishing	Decreasing	47,397	2021

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Tiger Shark	• Juvenile and adult life stage EFH in the Lease Area, Falmouth export cable corridor, and offshore portion of the Brayton Point export cable corridor	Unknown	Unknown	NA	NA	NA
White Hake	• EFH for juvenile and adult life stages only in the Lease Area • EFH for larval and juvenile life stages only in the Falmouth export cable corridor and offshore portion of the Brayton Point export cable corridor • EFH for juvenile life stage only at the Falmouth landfalls	Not overfished	Not subject to overfishing	Decreasing	NA	2017
White Shark	• EFH for all life stages in the Lease Area, offshore portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfalls • EFH for neonate life stage only in Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Unknown	Unknown	NA	NA	NA
Windowpane Flounder	• EFH for all life stages in the Lease Area, Falmouth export cable corridor, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for juvenile and adult life stages only at the Falmouth landfalls	Not overfished	Not subject to overfishing	Increasing	NA	2017
Winter Flounder	• EFH for all life stages in the Falmouth export cable corridor, Falmouth landfall, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for larval, juvenile, and adult life stages only in the Lease Area and offshore portion of the Brayton Point export cable corridor	Not overfished	Not subject to overfishing	Decreasing	3,353	2022
Winter Skate	• Juvenile and adult life stage EFH in the Lease Area, offshore portion of the Brayton Point export cable corridor, Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor, Falmouth export cable corridor, and Falmouth landfalls	Not overfished	Not subject to overfishing	No Change	NA	2020

Species	EFH Occurrence in Project Area	Stock Status	Harvest Trend	10 Year Stock Trend	Spawning Stock Biomass (metric tons)	Report Year
Witch Flounder	• EFH for all life stages in the Lease Area • EFH for egg, larval, and adult life stages only in the offshore portion of the Brayton Point export cable corridor • EFH for larval and adult life stages only in the Falmouth export cable corridor	Overfished	Unknown	Increasing	NA	2017
Yellowfin Tuna	• EFH for juvenile and adult life stages in the offshore portion of the Brayton Point export cable corridor • EFH for juvenile life stage only in the Lease Area, Falmouth export cable corridor, Falmouth landfalls, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor	Not overfished	Not subject to overfishing	NA	NA	2019
Yellowtail Flounder	• EFH for all life stages in the Lease Area, Falmouth export cable corridor, offshore portion of the Brayton Point export cable corridor, and Sakonnet River/Mount Hope Bay portion of the Brayton Point export cable corridor • EFH for juvenile life stage only at the Falmouth landfalls	Overfished	Not subject to overfishing	Decreasing	NA	2019

Stock status is determined as “overfished” if a stock’s biomass level is depleted to a degree that the stock's capacity to produce maximum sustainable yield is jeopardized.
Harvest Trend is determined to be “subject to overfishing” if the harvest rate is higher than the recruitment rate that produces maximum sustainable yield.
Source: NMFS 2022a
NA = not applicable

An HAPC designation has been proposed for complex habitat and Atlantic cod spawning, which would expand existing Atlantic cod HAPC and could potentially overlap with the Project area (NEFMC 2022). Evidence of cod spawning has been observed in an area known as Cox Ledge, which lies on the northwest corner of the Massachusetts and Rhode Island wind energy areas. Variations of this proposal would designate the area around Cox Ledge and parts of the wind energy area as an HAPC for cod spawning but would not overlap the Project area. An alternative variation of this proposal would extend the HAPC beyond Cox Ledge to cover all complex habitat in the southern New England wind energy area, with a 10-kilometer buffer around the wind energy area. This proposed expansion is in recognition of other species that use complex habitat during their life history. The species noted in addition to Atlantic cod are Atlantic herring, Atlantic sea scallop, little skate, monkfish, ocean pout, red hake, winter flounder, and winter skate. Under this variation of the HAPC designation, the entire Mayflower Wind Offshore Project area would be within Atlantic cod HAPC. The HAPC proposal notes the sensitivity of Atlantic cod spawning and its potential to be stressed from offshore wind development (NEFMC 2022).

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

Impact level definitions are provided in Table 3.5.5-2.

Table 3.5.5-2. Definitions of impact levels for finfish, invertebrates, and essential fish habitat

Impact Level	Type of Impact	Definition
Negligible	Adverse	Impacts on species or habitat would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur would be temporary or short-term in nature.
	Beneficial	A small and measurable beneficial impact on a few individuals. Habitat benefits would be temporary or short-term.
Moderate	Adverse	Impacts on species would be unavoidable but would not result in population-level effects. Impacts on habitat may be short-term, long-term, or permanent and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them.
	Beneficial	A notable and measurable beneficial impact on a larger number of individuals or multiple species but would not result in population-level effects. Habitat benefits would be short-term, long-term, or permanent.
Major	Adverse	Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would result in population-level impacts on species that rely on them.
	Beneficial	A regional or population-level beneficial impact on species or habitat.

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

When analyzing the impacts of the No Action Alternative on finfish, invertebrates, and EFH, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for finfish, invertebrates, and EFH. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH, described in Section 3.5.5.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH are generally associated with commercial harvesting and fishing activities, UXO interaction, fisheries bycatch, regulated fishing effort, water quality degradation and pollution, effects on benthic habitat via dredging and bottom trawling, accidental fuel leaks or spills, and climate change.

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

Seafloor habitat is routinely disturbed through dredging (for navigation, marine minerals extraction, and military purposes) and commercial fishing use of bottom trawls and dredge-fishing methods. Ongoing dredging for the purposes of navigation and other ongoing activities results in short-term, localized impacts, such as habitat alteration and change in complexity, on finfish, invertebrates, and EFH. Sandy or silty habitats, which are abundant in the geographic analysis area, are quick to recover from dredging disturbance. According to Newcombe and MacDonald (1991), impacts from settlement of resuspended sediment plumes increase with the concentration of resuspension and the duration over which invertebrates are exposed to that plume. In general, sediment plumes are localized, which results in larger and coarser sediment falling out of the water column and settling on the seafloor in the area near or immediately adjacent to the activity, while smaller, fine sediments may remain suspended in the water column for a longer period before settling potentially at a greater distance from the disturbance.

UXO interactions would be expected to continue due to ongoing development of aquaculture, fishing, wind farms, power cables, and oil or gas pipeline development. Additionally, an increase in ship traffic, in general, would result in an overall increase in potential interactions with UXO and the associated corrosion of UXO, subsequent releases of their constituents to the marine environment, and adverse impacts on marine habitats. Therefore, the potential for disturbance, injury, or mortality to fish and loss of habitat would also persist.

Regulated fishing would continue to affect finfish, invertebrates, and EFH in the geographic analysis area by direct removal of resources (i.e., harvests) and gear impacts on habitats (e.g., bottom disturbance). Ongoing fisheries management practices are anticipated to have positive population-level impacts on managed species in the long term. Existing legislation requires federally managed species to achieve maximum sustainable yield, meaning federally managed species in the region would see restored population numbers under successful fisheries management. Abandoned or lost fishing gear remains in the aquatic environment for extended time periods, often entangling or trapping mobile invertebrate and fish species. Based on data from NOAA, bycatch affects many species throughout the geographic analysis area—most notably, windowpane flounder, blueback herring, shark species, and hake species; the majority of bycatch is a result of open area scallop trawls, large-mesh otter trawls, conch pots, and fish traps (NOAA 2019). Water quality impacts from ongoing onshore and offshore activities affect nearshore habitats, and accidental spills can occur from pipeline or marine shipping. Invasive species can be accidentally released in the discharge of ballast water and bilge water from marine vessels. The resulting impacts on invertebrates and finfish depend on many factors but can be widespread and permanent, especially if the invasive species becomes established and outcompetes native species.

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

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

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on finfish, invertebrates, and EFH.

- Continued O&M of the Block Island project (5 WTGs) installed in State waters.
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect fish, invertebrates, and EFH through the primary IPFs of accidental releases, anchoring, discharges/intakes, EMF, lighting, cable emplacement and maintenance, noise, port utilization, and presence of structures. Ongoing offshore wind activities would have the same type of impacts that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect finfish, invertebrates, and EFH include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, and oil and gas activities (see Appendix D, *Planned Activities Scenario*, for a description of planned activities). Impacts from planned non-offshore wind activities would be similar to those from ongoing activities and may include temporary and permanent impacts on benthic resources from disturbance, injury, mortality, habitat degradation, and habitat conversion. While these impacts would have localized effects on finfish, invertebrates, and EFH, population-level effects would not be expected.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on finfish, invertebrates, and EFH during construction, O&M, and decommissioning of the projects. Planned offshore wind activities include offshore wind energy development activities on the Atlantic OCS other than the Proposed Action determined by BOEM to be reasonably foreseeable (see Attachment 2 in Appendix D for a complete description of planned offshore wind activities).

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

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

Another potential impact related to vessels and vessel traffic is the accidental release of invasive species, especially during ballast water and bilge water discharges from marine vessels. Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR § 151.2025) and USEPA National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim at least in part to prevent the release and movement of invasive species. Adherence to these regulations would reduce the likelihood of discharge of ballast or bilge water contaminated with invasive species. Although the likelihood of invasive species becoming established due to offshore wind activities is low, the impacts of invasive species invertebrates could be strongly adverse, widespread, and permanent if the species were to become established and outcompete native fauna. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities (e.g., transoceanic shipping).

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

Anchoring: Offshore wind energy development would lead to increased vessel anchoring during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. In addition, anchoring/mooring of meteorological towers or buoys could be increased. Anchoring causes temporary disturbance to the seafloor, which would be considered temporary, short-term impacts that occur regularly throughout the geographic analysis area. These activities would increase turbidity and could result in direct mortality from physical contact for finfish and invertebrate resources and degradation of sensitive hard-bottom habitats, including EFH. Other offshore wind projects could disturb up to 2,630 acres (10.6 square kilometers [km^2]) of seafloor habitat, increasing turbidity and potentially disturbing, displacing, or injuring benthic habitat, finfish, and invertebrates. This disturbance would be localized and temporary, representing considerably less than 1 percent of the total available benthic habitat in the geographic analysis area. Potential impacts would be minimized by the implementation of mitigation measures. For finfish specifically, it is unlikely that adult fish would be directly affected by anchoring, and impacts would be negligible. However, less-mobile life stages, such as eggs and larvae, could experience direct mortality or smothering from turbidity, with impacts occurring at a local, small scale, not at a population or species level, and they would be temporary, minor, and localized. It would be expected that recovery of any affected species would occur in the short term, although degradation of sensitive habitats could persist in the long term.

Physical seabed disturbance due to anchoring would generally result in localized and temporary impacts on invertebrate resources, with recovery in the short term. Mobile invertebrates would be temporarily displaced, whereas sessile and slow-moving invertebrates could be subject to localized lethal and sublethal impacts. Demersal eggs and larvae would be particularly vulnerable to sediment disturbance and resettlement. High rates of mortality can occur in longfin squid egg masses if exposed to abrasion (Steer and Moltschaniwskyj 2007). In contrast, if the anchoring activity leads to the restructuring of patchy cobble boulder habitat into more linear, continuous cobble habitat, the change may provide juvenile lobsters with higher-value small-scale habitat, where predation rates would be expected to be lower (Guarinello and Carey 2020).

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

Discharges/intakes: Increases in vessel discharges would occur during construction and installation, O&M, and decommissioning of offshore wind development. Offshore permitted discharges include uncontaminated bilge water and treated liquid wastes. Increases would be greatest during construction and decommissioning of offshore wind projects. Discharge rates would be staggered according to project schedules and localized. Certain discharges are required to comply with permitting standards that are established to minimize potential impacts on the environment.

Other offshore wind projects in the geographic analysis area may use HVDC converter OSPs that would convert AC to DC before transmission to onshore project components. As described in a recent white paper produced by BOEM (Middleton 2022), these HVDC systems are cooled by an open loop system that intakes cool sea water and discharges warmer water back into the ocean. Entrainment and impingement of finfish and invertebrates could occur at HVDC converter intakes on the OSPs. Impacts of entrainment and impingement on finfish and invertebrates at HVDC converter intakes would be limited to the immediate area of the OSPs and to intake volumes.

Additionally, entrainment and impingement would occur at intakes for cable-laying equipment. Impacts on finfish, invertebrates, and EFH from entrainment and impingement at intakes are expected to be localized. Further, as discussed under the *Cable emplacement and maintenance* IPF, entrainment and impingement at cable-laying equipment intakes would be short term. Impacts on finfish, invertebrates, and EFH from discharge volumes and intakes from offshore wind activities are expected to be moderate.

EMF: The marine environment continuously generates a variable ambient EMF. Additional EMFs would also emanate from new offshore export cables and interarray cables constructed for offshore wind projects. Up to 9,970 miles (16,045 kilometers) of cable would be added in the geographic analysis area from other planned offshore wind activities, producing an EMF in the immediate vicinity of each cable during operations. BOEM would require future submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. EMF effects from these future projects on finfish, invertebrates, and EFH would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., high-voltage alternating current or high-voltage direct current, transmission voltage). EMF strength diminishes rapidly with distance, and an EMF that could elicit a behavioral response in an organism would likely extend less than 50 feet (15.2 meters) from each cable. When submarine cables are laid, installers typically maintain a minimum separation distance of at least 330 feet (100 meters) from other known cables to avoid inadvertent damage during installation, which also precludes any additive EMF effects from adjacent cables.

Population-level impacts on finfish have not been documented for EMFs from alternating current cables (CSA Ocean Sciences, Inc. and Exponent 2019). There is no evidence to indicate that EMFs from undersea alternating current power cables adversely affects commercially and recreationally important fish species at a population level in the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019). A more recent review by Gill and Desender (2020) supports these findings. Other research has been conducted where fish were found to be affected by EMFs at high intensity for a small number of individual finfish species. For example, behavioral impacts have been documented for benthic species such as skates near operating DC cables (Hutchison et al. 2018, 2020). Skates exhibited changes in behavior in the form of increased exploratory searching and slower movement speeds near the EMF source, but EMFs did not appear to present a barrier to animal movement. A study on larval haddock (Cresci et al. 2022) found that a majority of larvae displayed reduced swimming speed when exposed to magnetic fields in the intensity range of those produced by HVDC cables. Exposure to these magnetic fields could alter the dispersal of Haddock larvae. The magnetic field is localized to the cable and its intensity drops off sharply with distance, meaning that effects on haddock dispersal would be limited to those larvae that come into close contact with the cables.

To date, the effects of EMFs on invertebrate species have not been extensively studied, and studies of the effects of EMFs on marine animals have mostly been limited to commercially important species such as lobster and crab (e.g., Love et al. 2017; Hutchison et al. 2020). Burrowing infauna may be exposed to stronger EMFs, but scientific data are limited. Recent reviews by Gill and Desender (2020), Albert et al. (2020), and CSA Ocean Sciences, Inc. and Exponent (2019) of the effects of EMFs on marine invertebrates in field and laboratory studies concluded that measurable effects can occur for some species but not at the relatively low EMF intensities representative of marine renewable energy projects. For example, behavioral impacts were documented for lobsters near a direct current cable (Hutchison et al. 2018) and a domestic electrical power cable (Hutchison et al. 2020), including subtle changes in activity (e.g., broader search areas, subtle effects on positioning, and a tendency to cluster near the EMF source), but only when the lobsters were within the EMF. There was no evidence of the cable acting as a barrier to lobster movement, and no effects were observed for lobster movement speed or distance traveled. Additionally, faunal responses to EMFs by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Taormina et al. 2018; Normandeau Associates, Inc. et al. 2011), include interfering with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). A study on bivalves (Jakubowska-Lehrmann et al. 2022) found that exposure to static magnetic fields decreased the filtration rates of a cockle species (*Cerastoderma glaucum*) while EMFs had no effect on filtration. EMF exposure in the cockles was found to lower the ammonia excretion rate and inhibit the activity of the enzyme acetylcholinesterase.

Other studies have found that an EMF does not affect invertebrate behavior. For example, Schultz et al. (2010) and Woodruff et al. (2012) conducted experiments exposing American lobster and Dungeness crab (*Metacarcinus magister*) to EMFs ranging from 3,000 to 10,000 milligauss and found that EMFs did not affect their behavior. Assuming the other wind projects with high-voltage alternating current cables in the geographic analysis area have similar array and export cable voltages as the Proposed Action, the induced magnetic field levels expected for the offshore wind projects are between two and three orders of magnitude lower than those tested by Schultz et al. (2010) and Woodruff et al. (2012). Similarly, a field experiment in Southern California and Puget Sound, Washington, found no evidence that the catchability of two species of crabs was reduced if the animals must traverse an energized alternating current low-frequency (35 kilovolt for one species and 69 kilovolt for the other) submarine power cable to enter a baited trap. Whether the cables were unburied or lightly buried did not influence the crab responses (Love et al. 2017). While these voltages are between two and eight times lower than those proposed for the Project and likely for other projects, the array and export cables would likely be shielded and buried at depth to reduce potential EMFs from cable operation.

A recent study concluded that, similar to invertebrates, impacts on finfish from EMFs are minor or short-term, specifically for species that are known to sense EMFs more acutely than pelagic fish species, such as elasmobranchs and benthic species (Bilinski 2021). Based on this study, impacts were limited to minor responses in elasmobranchs and benthic species, which included attraction to cabled areas. It is important to reiterate that EMF impacts on finfish have not been extensively studied, and it remains unknown if finfish experience physiological impacts, what life stages of finfish are most affected by EMFs, and if long-term impacts develop later in life (Bilinski 2021).

EMF levels would be highest at the seabed and in the water column above cable segments that cannot be fully buried and are laid on the bed surface under protective rock or concrete blankets. Wind energy development projects may not be able to bury all cables to sufficient depth and, thus, additional shielding of the cables may be used to dampen EMF effects. Invertebrates in proximity to these areas could experience detectable EMF levels but minimal associated effects. These unburied cable segments would be short and widely dispersed. CSA Ocean Sciences, Inc. and Exponent (2019) found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling finfish and invertebrates residing in the southern New England area. For pelagic species in the same area, no negative effects were expected from offshore wind energy development as currently proposed because of their preference for habitats located at a distance from the seabed.

The information indicates that EMF impacts on finfish, invertebrates, and EFH would be minor, highly localized, and limited to the immediate vicinity of cables and would be undetectable beyond a short distance; however, localized impacts would persist as long as cables are in operation. Most exposure is expected to be of short duration, and the affected area would represent an insignificant portion of the available habitat for finfish and mobile invertebrate species; therefore, impacts on finfish, invertebrates, and EFH would be expected to be minor.

Gear utilization: A range of monitoring activities has been proposed to evaluate the short-term and long-term effects of existing and planned offshore wind development on biological resources and are also likely for future wind energy projects on the OCS. Some of these monitoring activities are likely to affect finfish, invertebrates, and EFH. For example, the South Fork Wind Fisheries Research and Monitoring Plan (South Fork Wind, LLC and Inspire Environmental 2020) included both direct sampling of finfish and invertebrates and the potential for bycatch of finfish and invertebrates and/or damage to habitat-forming invertebrates and EFH by sample collection gear. Biological monitoring uses the same types of methods and equipment employed in commercial fisheries, meaning that impacts on invertebrates would be similar in nature but reduced in extent in comparison to impacts from current and likely future regulated fishing activity. Monitoring activities are commonly conducted by commercial fishers under contract who would otherwise be engaged in fishing activity. As such, research and monitoring activities related to offshore wind would not necessarily result in an increase in bycatch-related impacts on finfish and invertebrates, although the distribution of those impacts could change. Therefore, any bycatch-related impacts on invertebrates would be negligible to minor adverse and short term in duration.

Lighting: Light can attract finfish and invertebrates, including potential prey for finfish, further acting as an attractant for finfish. As such, light could affect finfish movement in highly localized areas. Light can also affect natural reproductive cycles for finfish, such as spawning; however, light would need to be persistent and present for long periods of time to influence natural reproductive cycles (Longcore and Rich 2004). Light is important in guiding the settlement of invertebrate larvae, and artificial light can change the behavior of aquatic invertebrates such as squid, although the direction of response can be species and life stage specific. Offshore wind activities include up to 2,884 offshore WTGs in the geographic analysis area. Construction and O&M of these structures would introduce short-term and long-term sources of artificial light to the offshore environment in the form of vessel lighting and navigation and safety lighting on offshore WTGs. Zooplankton diel migration and movement may also be influenced by changes in light exposure. Offshore wind development would result in increased light from offshore structures and vessels. Vessels would be lit during construction, maintenance, and decommissioning. Impacts from vessel lighting would likely be insignificant relative to activities not related to offshore wind activities that occur throughout the geographic analysis area. Furthermore, potential impacts from lighting would be anticipated to have little impact on finfish and invertebrates during daylight hours and would be limited by the depth of the water in the offshore wind lease areas.

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

Cable emplacement and maintenance: Cable emplacement and maintenance activities (including dredging) would disturb sediments and cause sediment suspension, which could disturb, displace, and directly injure finfish and invertebrate species and EFH. Seabed areas identified for cable emplacement are cleared of buried hazards by conducting a grapnel run. Larger boulders that cannot be avoided by rerouting are removed or relocated using a boulder plow. The intensity of impacts would depend on multiple factors, including time of year, sediment type, and habitat type being affected where activities occur. Short-term disturbance of seafloor habitats during grapnel runs, dredging, or the use of boulder plows could disturb, displace, and directly injure or result in mortality of invertebrates in the immediate vicinity of the cable-emplacement activities. Finfish that spawn in aggregations or close to the seabed may be vulnerable to direct impacts from cable emplacement activities, especially if those activities take place during spawning season.

Sand waves and smaller sand ripple clearance may be required to install cables at a sufficient depth that they would not be uncovered as a result of sand wave mobility. Larger-scale sand waves are considered to be more stable and permanent when compared with sand ripples, with associated slopes generally less than 1 degree, although vertical relief may be as much as 49 feet (15 meters). Cable emplacement and maintenance activities may flatten depressions and small sand waves, temporarily reducing benthic habitat suitability for species such as red and silver hake within the cable footprint. Prey organisms that use these habitats would also be displaced, potentially affecting habitat suitability for fish species. Trenching may leave behind temporary depressions. The extent of these natural features is difficult to quantify, as they are continually reshaped by natural sediment transport processes. Natural recovery from anthropogenic disturbance is likely to occur within several months of the disturbance, depending on timing relative to winter storm events. Due to their mobility, it is expected that the sand ripples would rapidly return after cable installation, while larger sand waves would take longer to reform.

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

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

When new cable emplacement and maintenance cause resuspension of sediments, increased turbidity could have an adverse impact on filter-feeding fauna such as bivalves. The impact of increased turbidity on invertebrates depends on both the concentration of suspended sediment and the duration of exposure. Plume modeling completed for other wind development projects in the region and with similar sediment characteristics (Vineyard Wind 1, Block Island Wind Farm, and Virginia Offshore Wind Technology Advancement) predict that suspended sediment would usually settle well before 12 hours have elapsed (Tetra Tech 2012; BOEM 2015). BOEM, therefore, expects relatively little impact from increased turbidity (separate from the impact of direct sediment deposition) due to cable-emplacement and maintenance activities. Depending on the substrate being disturbed, invertebrates could be exposed to contaminants via the water column or resuspended sediments, but effects would depend on the degree of exposure. Assuming projects use installation procedures similar to those proposed in Appendix D, the extent of impacts would be limited to approximately 13 feet (4 meters) to either side of each cable. Therefore, the duration and extent of impacts would be limited and short-term, and it would be expected that finfish and invertebrates would recover following this disturbance; however, EFH and other habitats such as eelgrass or hard-bottom habitats, discussed further in Section 3.5.2, may remain permanently altered (Hemery 2020), as eelgrass would be expected to require a greater amount of time to recover. Affected hard-bottom habitat would not be expected to recover, but the extent of hard-bottom habitat that could potentially be affected is assumed to be low relative to the amount of this habitat available throughout the geographic analysis area.

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

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

Noise: Noise impacts caused by offshore construction, geophysical and geotechnical, and O&M activities; cable laying/trenching; and pile driving could affect finfish and invertebrates. Of these noise-producing factors, noise from pile driving would likely have the greatest impact. Pile-driving noise occurs during installation of foundations for offshore wind structures. Pile driving for construction of more than one offshore wind project may occur concurrently in the geographic analysis area over an 8-year period.

In-water noise is transmitted through the water column and seabed and could cause injury or mortality to finfish present in the vicinity of each pile. Noise from pile driving would cause short-term stress and behavioral changes to finfish and invertebrates. Sound transmission depends on many environmental parameters, such as the sound speeds in the water and substrates. It also depends on the sound production parameters of a pile and how it is driven, including the pile material, size (length, diameter, and thickness), and make and energy of the hammer. Fish response would be highest near impact pile driving (within tens of meters), moderate at intermediate distances (within hundreds of meters), and low far from the pile (within thousands of meters) (COP Appendix U-2; Mayflower Wind 2022). Behavioral changes induced by sound can be observed in fish up to 7.5 kilometers away from the pile-driving site (Hastings and Popper 2005). During active pile-driving activities, highly mobile finfish likely would be displaced from the area, most likely showing a behavioral response; however, fish in the immediate area of pile-driving activities could suffer injury or mortality. Affected areas would likely be recolonized by finfish in the short term following completion of pile-driving activity. Early life stages of finfish, including eggs and larvae, could experience mortality or developmental issues as a result of noise; however, thresholds of exposure for these life stages are not well studied (Weilgart 2018).

Impacts from pile-driving noise on finfish would also depend on other factors that affect local fish populations, including time of year. Impacts from noise would be greater if occurring during spawning periods or in spawning habitat, particularly for species that are known to aggregate in specific locations to spawn, use sound to communicate, or spawn once in their lifetime. Prolonged localized behavioral impacts on specific finfish populations over the course of years could reduce reproductive success for multiple spawning seasons for those populations, which could result in long-term decline in local populations. Recent studies (de Jong et al. 2020) have found continuous noise exposure to be detrimental to the reproduction of species that use sound to coordinate reproductive behavior. Chronic exposure to continuous noise can induce hearing loss in fish. Anthropogenic noise may also overlap in frequency with the calls made by fish, causing the calls to be drowned out and inaudible to other individuals of the species. Fish-chorusing behavior has been found to change in the presence of noise from pile-driving activities (Siddagangaiah et al. 2021). Calls were found to increase in intensity and change in duration. Deviations in calling behavior may have effects on fish reproductive success, migration, and predation behavior. However, based on behavioral studies of black sea bass (Jones et al. 2020), fish behavior returns to a pre-exposure state following completion of noise impacts. Additionally, as acoustic impacts decline with distance, it is unlikely that impacts of pile driving from wind farms outside of a certain threshold distance would result in any local population being subject to multiple years of acoustic impacts that would result in long-term impacts on the population. Therefore, impacts on finfish from pile driving are anticipated to be temporary and intermittent during periods when pile driving is actively occurring. It is important to note that no planned non-offshore wind pile-driving activities have been identified in the geographic analysis area for this resource other than current ongoing activities.

Marine invertebrates lack internal air spaces and gas-filled organs needed to detect sound pressure and so are considered less likely to experience injury from overexpansion or rupturing of internal organs, the typical cause of lethal noise-related injury in vertebrates (Popper et al. 2001). Noise thresholds for adult invertebrates have not been developed because of a lack of available data, but some invertebrates are responsive to particle motion and are therefore capable of vibration reception (e.g., crustaceans, squid) (Mooney et al. 2020). This is supported by other studies that found American lobster and shore crabs (*Carcinus maenas*) to have some capability to detect and respond to sound (Jézéquel et al. 2021; Aimon et al. 2021).

The longfin squid (*Loligo pealeii*) has been found to perceive sound similar to fish, but with the use of a statocyst to detect particle motion. This leads to squid being especially sensitive to low frequency sounds (Mooney et al. 2010). Short exposure to low frequency sounds was found to cause traumatic lesions in the statocysts of squid, creating negative impacts on their sense of balance and direction (André et al. 2011). Upon exposure to pile-driving impulses recorded from a wind farm installation, the longfin squid has been found to exhibit an initial startle response, comparable to that of a predation threat, but upon exposure to additional impulses, the squid's startle response diminished quickly, indicating potential habituation to the noise stimulus (Jones et al. 2020). After a 24-hour period, the squid seem to re-sensitize to the noise, which is an expected response to natural stimuli as well. Squid schooling and shoaling behavior could be interrupted when exposed to pile-driving impulse noises, which could affect predation risk. The startle response to pile-driving impulses could disrupt squid spawning behavior should the pile driving occur during spawning season. During feeding, a lower proportion of squid captured live killifish (*Fundulus heteroclitus*) prey in noise exposure trials compared to silent control trials, but these differences in capture rates were not statistically significant. Regardless of whether they were hunting, squids exhibited comparable alarm responses to noise. Hearing measurements confirmed the noise was detected by the squid (Jones et al. 2021).

Noise transmitted through water and through the seabed can cause a disturbance response in invertebrates within a limited area around each pile and short-term stress and behavioral changes in individuals over a greater area (e.g., discontinuation of feeding activity). The extent depends on pile size, hammer energy, and local acoustic conditions, with the affected areas recolonized in the short term. These impacts are therefore anticipated to be temporary and intermittent, occurring only during active impact and vibratory pile driving. A study by Jézéquel et al. (2022) found that bivalve behavior is influenced by the noise generated by pile driving. Scallops across all life stages reacted to pile-driving impact noise by shutting their valves. Scallops did not become acclimated to the noise and continued to react after 2 weeks of repetitive exposure. This response expends energy and leads to increased respiration, leaving the scallops with less energy and more vulnerable to predation. The scallops were found to react to the intermittent, high intensity noise of impact hammer pile driving, but did not react to the continuous, low intensity noise created by vibratory hammer pile driving (Jézéquel et al. 2022).

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

Noise from trenching equipment for placement of new or expanded submarine cables and pipelines is likely to occur in the geographic analysis area due to planned and ongoing wind energy projects. It is assumed that while these disturbances are likely to occur, they would be infrequent over the next 35 years. Trenching noise depends on the substrate being trenched, where sandy sediments would be expected to create lower noise levels compared to rocky substrate, larger cobbles, or both. In a study by Subacoustech, noise from trenching was found to be composed of broadband noise, tonal machinery noise, and transients, likely associated with rock breakage; a source level of 178 decibels referenced to a pressure of 1 micropascal (dB re 1 μPa) at 1 meter distance was measured during the study (Nedwell et al. 2003), which is lower than the thresholds where injury to fish would be expected but above the threshold where behavioral changes may occur. Additionally, during cable-laying operations, vessels may use dynamic positioning to stay on course. The noise associated with dynamically positioning vessels has also been shown to illicit a diving response in fish (Peña 2019). As such, noise impacts from trenching would be expected to alter fish behavior at close range. Noise impacts associated with submarine cables and pipelines would be temporary and localized and extend only a short distance beyond the emplacement corridor. Impacts from noise would be lower than impacts from the trenching and disturbance to the seafloor; regardless, the most prominent noise-producing activities would be related to trenching and seafloor excavation, if burial of pipeline or cables is determined to be necessary. Noise from trenching could result in injury or mortality for finfish in the immediate vicinity of the activity and would likely result in temporary behavioral changes in a broader area. These impacts would be short-term, and finfish would be expected to return to the areas of impact following any cable or pipeline activities.

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

The overall impacts of noise on finfish, invertebrates, and EFH are likely to be moderate and long-term.

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

Traffic (vessel strikes): The presence of vessels introduces the risk of vessel collision with marine life, and vessel collisions with marine life are an ongoing threat in the geographic analysis area due to vessels from numerous industries such as trade, tourism, resource development, and offshore wind development. Marine species that spend a significant time near the water surface or in areas where vessel routes overlap with migration, feeding, or breeding grounds have the potential to be struck by vessels (SEER 2022). Vessel collisions may result in blunt-force and sharp-force trauma, both of which can result in death, but are likely to be underrepresented due to a lack of reporting awareness and because not all struck marine animals are recoverable for documentation. Vessel speed reductions and route restrictions have shown to be effective mitigation measures for reducing the probability of injury and mortality related to vessel collisions. Impacts of vessel collisions can result in injury and mortality and may affect populations in some ESA-listed species.

Presence of structures: Presence of structures could lead to impacts on finfish, invertebrates, and EFH through entanglement, gear loss or damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances. These impacts could occur through addition of buoys, meteorological towers, WTG foundations, scour/cable protection, and transmission cable infrastructure. Over the next 35 years, development is expected to continue in the geographic analysis area, providing additional structures on the seafloor. Based on assumptions of development for other offshore wind projects, 2,945 foundations would be developed in the geographic analysis area (Appendix D, Table D2-2). BOEM assumes that offshore wind projects would include similar components for construction—that is, WTGs, offshore and onshore cable systems, OSP, onshore O&M facilities, and onshore interconnection facilities—all of which would increase the total number of structures in the geographic analysis area over the next 35 years. In the geographic analysis area, structures are anticipated predominantly on sandy bottom, except for cable protection, which is more likely to be needed where cables pass through hard-bottom habitats. The potential locations of cable protection for planned activities have not been fully determined at this time; however, any addition of scour protection/hard-bottom habitat would represent substantial new hard-bottom habitat, as the geographic analysis area is predominantly composed of sand, mud, and gravel substrates.

Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016), as further described in Section 3.4.2, *Water Quality*, and Section 3.5.6, *Marine Mammals*. During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures.

The presence of WTGs is likely to create hydrodynamic effects that could have localized impacts on food web productivity and pelagic eggs and larvae. Addition of vertical structure that spans the water column could alter vertical and horizontal water velocity and circulation. The geographic analysis area is considered seasonally stratified, with warmer waters and high salinity leading to weak stratification in the late summer and early fall. Presence of the monopiles in the water column can introduce small-scale mixing and turbulence that also results in some loss of stratification (Carpenter et al. 2016; Floeter et al. 2017; Schultze et al. 2020). In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017). Refer to Section 3.5.6, *Marine Mammals*, for additional discussion regarding hydrodynamic and atmospheric wake effects on secondary impacts to larval transport and primary production.

Monopiles can also influence current speed and direction. Monopile wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles, there is evidence of hydrodynamic effects out to a kilometer from a monopile (Li et al. 2014). However, other work suggests the influence of a monopile is primarily limited to within 328 to 656 feet (100 to 200 meters) of the pile (Schultze et al. 2020). The discrepancy is likely related to local conditions, wind farm scale, and sensitivity of the analysis. Here, the conservative assumption is made that wake effects could occur within 656 to 1,312.3 feet (200 to 400 meters) downstream of each monopile. Because the WTGs would be spaced 1 by 0.8 nautical mile (1.9 by 1.5 kilometers), which is greater than the downstream extent of individual hydrodynamic effects, the hydrodynamic effects of one monopile are not expected to influence the effects of another. Thus, there are no anticipated large-scale hydrodynamic effects of the monopile array, simply local effects of each individual monopile.

Wind wake may disturb fish larvae transport pathways (van Berkel et al. 2020). Importantly, net primary productivity is driven by photosynthesis in marine phytoplankton and accounts for half of global-scale photosynthesis and supporting major ocean ecosystem services (Field et al. 1998). There are few empirical data showing the impact of WTGs on ocean stratification (Tagliabue et al. 2021), although recent models have demonstrated ocean mixing as a result of the wind-wake effect of WTGs in the North Sea (Carpenter et al. 2016; Floeter et al. 2017, Dorrell et al. 2022). However, interannual changes in net primary productivity in the North Atlantic are poorly correlated with parallel changes to stratification and emphasize the importance of other physical mechanisms, especially the Gulf Stream (Tagliabue et al. 2021). In addition, Golbazi et al. (2022) modeled surface effects of next-generation large turbines (> 10 MW) along the Atlantic OCS and found that due to the higher hub heights of larger turbines, meteorological changes at the water surface would be nearly imperceptible.

No future activities were specifically identified in the geographic analysis area specific to entanglement, gear loss, and damage; however, it is reasonable to assume that fishing activities (both commercial and recreational) may increase over time in the vicinity of structures due to the likelihood of fish and crustacean aggregation. Damaged and lost fishing gear caught on structures may result in ghost fishing[2] or other disturbances, potentially leading to finfish mortality. Impacts from fishing gear would be localized; however, the risk of occurrence would remain as long as the structures are present. The presence of structures in an otherwise primarily sandy benthic environment would provide a more complex environment, likely to attract finfish and invertebrates such as mobile crustaceans of commercial value. As such, entanglement and gear loss may cause increased impacts on finfish,

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

including mortality and alteration of habitats. These impacts would be localized and short-term; however, they would likely persist intermittently as long as structures remain in place.

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

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

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

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

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

Several ESA-listed species may occur in the geographic analysis area, including Atlantic sturgeon (*Acipenser oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), giant manta ray (*Manta briostris*), Gulf of Maine distinct population segment of Atlantic salmon (*Salmo salar*), and oceanic whitetip shark (*Carcharhinus longimanus*). Ongoing and planned activities, including offshore wind activities, would continue to affect these ESA-listed species through both temporary and permanent impacts. Due to the mobile nature and preferred habitats of these species, the presence of structures, light, and offshore cable emplacement and maintenance IPFs are expected to have negligible impacts. Nearshore cable emplacement, maintenance, and resulting EMFs may affect shortnose and Atlantic sturgeon, but these impacts are expected to be minor. The primary impacts expected to affect ESA-listed finfish include noise (specifically, pile-driving activities), regulated fishing efforts, and climate change. Of these, regulated fishing and climate change would likely have long-term minor to moderate impacts from bycatch and similar climate change effects on ESA-listed finfish as on other finfish. Noise from pile driving has the potential to injure or kill sturgeon, but the scale of duration and the area of effects would likely lead to minor impacts with appropriate mitigation. Other ongoing and planned activities such as increased vessel traffic, new subsea cables and pipelines, onshore construction (including ports), channel maintenance, and installation of permanent non-offshore wind-related structures would be expected to have negligible to minor effects. Shortnose and Atlantic sturgeon are prone to vessel strikes in nearshore environments, while giant manta rays are at risk of vessel strikes occurring offshore. However, the dispersed nature of vessel traffic makes these events unlikely. Accidental releases are likely to have minor impacts on sturgeons in most locations. Combining all offshore wind and ongoing and planned non-offshore wind activities (including all of the IPFs discussed) in the geographic analysis area would result in long-term minor to moderate impacts on ESA-listed finfish and invertebrates. Any future federal or private activities that could affect federally listed fish in the geographic analysis area would need to comply with ESA Section 7 or Section 10, respectively, to ensure that the proposed activities would not jeopardize the continued existence of the species.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, finfish and invertebrates would continue to be affected by existing environmental trends and ongoing activities throughout the geographic analysis area. BOEM expects ongoing activities to have continuing short-term, long-term, and permanent impacts (e.g., disturbance, injury, mortality, habitat degradation, habitat conversion) on finfish, invertebrates, and EFH primarily through regular maritime activity, ongoing offshore wind activity, and climate change. The No Action Alternative would likely have **minor** to **moderate** impacts on finfish and invertebrates.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and finfish, invertebrates, and EFH would continue to be affected by natural and human-caused IPFs. Planned non-offshore wind activities would contribute to the impacts on finfish, invertebrates, and EFH through increased vessel traffic, new subsea cables and pipelines, onshore construction (including ports), channel maintenance, and installation of permanent non-offshore wind-related structures.

Offshore wind activities are anticipated to affect finfish, invertebrates, and EFH through primary IPFs that include cable emplacement and maintenance, noise (specifically pile-driving activities), and presence of structures. Considering all the IPFs together, BOEM anticipates that the No Action Alternative, when combined with planned activities in the geographic analysis area, would result in **moderate** impacts on finfish, invertebrates, and EFH. However, regardless of offshore wind-related activities in the geographic analysis area, it is anticipated that the greatest impact on finfish and invertebrates would be caused by ongoing regulated fishing activity and climate change.

3.5.5.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the Project Design Envelope would result in impacts similar to or less than those described in the following sections. The following Project Design Envelope parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on finfish, invertebrates, and EFH include the following:

- The number, size, and locations of WTGs and OSPs;
- Total length of export and interarray cables; and
- The time of year during which construction occurs.

Variability of the proposed Project design exists as outlined in Appendix C. A summary of potential variances in impacts follows.

- WTG number and locations: The level of hazard related to WTGs is proportional to the number of WTGs installed, with fewer WTGs requiring fewer foundations resulting in fewer construction-related impacts on finfish, invertebrates, and EFH.
- Season of construction: Finfish vary in their migration movements, meaning that certain species may be present at different times of year, and their chosen depth in the water column may also be influenced by time of year and water temperature. Some mobile invertebrates also vary in their migration movements, and sensitive life stages are present at certain times of the year. Any construction window would affect finfish species; however, certain windows may avoid larger migratory movements and potential impacts on sensitive fish species, such as Atlantic sturgeon, that may occur in the Project area and are listed under the ESA.

Mayflower Wind has committed to measures to minimize impacts on finfish, invertebrates, and EFH by conducting and evaluating geotechnical and geophysical surveys to identify and avoid sensitive habitats if possible, as well as vessel speed restrictions, sound-attenuation measures, soft starts during pile driving, varied species monitoring and reporting, and several BOEM best management practices (COP Volume 2, Table 16-1; Mayflower Wind 2022).

3.5.5.5 Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

The following sections summarize potential impacts of the Proposed Action on finfish, invertebrates, and EFH during construction and installation, O&M, and conceptual decommissioning of the Project, as described in Chapter 2, *Alternatives*.

Accidental releases: As discussed in Section 3.5.5.3, *Impacts of Alternative A – No Action on Finfish, Invertebrates, and Essential Fish Habitat*, nonroutine events, such as accidental oil or chemical spills, can have adverse or lethal effects on marine life; however, applicant-proposed measures, such as a spill prevention and a response plan, would be developed and implemented during all phases of the Proposed Action. The risk of any type of accidental release would be increased, primarily during construction, but also during O&M and decommissioning of offshore wind facilities (COP Appendix AA, Section 8.3.1, Table 8-3; Mayflower Wind [2022] discusses the maximum-case scenarios of potential releases). Modeling by Bejarano et al. (2013) predicted that the impact of smaller spills on benthic invertebrates would be low, and any accidental releases from the Project are expected to be localized. Larger spills are unlikely but could have a larger impact on benthic fauna due to adverse effects on water quality (Section 3.4.2, *Water Quality*). Compliance with USCG regulations would minimize the risk of accidental release of trash or debris. Another potential impact related to vessels and vessel traffic is the accidental release of invasive species, especially during ballast water and bilge water discharges from marine vessels. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR § 151.2025) and USEPA National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim at least in part to prevent the release and movement of invasive species. Adherence to these regulations would reduce the likelihood of discharge of ballast or bilge water contaminated with invasive species. The risk of accidental releases would be increased by the additional vessel traffic associated with the Proposed Action, especially traffic from foreign ports, primarily during construction. The potential impacts on benthic resources are described in Section 3.5.2.

Anchoring: Vessel anchoring would cause short-term impacts on finfish and invertebrates in the immediate area where anchors and chains meet the seafloor in offshore sandy environments. Impacts would include turbidity affecting finfish and invertebrates and injury, mortality, and habitat degradation, primarily of invertebrates. All impacts would be localized, turbidity would be temporary, and displacement and mortality from physical contact would be recovered in the short term. Impacts may be higher in sensitive habitats (e.g., eelgrass beds, hard-bottom habitats) and other EFH. Degradation of EFH and other sensitive habitats such as SAV or hard-bottom habitats, if it occurs, could be long term to permanent. BOEM could require Mayflower Wind, as a condition of COP approval, to develop and implement an anchoring plan, potentially in combination with additional habitat characterization. Such a plan could reduce the area of sensitive habitats affected by anchoring, but avoidance of all sensitive habitats is not likely feasible.

Discharges/intakes: Increases in Project vessel discharges would occur during construction and installation, O&M, and decommissioning. As described under the No Action Alternative, certain discharges are required to comply with permitting standards that are established to minimize potential impacts on the environment. Impacts from entrainment and impingement of finfish and invertebrates associated with cable emplacement would be mostly confined to cable centerlines and would be short-term and minor.

Entrainment and impingement of finfish and invertebrates could also occur at HVDC converter intakes if Mayflower Wind selects an HVDC converter OSP. If HVAC OSPs are used, entrainment and impingement impacts would not occur. Mayflower Wind developed an NPDES permit application for one offshore HVDC converter OSP in the Lease Area (in an approximate location, see Appendix B, Figure B-2) (TetraTech and Normandeau Associates, Inc. 2022). The HVDC converter OSP is expected to withdraw cooling water from the ocean at a rate of approximately 8 to 10 million gallons per day from three intakes approximately 32.8 feet (10 meters) above the seafloor. Entrainment and impingement of organisms may occur at cooling water intakes for HVDC converters, but the system is designed to maintain an intake velocity of less than 0.5 feet per second to minimize impingement impacts.[3]

Impacts of entrainment on finfish and invertebrates at HVDC converter intakes are anticipated to be limited to the immediate area of the OSP. To minimize potential impacts on zooplankton from entrainment, Mayflower Wind has committed to siting the northernmost HVDC converter OSP outside of a 10-kilometer buffer of the 30-meter isobath from Nantucket Shoals, an area of high productivity and foraging value for several marine species (COP Volume 2, Table 16-1; Mayflower Wind 2022). Given the limitations of recent data immediately in the vicinity of the intake location, Mayflower Wind's NPDES permit application used EcoMon plankton data from 1977–2019 to estimate entrainment abundance from cooling water withdrawal at the OSP (TetraTech and Normandeau Associates, Inc. 2022). The minimum, mean, and maximum larval densities observed within 10 miles (16 kilometers) of the OSP location were used to extrapolate the range of entrainment abundance. The annual entrainment abundance of fish larvae was estimated to range from 8.4 million to 176.2 million with a mean estimate of 84.0 million. Based on monthly mean larval densities and excluding unidentified fish, the taxa with the highest estimated larval entrainment annually were hakes (3.94 million), Atlantic herring (3.92 million), sand lances (3.3 million), summer flounder (1.4 million) and silver hake (0.50 million) (TetraTech and Normandeau Associates, Inc. 2022).[4] Impacts from entrainment of finfish and invertebrates associated with HVDC converter OSPs would be continuous during the O&M phase resulting in long-term and moderate impacts.

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[3] USEPA considers intake velocities less than 0.5 feet per second the best technology available to minimize impingement impacts.

[4] As further described in the NPDES application (TetraTech and Normandeau Associates, Inc. 2022), due to limitations in the available data, there are uncertainties in these results. For example, entrainment estimates do not fully capture the annual entrainment abundance of all fish and life stages, as all fish eggs and the larvae of less common taxa are excluded from the publicly available EcoMon data set. Additionally, the estimates assume the 1977–2019 time series is representative of the current and future species composition, and that abundance will remain constant each year. The data also represents sampling of ichthyoplankton at various depths, whereas the OSP intake would withdraw water from a discrete depth in the water column (32.8 feet [10 meters] above the seafloor). This may result in overestimation of larval entrainment, as individuals settling in demersal habitats or floating on the surface may not be susceptible to the intake flow.

In addition to entrainment impacts, the HVDC converter OSP would discharge warmer water into the surrounding ocean, which could have localized impacts on fish species. The impact of raised water temperatures on living organisms is most frequently seen in the lowered dissolved oxygen saturation level of warmer water since dissolved oxygen levels are often a limiting factor for organism survival (Mel'nichenko et al. 2008). Further, temperature affects the speed of egg development and growth of offspring (Walkuska and Wilczek 2009). Mayflower Wind modeled thermal plumes of the discharged cooling seawater from the HVDC converter OSP. Four different thermal discharge scenarios were modeled, two in the winter and two in the summer, and the anticipated impacts on water temperature from the effluent discharge were found to be minimal. Thermal plumes up to 0.5°F above ambient sea temperatures extended from 75 meters to approximately 400 meters from the OSP, varying by seasonal ocean currents. The maximum plume range of seawater 5°F above ambient seawater conditions extended 43 meters in the winter with maximum current speeds (TetraTech and Normandeau Associates, Inc. 2022). The limited range of warmed water, local oceanographic conditions, and the ability of fish to move out of the affected area would likely result in long-term and minor impacts on fish species.

Gear Utilization: Mayflower Wind has proposed a variety of survey methods to evaluate the effect of construction and operations on benthic habitat structure and composition and economically valuable fish and invertebrate species. The survey methods in Table 3.5.5-3 either directly or indirectly assess finfish, invertebrates and EFH and could affect these resources. Video trawl surveys used to assess abundance and distribution of target fish and invertebrate species within the Offshore Project area could affect a variety of finfish and invertebrate species, but any impacts would be greatly reduced as these would be open cod-end video surveys, ideally resulting in no mortality of sampled organisms. However, if traditional trawl surveys are proposed, the capture of fish species, including ESA-listed species like the Atlantic sturgeon, in trawl gear has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). Capture of sturgeon in trawl gear could result in injury or death; however, the use of trawl gear is considered a safe and reliable method to capture sturgeon if tow and onboard handling times are limited (Beardsall et al. 2013).

Table 3.5.5-3. Fisheries surveys considered by Mayflower Wind

Marine Fish Surveys and Studies in Planning Stage	Focus
Trawl Surveys	Collect baseline data to evaluate changes to mesoscale abundance and distribution of fish (demersal and benthic species) within the Offshore Project area. Trawl surveys would be video trawls of finfish and squid resources in the Lease Area and control areas.
Acoustic Surveys	Collect baseline data to evaluate changes to abundance and distribution of fish (pelagic and highly migratory species) around offshore structures. These surveys would be incorporated into innovation and environmental research partnerships.

Marine Fish Surveys and Studies in Planning Stage	Focus
Underwater video/photography surveys (drop camera system, remotely operated vessels (ROVs)	Collect baseline data to evaluate changes to abundance and distribution of invertebrate (scallops, etc.) and benthic habitats. Monitor reef effects of offshore structures and foundations. Surveys would use SMAST drop camera and net camera technology. A component of these is incorporated into innovation and environmental research partnerships.

Source: Mayflower Wind 2022; COP Volume 2, Table 11-20.

Benthic habitat surveys using sonar, video, and photographic imaging are used to evaluate changes in benthic habitat structure and invertebrate community composition. These surveys involve similar methods to and would complement other survey efforts conducted by various state, federal, and university entities supporting regional fisheries research and management. The trawl and underwater video surveys would target specific finfish/invertebrate species using methods and equipment commonly employed in regional commercial fisheries. If physical biological sampling is proposed, organisms captured during surveys would be removed from the environment for scientific sampling and commercial use. Other species of finfish/invertebrates could also be impacted by sampling activities. For example, benthic invertebrates could be injured or killed when survey equipment contacts the seafloor or when inadvertently captured as bycatch. In the event of physical sampling, non-target organisms would be returned to the environment where practicable, but some of these organisms would not survive. While the fishery resource monitoring plan would result in unavoidable impacts to individual finfish/invertebrates, the extent of habitat disturbance and number of organisms affected would be small in comparison to the baseline level of impacts from commercial fisheries and would not measurably affect the viability of any species at the population level. Any sampling would use a random sampling distribution, which means that repeated disturbance of the same habitat is unlikely. As such, habitat impacts from implementation would likely be short term in duration. The intensity and duration of impacts anticipated from Mayflower Wind fishery resource implementation would constitute a minor adverse effect on finfish/invertebrates.

EMF: During operation, powered transmission cables would produce EMFs (Taormina et al. 2018). To minimize EMFs generated by cables, cabling under the Proposed Action would include industry standard electric shielding (COP Volume 2, Table 16-1; Mayflower Wind 2022). The strength of the EMF rapidly decreases with distance from the cable (Taormina et al. 2018). Mayflower Wind proposes to bury interarray and export cables to a target depth of 6 feet (1.8 meters). Due to variable conditions in the Lease Area and along the proposed ECC routes, the anticipated burial depth ranges from 3.2 feet (1.0 meters) to 8.2 feet (2.5 meters) for interarray cables and from 3.2 feet (1.0 meters) to 13.1 feet (4.0 meters) for export cables. This depth is well below the aerobic sediment layer where most benthic infauna live. EMF impacts would be greater in areas where cable burial depth meets only the lower end of the anticipated burial depth range or cannot be buried. However, EMF impacts would still be localized to the areas around the cables. EMF levels would be highest at the seabed and in the water column above cable segments that cannot be fully buried and are laid on the bed surface under protective rock or concrete blankets. Mayflower Wind estimates that up to 10 percent of the length of the offshore export cables to Falmouth and 15 percent of the offshore export cables to Brayton Point may require additional cable protection.

The scientific literature provides some evidence of responses to EMFs by fish and mobile invertebrate species (Hutchison et al. 2018; Taormina et al. 2018; Normandeau Associates, Inc. et al. 2011), although recent reviews (CSA Ocean Sciences, Inc. and Exponent 2019; Gill and Desender 2020; Albert et al. 2020) indicate the relatively low intensity of the EMF associated with marine renewable projects would not result in impacts. Effects of an EMF may include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). Review of responses to a direct current EMF found that behavioral responses to EMF is species-specific and varies based on life stages. Demersal fish such as haddock (Cresci et al. 20220) and the larval stages of crustaceans (Harsanyi et al. 2022) are among the groups that have shown responses to EMF. However, there is a lack of conclusive evidence supporting the observed behavioral responses as being indicative of potential population-level detrimental impacts (COP Appendix P2; Mayflower Wind 2022).

CSA Ocean Sciences, Inc. and Exponent (2019) found that offshore wind energy development as currently proposed would have minor effects, if any, on bottom-dwelling finfish and invertebrates residing within the southern New England area. Although demersal biota would be most likely to be exposed to the EMF from power cables, potential exposure would be minimized because an EMF quickly decays with distance from the cable source (CSA Ocean Sciences, Inc. and Exponent 2019). Project-specific modeling confirmed that EMFs diminished rapidly (COP Appendix P1; Mayflower Wind 2022). In the case of mobile species, an individual exposed to an EMF would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on whether previous exposure to an EMF would influence the impacts of future exposure. For pelagic species in the southern New England area, no negative effects were expected from offshore wind energy development as currently proposed because of their preference for habitats located at a distance from the seabed. Therefore, BOEM expects localized and long-term, though not measurable, impacts on finfish, invertebrates, and EFH from EMFs from the Proposed Action.

Lighting: Activities associated with the Proposed Action that could cause impacts from lighting on finfish and invertebrates include presence of vessels throughout construction, operation, and decommissioning. Transiting and working vessels associated with construction would use artificial lighting during any operations outside of daylight hours. Light is generally considered an attractant to finfish (Marchesan et al. 2005); thus, it would be expected that areas where artificial light strikes and penetrates the ocean surface would experience increased fish activity. Lighting may result in impacts on normal behavior of fish and pelagic eggs and larvae by altering their movement and potentially causing temporary increases in predation pressure and disruption of normal swimming behavior, where light may be an attractant to finfish. Light sources from the Project would involve obstruction lights on the nacelle and mid-mast, which are characterized by intermittent flashes of red hues, and marine navigational lights, which are characterized by intermittent flashes of yellow hues, neither of which present a continuous light source. Artificial light would be minimized to the extent practicable through use of BMPs.

Cable emplacement and maintenance: The Proposed Action would entail a maximum of approximately 1,676 miles (2,697 kilometers) of new cable installation, which includes 497 miles (800 kilometers) of interarray cables and 1,179 miles (1,897 kilometers) of offshore export cables. The primary impact on finfish, invertebrates, and EFH associated with cable emplacement is related to sediment resuspension during burial of cables and cable placement. Nearshore/inshore environments, such as bays where cable installation would occur, would likely cause temporary displacement of finfish and mobile invertebrates due to sediment resuspension in the water column. In general, nearshore environments have finer sediments that take longer to settle back to the seafloor, thus potentially causing impacts on EFH.

Array cables would be installed via jet trenching, precut plow, mechanical plow, and mechanical cutting remotely operated vessel system as necessary. Export cables would be installed with the same equipment, with the addition of dredging, vertical injection, and nearshore horizontal directional drilling. Several of these methods use water withdrawals that can entrain invertebrate larvae (MMS 2009). Negligible impacts would result from the unavoidable entrainment of benthic organisms or their planktonic larvae during cable installation. Due to the limited time and area involved, BOEM does not expect population-level impacts. The consequences of increased turbidity caused by this IPF are discussed in Section 3.5.5.3.

Project-specific sediment dispersion modeling was completed using proposed cable installation methods, site-specific sediment grain size and bathymetric data, and a high-resolution wave and current model for each export cable corridor and interarray cables. Results showed that redeposition of suspended sediments occurs quickly before being transported long distances. Total suspended solid concentrations above 100 milligrams per liter (mg/L) (0.0008 pounds per gallon) extended a maximum of 1,214 feet (370 meters) for any scenario except for nearshore areas of the Brayton Point corridor, where they extended to just over 1 kilometer (0.62 mile). The maximum total suspended solid level dropped below 10 mg/L (0.00008 pounds per gallon) within 2 hours for all simulated scenarios and dropped below 1 mg/L (0.000008 pounds per gallon) within 4 hours for any scenario except for nearshore areas of the Brayton Point corridor, where 100 mg/L and 10 mg/L concentrations lasted for less than 5 hours and a little over 2 days, respectively. Deposition thicknesses exceeding 0.20 inches (5 millimeters) were generally limited to a corridor with a maximum width of 79 feet (24 meters) around the cable routes but reached a maximum of 590 feet (180 meters) from the centerline for the interarray cables (COP Appendices F1 and F3; Mayflower Wind 2022).

Even though invertebrates have a range of susceptibility to suspended sediments and sediment deposition based on life stage, mobility, and feeding mechanisms, invertebrates in this area would be expected to recover in the short term. Sediment plumes in the water column would likely cause temporary displacement of finfish and mobile invertebrates, but they would be expected to return following settlement of sediments.

Offshore construction could also cause adverse impacts on invertebrates from loss or conversion of habitat. Ridges and troughs, sand waves, and boulders are all features present in the Lease Area and export cable route corridors; however, disturbance for cable emplacement would be temporary and short-term. Despite unavoidable mortality, damage, or displacement of invertebrate organisms during sand wave and boulder clearance, the area affected by the construction footprint in the Lease Area and export cable route corridor (3,888 acres [15.7 km^2] total of export and interarray cables) would be a fraction of available benthic habitat. Cable microrouting based on geophysical surveys is expected to minimize impacts on the complex bottom and maximize the likelihood of sufficient cable burial. The seafloor within the Lease Area is generally flat with slopes ranging from very gentle (less than 1°) to gentle (1° to 4.9°) (COP Appendix E, Marine Site Investigation Report; Mayflower Wind 2022). The central portion of the Lease Area has ridges with moderate slopes (5.0° to 9.9°) associated with shallow channels. No large-scale seabed topographic features or bedforms larger than ripples are present within the Lease Area. Megaripples and sand waves are present throughout the northern half of the Falmouth ECC. No megaripples or sand waves were seen within the Sakonnet River, nor anywhere else within the surveyed Brayton Point ECC. Contractors and engineers for Mayflower Wind would perform additional surveys and evaluation of geological conditions in the surface and shallow subsurface layers prior to developing the precise route. This process would minimize impacts on complex bottom habitat and maximize the likelihood of sufficient cable burial. BOEM does not expect population-level impacts on benthic invertebrates (i.e., generally accepted ecological and fisheries methods would be unable to detect a change in population, which is the number of individuals of a particular species that live in the geographic analysis area) as a result of the Proposed Action. Invertebrates would recolonize disturbed areas that have not been displaced by new structures, as discussed in Section 3.5.2.

During construction, seabed alterations resulting from the Proposed Action could lead to short-term impacts on invertebrates, including habitat alteration, injury, and mortality. Under the Proposed Action, the impacts on benthic resources from seabed alteration, including injury, mortality, and short-term habitat disturbance, would be negligible to minor. Sand waves, sand ripples, and boulders are all features present in the Lease Area and export cable route corridors; however, disturbance for cable emplacement would be temporary and short term.

Mayflower Wind is considering benthic imagery surveys to monitor benthic habitats and invertebrate impacts and recovery during the construction, O&M, and decommissioning phases (COP Volume 2, Table 11-20; Mayflower Wind 2022). Such surveys would aid in evaluating the impacts from cable installation and maintenance.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on finfish and invertebrates are pile driving, vessel traffic, aircraft, geophysical surveys (HRG surveys and geotechnical surveys), WTG operation, cable installation, foundation removal, and seabed preparation activities. Pile driving during construction would produce the most intense underwater noise impacts with the greatest potential to cause injury and behavioral effects on finfish and invertebrates, and operational WTG noise would occur over the longest duration; therefore, these effects are the focus of the following Proposed Action assessment.

Impacts from sound vary based on the intensity of the noise and the method of sound detection used by the animal. However, severe impacts could include physiological reactions, such as ruptured capillaries in fins, hemorrhaging of major organs, or burst swim bladders (Popper et al. 2014), which could lead to mortality or behavioral reactions, such as temporary displacement or temporary disruption of normal activities (e.g., feeding, movement). Assessment of the potential for underwater noise to injure or disturb a fish or invertebrate requires acoustic thresholds against which received sound levels can be compared. The most conservative available injury thresholds for fish were developed by the Fisheries Hydroacoustic Working Group (2008) and Popper et al. (2014) and are provided in Table 3.5.5-4. Currently, there are no underwater noise thresholds for invertebrates. The current threshold classification considers effects on fish mainly through sound pressure, without taking into consideration the effect of particle motion. Popper et al. (2014) and Popper and Hawkins (2018) suggest that extreme levels of particle motion induced by various impulsive sources may also have the potential to affect fish tissues and that proper attention needs to be paid to particle motion as a stimulus when evaluating the effects of sound on aquatic life. However, lack of evidence for any source due to extreme difficulty of measuring particle motion and determining fish sensitivity to particle motion renders establishing of any guidelines or thresholds for particle motion exposure currently not possible (Popper et al. 2014; Popper and Hawkins 2018).

Table 3.5.5-4. Acoustic metrics and thresholds for fish currently used by NMFS and BOEM for impulsive pile driving

Faunal Group	Injury L_{pk}	Injury SEL_{24hr}	Behavior L_{rms}
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	--
Fish with swim bladder not involved in hearing [c]	207	203	--
Fish with swim bladder involved in hearing [c]	207	203	--

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

[b] NMFS recommended criteria adopted from Andersson et al. 2007); Mueller-Blenkle et al. 2010); Purser and Radford 2011; Wysocki et al. 2007).

[c] BOEM recommended criteria Popper et al. 2014

Source: COP Appendix U2; Mayflower Wind 2022; FHWG 2008; Popper et al. 2014.

SEL_{24hr} = sound exposure level over 24 hours (decibel re 1 micropascal squared second); L_{rms} = root-mean-square sound pressure (decibel re 1 micropascal); L_{pk} = peak sound pressure (decibel re 1 micropascal)

The primary impacts of noise on finfish and invertebrates would occur during offshore construction activities associated with the Proposed Action. Primary noise impacts would occur from pile-driving activities; research has shown that finfish can suffer behavioral and physiological effects based on received sound levels, distance from the noise, and variables related to the noise-producing impact (e.g., materials, size of hammer).

Under the Proposed Action, noise from pile driving could affect the same populations or individuals multiple times over the 2 years that pile driving would occur; it is currently unknown whether it would have less impact to drive many piles sequentially or concurrently.

As explained in Section 3.5.5.3, any response from invertebrates would be of lower magnitude than that of fish because they tend to be less sensitive to noise exposure. Noise from impact pile driving for the installation of WTGs and OSP foundations would occur intermittently during the installation of offshore structures. A maximum total of 147 WTGs and five OSPs at a maximum of 149 WTG/OSP positions are anticipated for the Proposed Action. Each WTG requires one monopile or 3 to 8 pin piles, and each OSP requires one monopile or up to 27 pin piles, with each pin pile or monopile requiring 2 or 4 hours of driving to install, respectively. This would occur over a maximum-case scenario of a total of 146 days for WTGs and 7 days for OSPs in 1 year (COP Appendix U-2, Table 5; Mayflower Wind 2022). Acoustic propagation modeling of the impact pile-driving activities for the Proposed Action was undertaken to determine distances to the established injury and disturbance thresholds for fish (COP Appendix U2; Mayflower Wind 2022). Two scenarios were considered: the realistic and maximum-case scenarios. Two types of piles were considered under the realistic scenario: 36-foot (11 meter) monopiles and 9.5-foot (2.9 meter) pin piles as part of three-legged jacket foundations. Two types of piles were considered under the maximum-case scenario: 52-foot (16-meter) monopiles and 15-foot (4.5-meter) pin piles as part of four-legged jacket foundations. Impact hammer installation of the monopile foundations would produce the most intense underwater noise impacts with the greatest potential to cause injury-level effects on fish; therefore, these effects are the focus of the following assessment. Sound fields from monopiles and pin piles were both modeled at two locations, representing the variation in water depth in the Lease Area using a Menck MHU1900S impact hammer for the pin piles and Menck MHU4400s for the monopiles for the realistic scenario or a Menck MHU 3500S impact hammer for the pin piles and theoretical 6,600-kilojoule impact hammer for the monopiles for the maximum-case scenario. The modeling also applied 0-decibel (dB), 6 dB, 10 dB, and 15 dB noise attenuation to incorporate the use of a noise-abatement system[5] (e.g., one or multiple bubble curtain[s]). This attenuation is considered achievable with currently available technologies (Bellmann et al. 2020). The modeling results represent a radius extending around each pile where potential injurious-level or behavioral effects could occur and are presented in Table 3.5.5-5.

Table 3.5.5-5. Summary of acoustic radial distances ($R_{95\%}$ in kilometers) for fish during monopile impact pile installation at two locations under the maximum-case and realistic scenario monopile installation with 10-decibel noise attenuation from a noise-abatement system

Threshold Type	Threshold Measurement	Threshold Level	Acoustic Radial Distances ($R_{95\%}$ in km) at Location 1	Acoustic Radial Distances ($R_{95\%}$ in km) at Location 2
Maximum-Case Scenario				
All Fish Behavioral	L_{rms} (unweighted)	150 dB re 1 µPa	14.626	10.304
Small Fish Injury	SEL (unweighted)	183 dB re 1 µPa^2·s	16.653	9.762
Small Fish Injury	L_{pk} (unweighted)	206 dB re 1 µPa	0.153	0.11
Large Fish Injury	SEL (unweighted)	186 dB re 1 µPa^2·s	13.799	8.188
Large Fish Injury	L_{pk} (unweighted)	206 dB re 1 µPa	0.153	0.11

[5] Note that the noise-abatement system implemented must be chosen, tailored, and optimized for site-specific conditions.

Threshold Type	Threshold Measurement	Threshold Level	Acoustic Radial Distances ($R_{95\%}$ in km) at Location 1	Acoustic Radial Distances ($R_{95\%}$ in km) at Location 2
Realistic Scenario				
All Fish Behavioral	L_{rms} (unweighted)	150 dB re 1 µPa	11.154	8.76
Small Fish Injury	SEL (unweighted)	183 dB re 1 µPa^2·s	12.013	7.638
Small Fish Injury	L_{pk} (unweighted)	206 dB re 1 µPa	0.139	0.48
Large Fish Injury	SEL (unweighted)	186 dB re 1 µPa2·s	9.652	5.983
Large Fish Injury	Lpk (unweighted)	206 dB re 1 µPa	0.139	0.48

Source: COP Appendix U2 Tables 45 and 46; Mayflower Wind 2022.
Notes: Cumulative sound exposure level values were calculated for a 24-hour period for the installation of a single 16-meter monopile using a 6,600-kilojoule hammer.
dB re 1 µPa = decibel referenced to 1 micropascal; dB re 1 µPa^{2}s = decibel referenced to 1 micropascal squared second; km = kilometer; L_{rms} = root-mean-square sound pressure; Lpk = peak sound pressure; $R_{95\%}$ = 95% range; SEL = sound exposure level.

Single-strike peak sound pressure (L_{pk}) injury distances represent how close a fish would have to be to the source to be instantly injured by a single pile strike. The cumulative injury distances based on sound exposure level (SEL) consider total estimated daily exposure, meaning a fish would have to remain within that threshold distance over the entire daily period of installation to experience injury. The exposure distances for behavioral effects can be met without prolonged exposure, meaning that any animal within the effect radius is assumed to have experienced behavioral effects.

The likelihood of injury from monopile installation depends on proximity to the noise source, intensity of the source, effectiveness of noise-attenuation measures, and duration of noise exposure. Results from the modeling show that injury to fish from a single strike is limited to 139 meters (realistic) and 153 meters (maximum-case), and injury from prolonged cumulative exposure (over the entire installation of a pile) extends as far as 12.013 kilometers (realistic) to 16.65 kilometers (maximum case) from the monopile for the larger-impact location when 10 dB of attenuation is applied. Modeling indicates that behavioral effects on fish could occur up to 11.2 kilometers (realistic) to 14.6 kilometers (maximum case) from the pile source with 10 dB of attenuation. Within this area, it is likely that some level of behavioral reaction is expected and could include startle responses or migration out of areas exposed to underwater noise (Hastings and Popper 2005). Behavioral disturbance to fish from pile-driving noise is therefore considered temporary for the duration of the activity. Additionally, the Project would employ soft starts during impact pile driving, allowing a gradual increase of hammer blow energy, thus, allowing mobile marine life to leave the area.

Offshore WTGs produce continuous, non-impulsive underwater noise during operation, mostly in lower-frequency bands below 8 kilohertz. There are several recent studies that present sound properties of similar turbines in environments comparable to that of the Proposed Action. Field measurements during operations indicate that sound levels are much lower than during construction; on average broadband root-mean-square sound pressure levels (SPL or L_{rms}) measured 164 feet (50 meters) from a Block Island Wind Farm turbine on average were 119 dB re 1 µPa and tonal peaks were observed at 30, 60, 70, and 120 Hz (Elliott et al. 2019). The Block Island Wind Farm turbines are 6 MW, direct-drive, four-legged jacket-pile structures. At the Block Island Wind Farm in winter, a 71 Hz constant tone was measured 328 feet (100 meters) from a turbine. In summer, sound levels increased between 70 Hz to 120 Hz. The maximum particle velocity during operations (as measured 328 feet [100 meters] from the turbine, just above the seabed) in winter was 40 dB re 1 nanometer per second, while in summer it was closer to 90 dB re 1 nanometer per second; most of the energy was below 25 Hz (Elliott et al. 2019). Overall, results from this study indicate that there is a correlation between underwater sound levels and increasing wind speed, but this is not clearly influenced by turbine machinery; rather it may be the natural effects that wind and sea state have on underwater sound (Elliott et al. 2019; Urick 1983). Furthermore, a recent compilation of operational noise from several wind farms with turbines up to 6.15 MW in size, showed that operational noise generally attenuates rapidly with distance from the turbines (falling below normal ocean ambient noise within 0.6 mile [1 kilometer] from the source), and the combined noise levels from multiple turbines is lower or comparable to that generated by a small cargo ship (Tougaard et al. 2020). Larger turbines do produce higher levels of operational noise, and the least squares fit of that dataset would predict that an SPL measured 328 feet (100 meters) from a hypothetical 15 MW turbine in operation in 10 meters per second (m/s) (19 knots or 22 miles per hour) wind would be 125 dB re 1 μPa. However, all of the turbines in the dataset, apart from the Block Island Wind Farm, were operated with gear boxes of various designs that did not use newer direct-drive technology that is expected to lower noise levels significantly. Stober and Thomsen (2021) noted that the Block Island Wind Farm, using direct drive, is expected to be approximately 10 dB quieter than other equivalent sized jacket-pile turbines. Based on the Tougaard et al. 2020 dataset, operational noise from jacket piles could be louder than from monopiles due to there being more surface area for the foundation to interact with the water; however, the paper does point out that received level differences among different pile types could be confounded by differences in water depth and turbine size. In any case, additional data are needed to fully understand the effects of size, foundation type, and drive type on the amount of sound produced during turbine operation.

Other studies have concluded that operational noise from WTGs is detected by finfish and can affect their behavior. For example, the particle motion generated at a WTG foundation from the turbine operation was found to generate relatively strong broadband sounds, as well as tones likely to induce behavioral responses by fishes, such as cod and plaice in the Baltic Sea (Hawkins 2020). Mooney et al. (2020) reported on increased catchability of cod and roach (*Rutilus rutilus*) within 100 meters of a stopped WTG (i.e., with no noise) as compared to an operating WTG (i.e., with noise) that showed delayed metamorphosis of crab megalopae (larval stage). WTG noise frequency and level were found to overlap with the auditory sensitivity of the marbled rockfish (*Sebastiscus marmoratus*), indicating turbine noise could be detected by fish and may have a masking effect on their acoustic communication (Zhang et al. 2021).

Ship noise, such as from transport or survey boats, is intermittent but can mask the communication signals of haddock (*Melanogrammus aeglefinus*), cod, and other taxa, which may also induce physiological stress and impair foraging and predator responses in both fish and invertebrates. However, acoustic masking is an environmental stressor that ceases as soon as the noise source stops, and, unlike with other stressors, there is no lingering effect.

In addition to operational noises described above, there is a potential for interactions with UXOs, as well as the corrosion of UXOs in the Lease Area. Mayflower Wind may encounter UXOs on the seabed in the Lease Area and along export cable routes. While non-explosive methods may be employed to lift and move these objects, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could kill, injure, or disturb fish species, including ESA-listed species like the Atlantic sturgeon. Should fish species be exposed to noises above behavioral thresholds, the effects would likely be brief (e.g., fish may be startled and divert away from the area), and any effects would be so small that they could not be measured, detected, or evaluated. Seasonal restrictions of UXO detonations from December through April (Incidental Take Regulations application Section 6.6; Mayflower Wind 2022) implemented to avoid marine mammal takes would effectively eliminate the likelihood of any exposures for Atlantic sturgeon.

Geotechnical surveys (drilling, cone penetration testing, and vibracores) related to offshore activities are typically numerous, but very brief, sampling activities that introduce relatively low levels of sound into the environment. The geotechnical surveys would take place prior to construction, with no geotechnical surveys planned to occur during the construction or post-construction phases. The HRG and geotechnical surveys would help identify sensitive habitats (e.g., shellfish, SAV beds) and allow these areas to be avoided to the extent practicable for siting of the WTGs, OSPs, and cable routes. BOEM's regulations and guidance under 30 CFR 585.626 and 585.627 require the lessee to submit detailed G&G data and analysis, among other data requirements to establish engineering and other construction parameters, and the G&G activities are therefore mandatory. The Programmatic BA prepared to evaluate impacts from geotechnical and HRG surveys on the OCS (NMFS 2021d) concluded that no impacts on ESA-listed species, including the Atlantic sturgeon, from these activities are likely to occur.

Surveys would include equipment operating at less than 180 kilohertz and consist of multibeam depth sounding, seafloor imaging, and shallow- and medium-penetration sub-bottom profiling in the Project area. General vessel noise is produced from vessel engines and dynamic positioning to keep the vessel stationary while equipment is deployed and sampling is conducted for these surveys. No population-level impacts on finfish, invertebrate, and EFH resources from noise associated under the Proposed Action are anticipated. Overall impacts of noise on finfish are anticipated to be short term, temporary, and negligible to minor.

Presence of structures: Various impacts on finfish, invertebrates, and EFH resulting from the presence of new structures associated with the Proposed Action are described in detail in Section 3.5.5.3. The Proposed Action would include up to 149 WTG/OSP positions which would be constructed in mostly sandy seafloor. The size of the impact area would vary based on construction design (i.e., monopile, jacket, gravity, or suction bucket foundation). The primary impact would be from the foundations, which would be constructed in mostly soft-bottom seafloor, creating new habitat in the water column and transforming small portions of EFH. New structures could affect finfish and invertebrate migration through the area by providing unique complex features (relative to the primarily soft-bottom seafloor) and altering water currents. This could lead to retention of those species and possibly affect spawning opportunities. Impacts on fish migration as a result of structures associated with offshore wind are unknown, as studies related to this potential impact are not available.

New complex structures could result in additional impacts such as aggregation of fish, entanglement, gear loss, and habitat conversion. These impacts would be highly localized but could be long term for those structures that are not removed. Additionally, new structures could be beneficial to finfish and invertebrate species, providing potential feeding grounds and areas of protection from predators. The structures would create an artificial reef effect, whereby more sessile and benthic organisms would likely colonize these structures over time (e.g., sponges, algae, mussels, shellfish, sea anemones). Higher densities of invertebrate colonizers would provide a food source and habitat to other invertebrates such as mobile crustaceans. The addition of scour and cable protection would have similar effects. Structures may also reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing. During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. Species that rely on soft-bottom habitat, such as surfclams and longfin squid, would experience a reduction in favorable conditions but not to the extent that population-level impacts would be expected. The presence of structures also has potential to influence sediment transport dynamics creating seabed scour that is often reported to reach equilibrium depths of about 1.3 times the foundation diameter (COP Appendix F2; Mayflower Wind 2022). Project-specific modeling estimated scour would be less than this level (COP Appendix F2; Mayflower Wind 2022). Species, such as surfclams, that reside in soft-bottom habitat may experience altered dynamics, but not to the extent that population-level impacts would be expected.

The presence of WTGs is expected to result in wind-wake alterations in and around the Lease Area, which could result in changes to ocean stratification (mixing) that can reduce nutrient supplies to the surface ocean and alter net primary productivity. As described in Section 3.5.5.3, potential impacts on net primary productivity in the North Atlantic from the presence of structures may occur but, without additional data, impacts would be negligible when compared with the effects of the Gulf Stream. The influence of the wake likely extends a few hundred meters from a monopile (NMFS 2019). Wake impacts would likely be permanent but variable, and because of the relatively low offshore wind blocking effect, impacts would be expected to be minor when compared to natural variability (Floeter et al. 2017).

Traffic: Project-related vessels used in pre-construction, construction, O&M, and decommissioning may pose a potential collision risk to finfish. Impacts would be greatest during construction, which would require a daily average of 15 to 35 vessels operating with the Offshore Project area or transiting to and from ports. Impacts would be reduced during O&M because fewer vessel trips would be required and increase again during decommissioning. As described in Section 3.5.5.3, impacts of vessel collisions can result in injury and mortality but no population-level effects would be anticipated. In comparison to existing vessel traffic in the geographic analysis area, the Proposed Action would not have a measurable increase in potential vessel strikes and impacts would be negligible.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Ongoing and planned non-offshore wind activities that would contribute to impacts on finfish, invertebrates, and

EFH include submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, fisheries use and management, global climate change, and oil and gas activities.

Cumulative impacts of the Proposed Action would result in negligible to moderate impacts on finfish, invertebrates, and EFH from noise, cable emplacement, accidental releases, anchoring, discharges, EMF, and lighting. Most of the risk of accidental releases of invasive species comes from ongoing activities, and the impacts (mortality, decreased fitness, disease) due to other types of accidental releases are expected to be negligible. Ongoing and planned activities, including the Proposed Action, could collectively affect up to 3,072 acres (12.4 km^2) of seabed from anchoring, of which the Proposed Action would contribute 442 acres (1.78 km^2) or 14 percent. Cumulative impacts from anchoring would likely be minor and short term, with localized impacts only occurring in the immediate vicinity of anchors. The Proposed Action's contribution to impacts from discharge are anticipated to be minimal considering that the Project would contribute only 149 of the 3,094 future offshore wind structures (5 percent). Impacts from other offshore wind projects from EMF and lighting would result in similar impacts as the Proposed Action and result in overall negligible to minor impacts.

Impacts (disturbance, displacement, injury, and mortality) of new cable emplacement and maintenance under the Proposed Action and other offshore wind projects are estimated to affect up to 185,710 acres (751.5 km^2) on the Atlantic OCS. Of this, the Proposed Action would contribute 2,480 acres (10.6 km^2) of seafloor disturbance within the export cable route corridors and 1,408 acres (5.7 km^2) of seafloor disturbance in the Lease Area. In locations experiencing construction, the affected areas are expected to show some natural recovery. Seabed scars associated with jet plow cable installation are expected to recover in a matter of weeks, allowing for recolonization (MMS 2009). Mechanical trenching, which could be used in coarser sediments, could result in more-intense disturbances and a greater width of the impact corridor. Overall, cable placement activities are expected to cause permanent habitat conversion, leading to long-term localized impacts.

Construction and O&M of 3,094 offshore wind structures, including the Proposed Action, would contribute to impacts on finfish, invertebrates, and EFH from the presence of structures and noise. The Proposed Action's contribution to these impacts from installation of 149 structures would be relatively minimal. The cumulative impacts from the presence of structures would likely be minor to moderate, potentially beneficial, and long term, given that hard-structure surfaces could provide benefits to finfish and invertebrates while they are in place. Impacts of the Proposed Action from noise and the presence of offshore wind structures are expected to be long term, over the course of up to 10 years of construction, and negligible to moderate.

Impacts of Alternative B – Proposed Action on ESA-Listed Species

Impacts of the Proposed Action on ESA-listed finfish and invertebrates are limited to impacts on shortnose sturgeon and Atlantic sturgeon due to their occurrence in the Project area. Other ESA species in the geographic analysis area, including the giant manta ray, oceanic whitetip shark, and Atlantic salmon, are not expected to be present in the Offshore Project area. While these species may occur along Proposed Action vessel routes to and from ports, interactions between vessels and species are considered unlikely or are not identified as a threat to the species, as described in Section 3.5.5.1.

The Proposed Action would have similar impacts on Atlantic sturgeon as other non-ESA species. Presence of structures, emplacement and maintenance of cables, EMFs, and traffic are the primary IPFs that may affect migrating Atlantic sturgeon. To a lesser extent, shortnose sturgeon may be affected by nearshore cable emplacement and maintenance, EMFs, and traffic. Shortnose sturgeon may occur in the nearshore ECCs and landfall locations but are not expected in the Lease Area and, thus, would avoid offshore-related impacts from WTG installation.

Atlantic sturgeon would rarely occur in the Lease Area (Stein et al. 2004; Eyler et al. 2009; Dunton et al. 2010; Erickson et al. 2011) and are unlikely to be affected by WTG installation activity. Given the relatively short range to injury thresholds, and that fish are expected to move away from disturbing levels of noise, it is unlikely that Atlantic sturgeon would remain in sufficient proximity to pile driving for the duration of a pile-driving event to experience injury. Therefore, injuries associated with noise are not expected. The greatest concern for Atlantic sturgeon with respect to placement of structures would be the changes in oceanographic and hydrologic conditions resulting from structures in the open ocean and the subsequent impacts on prey sources. However, Atlantic sturgeon consume prey, such as the sand lance, mollusks, polychaete worms, amphipods, isopods, and shrimp, not as closely affected by physical oceanographic features as other ESA-listed species. Potential impacts on larval dispersion and survival of Atlantic sturgeon prey species from changes in hydrologic conditions are unlikely and impacts are expected to be negligible.

Both Atlantic sturgeon and shortnose sturgeon could be affected by Project vessel traffic to and from ports, with Atlantic sturgeon having the greatest potential for impact. While sturgeon are known to be struck and killed by vessels in rivers and estuaries, there are no reports of vessel strikes in the marine environment, likely due to the space between bottom-oriented sturgeon and the propellers and hulls of vessels (BOEM 2021). Dunton et al. (2010) reported approximately 95 percent of all Atlantic sturgeon captured in a sampling off New Jersey occurred in depths less than 66 feet (20 meters) with the highest catch per unit of effort at depths of 33 to 49 feet (10 to 15 meters). At these depths in open coastal and marine environments, Atlantic sturgeon are not likely to be struck by Project-related vessels. The dispersed nature of vessel traffic and individual sturgeons reduces the potential for co-occurrence of individual sturgeon and individual vessels throughout most of the Project area.

The majority of vessel-related Atlantic sturgeon mortality is likely caused by large transoceanic vessels in river channels (Brown and Murphy 2010; Balazik et al. 2012). Atlantic sturgeon strikes are most likely to occur in areas with abundant boat traffic such as large ports or areas with relatively narrow waterways (ASSRT 2007). In offshore areas, the risk of a vessel strike is likely to be minimal due to overall lower densities of sturgeon and available space for sturgeon to avoid vessels in these areas. Therefore, the potential for vessel strikes to ESA-listed Atlantic sturgeon is considered extremely unlikely to occur. Vessel traffic in relation to the Project is not expected to have a measurable impact on the listed sturgeon species in comparison to existing vessel traffic.

BOEM is in the process of assessing the impacts of the Proposed Action on ESA-listed finfish in the BA and on EFH in the EFH Assessment. BOEM will continue to consult with NMFS under the ESA and results of consultation will be included in the Final EIS. In addition, impacts on EFH will be described in the Final EFH Assessment.

Conclusions

Impacts of the Proposed Action: Activities associated with construction and installation, O&M, and decommissioning of the Proposed Action would have **negligible** to **moderate** impacts on finfish, with the primary impacts on finfish occurring as a result of noise during construction of the Proposed Action. The majority of impacts would likely be behavioral and temporarily displace some finfish, with mortality being a relatively uncommon event as a result of the Proposed Action.

Activities associated with construction and installation, O&M, and decommissioning of the Proposed Action would have long-term but localized and **negligible** to **moderate** impacts on EFH, through temporary to permanent but localized disturbance and habitat conversion. Primary impacts on EFH would result from new cable emplacement, the presence of structures, and anchoring. The resources would likely recover naturally over time. Soft bottom habitat and sand ripples are expected to recover quickly. Sedimentation due to development activities would only affect habitat in the short term before dissipating. The presence of structures is expected to lead to aggregations and the formation of artificial reefs, creating new habitat with beneficial impacts.

Activities associated with construction and installation, O&M, and decommissioning of the Proposed Action alone would have **negligible** to **moderate** impacts on invertebrates through temporary disturbance and displacement, habitat conversion, and behavioral changes, injury, and mortality of sedentary fauna. The presence of structures may have a **minor beneficial** effect on invertebrates through an artificial reef effect. Despite invertebrate mortality and varying extents of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be **moderate**. Although some resources would likely recover naturally over time, the proposed activities are likely to create areas of permanent habitat conversion. In general, the impacts are likely to be local and thus would not be expected to extend to the far-larger geographic analysis area (i.e., LME). The larger invertebrate geographic analysis area was selected to account for migratory movement of mobile species that are predicted to experience **negligible** impacts with respect to the Proposed Action's contribution to the impacts of individual IPFs resulting from ongoing and planned activities. The primary impacts on invertebrates would be expected to occur as a result of new cable emplacement, the presence of structures, noise from pile driving, and anchoring.

Cumulative Impacts of the Proposed Action: Cumulative impacts from the Proposed Action when combined with the impacts from ongoing and planned activities, including offshore wind activities, would result in **negligible** to **moderate** impacts on finfish, invertebrates, and EFH in the geographic analysis area.

3.5.5.6 Impacts of Alternative C on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternative C: Alternative C would avoid EFH and HAPC by avoiding cable installation in the Sakonnet River through an onshore alternative route. Alternative C-1 would reduce the total offshore export cable route by 9 miles (14 kilometers) and Alternative C-2 would reduce the total offshore export cable route by 12 miles (19 kilometers). These reductions in offshore export cable length would eliminate the construction and installation impacts from cable emplacement and anchoring in the Sakonnet River compared to the Proposed Action. The sensitivity of the Alternative C local environment relative to the environment where the cable would be located under the Proposed Action could influence the magnitude of the potential reduction in impacts from Alternative C-1 and Alternative C-2. The Sakonnet River contains a mix of soft bottom and complex substrates, which can be important benthic habitats for fish and invertebrates (refer to the analysis of Alternative C in Section 3.5.2, *Benthic Resources* for a description of benthic habitat impacts along the Brayton Point ECC). In a few locations, live *Crepidula* reefs or *Crepidula* shell hash were found on the sediment surface overlying reduced silt (COP Appendix M.2; Mayflower Wind 2022), which is a biogenic habitat that also adds complexity to the seafloor. This complex habitat, along with some boulder fields in Mount Hope Bay, are EFH for many species, and Alternative C will avoid the disturbance of this benthic habitat. Because the Sakonnet River is HAPC for juvenile Atlantic cod, there is a greater potential for Alternative C to avoid or minimize impacts on this species than the Proposed Action because cable emplacement would not occur in the Sakonnet River. Site assessment surveys are not available for the portion of the Alternative C export cable corridors that diverge from the Proposed Action cable corridors. The sensitivity of these habitats relative to the Proposed Action are not fully known, although they are anticipated to be similar to the habitats found along the Proposed Action's cable corridor given the proximity of the routes. As under the Proposed Action, Mayflower Wind would use HDD for the installation of the Alternative C offshore export cables beneath the shallower nearshore areas at all landfall locations. This is expected to substantially reduce impacts of sediment dispersion on sensitive habitats, such as SAV and wetlands, which could serve as EFH. Based on the negligible to minor and temporary to short-term nature of impacts from cable emplacement for the Proposed Action, BOEM anticipates that potential effects from avoiding the installation of export cables in the Sakonnet River would result in a reduced, but not measurably different, impact on finfish, invertebrates, and EFH.

The reductions in offshore export cable length would likewise reduce the O&M impacts associated with the long-term presence of cable protection compared to the Proposed Action. The potential difference in impacts between the Proposed Action and Alternative C from the presence of structures would depend on the amount of cable protection required and the habitat type where it is placed. The amount of cable protection depends on the coarseness of the benthic habitat, which is not known at this time between the Proposed Action and Alternative C cable routes, but generally can be assumed to be less for Alternative C-1 followed by Alternative C-2 based on cable length. Anticipated impacts associated with finfish, invertebrates, and EFH during operation of cables under the Proposed Action are expected to be minor, potentially beneficial, and long term, given that hard-structure surfaces could provide benefits to finfish and invertebrates while they are in place. Due to the potentially adverse and beneficial long-term impacts of the presence of structures, BOEM anticipates that potential benefits from avoidance of cable emplacement impacts within Sakonnet River habitats would not measurably reduce O&M impacts on finfish, invertebrates, and EFH.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Impacts of Alternative C on ESA-Listed Species

The export cable reroute under Alternatives C-1 and Alternative C-2 would not cross other habitats important to ESA-Listed species, but it would have a reduced total length of offshore export cable installation and, therefore, reduced potential impacts from construction, installation, operations, and maintenance. Under the Proposed Action, new cable emplacement and maintenance are expected to have negligible impacts on ESA-listed species. Therefore, BOEM anticipates that impacts on ESA-listed species under Alternative C would not be measurably different from those anticipated under the Proposed Action.

Conclusions

Impacts of Alternative C: Alternative C would reduce cable-related impacts on finfish, invertebrates, and EFH within the Sakonnet River compared to the Proposed Action. The Sakonnet River is an important area for juvenile Atlantic cod and other species with EFH present, but overall impacts on this area under the Proposed Action area are anticipated to be small and make up a small portion of the overall Project impacts. Therefore, construction and installation, O&M, and decommissioning of Alternative C would likewise result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH and could include **minor beneficial** impacts.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative C would be similar to the Proposed Action and result in **negligible** to **moderate** impacts on finfish, invertebrates, and EFH.

3.5.5.7 Impacts of Alternative D on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternative D: Alternative D would eliminate up to six WTGs in the northeastern portion of the Lease Area to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals (see Figure 2-7 in Chapter 2). The northeastern edge of the Lease Area is located about 3.1 miles (5 kilometers) from the 30-meter isobath boundary of Nantucket Shoals. Nantucket Shoals provides important habitat for fish species and removing WTGs near this area may reduce impacts on finfish, invertebrates, and EFH. Notably, the northeastern portion of the Lease Area is approximately 20 miles (32 kilometers) from the Great South Channel Habitat Management Area (GSC HMA) in Nantucket Shoals, which the New England Fishery Management Council (NEFMC) established to protect complex benthic habitats important to juvenile cod and other groundfish species from mobile bottom-tending fishing gear (NOAA 2020). The species with EFH designations in the GSC HMA, and by extension Nantucket Shoals, are the same species that have EFH designations within the Lease Area for all life stages, including Atlantic cod, Atlantic sea scallop, windowpane flounder, winter flounder, and yellowtail flounder (NEFMC 2018). Excluding Atlantic sea scallop, these species are designated as overfished as a result of overfishing, habitat degradation, pollution, climate change, and disease (NOAA 2021). Eliminating WTGs would reduce impacts on these species associated with the construction and O&M of the Project.

The greatest source of impacts generated by WTG installation on fish is noise pollution from pile driving. As discussed in Section 3.5.5.5, *Impacts of Alternative B,* injury from prolonged cumulative exposure (over the entire installation of a pile) would extend as far as 10 miles (16.65 kilometers) (Table 3.5.5-5). Because the northeastern edge of the Lease Area is located within 3.1 miles (5 kilometers) of the 30-meter isobath of Nantucket Shoals, removal of up to six WTGs at the edge of the Lease Area would lessen, but not avoid, noise exposure on EFH in Nantucket Shoals, as noise impacts from pile driving activity from other WTGs would still extend beyond the 30-meter isobath.

Other impacts from WTG installation, such as sediment dispersion from installation activities, would be reduced locally near the site of the WTGs, but these impacts would likely not extend into Nantucket Shoals regardless of Alternative D. The removal of up to six WTGs would also likely not result in a meaningful change in impacts associated with the presence of structures on hydrodynamic and atmospheric effects, because these effects have been shown to extend for several tens of kilometers beyond a wind farm (Christiansen et al. 2022). Other effects, whether adverse, beneficial, or neutral would likely not be greatly affected by the elimination of up to six WTGs as impacts from construction and O&M of 143 WTG/OSP foundations would still occur. Overall, BOEM anticipates that Alternative D would reduce impacts on finfish, invertebrates, and EFH by increasing the distance from the boundary of construction activities to the boundary of Nantucket Shoals but the overall impact magnitudes would be the same as the Proposed Action.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to those described under the Proposed Action.

Impacts of Alternative D on ESA-Listed Species

Impacts on ESA-listed species associated with Alternative D would be largely similar to the impacts associated with the Proposed Action.

Conclusions

Impacts of Alternative D: Alternative D would reduce impacts on finfish, invertebrates, and EFH compared to the Proposed Action by eliminating up to six WTGs nearest to Nantucket Shoals, which provides important fish habitat and EFH for several fish species. While impacts would be reduced locally near the sites of the up to six removed WTG positions, impacts from the remaining 143 WTG/OSP foundations would still occur. Therefore, Alternative D is not expected to change the overall impact magnitude of the Project compared to the Proposed Action. Construction and installation, O&M, and decommissioning of Alternative D would likewise result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH and could include **minor beneficial** impacts.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative D would be similar to the Proposed Action and result in **negligible** to **moderate** impacts on finfish, invertebrates, and EFH.

3.5.5.8 Impacts of Alternative E on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternative E: Alternative E includes the use of all piled (Alternative E-1), all suction bucket (Alternative E-2), or all GBS (Alternative E-3) foundations for WTGs and OSPs. Because the Proposed Action already considers maximum pile-driving impacts of all 149 structures, there would be no difference in impacts from Alternative E-1. Alternative E-1 would install the WTGs and OSPs on either monopile or piled jacket foundations. These foundations would require installation via pile-driving. All noise-related impacts, including acoustic stress and alterations of movement, calling, and spawning behavior in finfish and invertebrates described under the Proposed Action are applicable under Alternative E-1. Impact pile driving for piled jacket foundations would occur for 2 hours per foundation with a maximum of eight piles installed per day. Impact pile driving for monopiles would occur for 4 hours per foundation with a maximum of two piles installed per day. Under Alternative E-2 and Alternative E-3, no impact pile driving would be conducted, eliminating impacts due to underwater noise. Absent the potential impacts on finfish and invertebrates from pile-driving noise, the overall construction and installation impacts on finfish and invertebrates would be reduced under Alternative E-2 and Alternative E-3 compared to the Proposed Action.

GBS foundations, under Alternative E-3, would result in the greatest area of habitat conversion due to foundation footprint and scour protection. Alternative E-1 would result in at least a 77 percent reduction in footprint and scour protection as compared to Alternative E-3, and Alternative E-2 would result in at least a 58 percent reduction in footprint and scour protection, compared to Alternative E-3. Such reductions would reduce O&M impacts due to the presence of structures. Less scour protection would result in loss of less soft-bottom habitat. This would benefit the existing benthic, surficial, and infaunal fish and invertebrate communities.

All foundations would require some seabed preparation before construction. Seabed preparation may be required especially if the seabed is not sufficiently level. For Alternative E-1 piled foundations, in addition to permanent foundation and scour protection, there would be an additional 0.5 acre of temporary seabed disturbance per foundation. Alternative E-2 suction bucket jacket foundations require an additional 0.6 acre of temporary seabed disturbance per foundation. Alternative E-3 GBS foundations may include rock layer/scour protection and dredging. In addition to permanent foundation and scour protection, an additional 1.0 acre of temporary seabed disturbance per WTG foundation and 1.5 acre per OSP foundation would be required for Alternative E-3.

Alternative E-3 would result in the greatest artificial reef creation, due to the GBS foundations having the largest footprint. As discussed under the Proposed Action, the artificial reef effect from scour protection may increase overall abundance and diversity of finfish and invertebrates. Alternative E-2 and the piled jacket foundations of Alternative E-1 would provide more surface area for aggregation, while monopiles would provide the least. The increased surface area would also increase the potential of invasive species impacts. With more area to colonize, Alternative E-3 would have the largest risk of harboring invasive species.

Given that Alternative E would result in reductions in both adverse and beneficial impacts, O&M impacts on finfish, invertebrates, and EFH are not expected to be measurably different from those anticipated under the Proposed Action.

Cumulative Impacts of Alternative E: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative E would be similar to those described under the Proposed Action.

Impacts of Alternative E on ESA-Listed Species

Activities would not differ between the Proposed Action and Alternative E-1. Under Alternative E-2 and Alternative E-3, no impact pile driving would be conducted, eliminating impacts due to underwater noise on ESA-listed species compared to the Proposed Action. Other impacts of Alternative E on ESA-listed species would be similar to the impacts of the Proposed Action.

Conclusions

Impacts of Alternative E: Impacts of Alternative E-1 would not be measurably different than the impacts of the Proposed Action. Therefore, construction, O&M, and decommissioning of Alternative E-1 would result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH and could include **minor beneficial** impacts.

Impacts of Alternative E-2 and Alternative E-3 would be similar to impacts of the Proposed Action with the most notable difference the reduction in short-term impacts from avoidance of pile-driving noise and the increase in long-term impacts from larger foundation footprints. Construction, O&M, and decommissioning of Alternative E-2 and Alternative E-3 would still result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH and could include **minor beneficial** impacts.

Cumulative Impacts of Alternative E: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative E would be similar to the Proposed Action and result in **negligible** to **moderate** impacts on finfish and invertebrates.

3.5.5.9 Impacts of Alternative F on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternative F: Under Alternative F, the Falmouth offshore export cable route would include the use of up to three ±525kV HVDC cables connected to one HVDC converter OSP, instead of up to five HVAC cables connected to one or more HVAC OSPs as proposed under the Proposed Action. The addition of an HVDC converter OSP would result in the same types of impacts as described under the Proposed Action, including entrainment of fish larvae at cooling water intakes and thermal plume discharge, but impacts would be greater because there would be one additional HVDC converter OSP under Alternative F. The reduction in the number of cables from three to five would reduce seabed disturbance and benthic habitat disturbance in the Falmouth ECC by approximately 700 acres (2.8 square kilometers). Impacts from cable emplacement and anchoring may be reduced under Alternative

F due to fewer cables installed. The fewer cables would also reduce the potential EMF effects and temporary entrainment/impingement effects during cable-laying operations compared to the Proposed Action. A 40 percent reduction in seabed disturbance from installation of the Falmouth offshore export cables would reduce impacts on benthic habitat, in particular some complex habitats found in the Muskeget Channel that may be important EFH. The same temporary construction impacts and long-term operational impacts from cable installation would still occur. There would be no change in impacts from other offshore components (e.g., WTGs). Therefore, the overall impact magnitude would be the same as the Proposed Action.

Cumulative Impacts of Alternative F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative F would be similar to those described under the Proposed Action.

Impacts of Alternative F on ESA-Listed Species

Impacts on ESA-listed species for Alternative F would be slightly reduced due to fewer cables being installed compared to the Proposed Action.

Conclusions

Impacts of Alternative F: Impacts of Alternative F would not be measurably different from the impacts of the Proposed Action. Therefore, construction and installation, O&M, and decommissioning of Alternative F would likewise result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH and could include **minor beneficial** impacts.

Cumulative Impacts of Alternative F: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative F would be similar to the Proposed Action and result in **negligible** to **moderate** impacts on finfish, invertebrates, and EFH.

3.5.5.10 Proposed Mitigation Measures

The following mitigation measures are proposed to minimize impacts on finfish, invertebrates, and EFH (Appendix G, Table G-2). If the measures analyzed below are adopted by BOEM, some adverse impacts could be further reduced.

- **HVDC converter station area to avoid.** Precluding open-loop cooling systems from the enhanced mitigation area (Appendix G, Figure G-1) near Nantucket Shoals would minimize potential impacts on finfish and invertebrates from impingement and entrainment in offshore HVDC converter station open-loop cooling systems in this area. This would reduce impacts on species in the highly productive Nantucket Shoals but impacts from impingement and entrainment would still occur from the HVDC converter station(s) location in other parts of the Lease Area. Overall impacts would remain the same.
- **Pile-driving noise limitations.** Pile driving in the enhanced mitigation area (Appendix G, Figure G-1) would only be allowed to occur between June 1 and October 31. Pile-driving noise limitations in the form of time/area closures largely overlap Atlantic cod spawning in southern New England waters from November 1 through May 31, with overlap in the month of June (Evans et al. 2011).

Presumably, pile-driving noise limitations would benefit spawning Atlantic cod, whereas post-spawning adult winter flounder migrating from coastal embayments to southern New England waters before June (Evans et al. 2011) may partially benefit from seasonal restrictions on pile driving.

- **Sand Wave Leveling and Boulder Clearance.** Sand wave leveling and boulder clearance would be limited to the extent practicable and best efforts would be made to microsite to avoid these areas. Avoiding impacts on these features, which provide habitat for various organisms, would minimize impacts on benthic habitat.
- **BOEM-proposed Mitigation and Monitoring Measures included in the NMFS BA.** Implementation of these measures, as listed in Appendix G, Table G-2, would reduce impacts on ESA-listed species.

If these mitigation measures are adopted, they would minimize potential impacts on finfish, invertebrates, and EFH but would not change the impact rating.

3.5 Biological Resources

3.5.6 Marine Mammals

This section discusses potential impacts on marine mammal resources from the proposed Project, alternatives, and ongoing and planned activities in the marine mammal geographic analysis area. This geographic analysis area, as shown on Figure 3.5.6-1, includes the Canadian Scotian Shelf, Northeast U.S. Continental Shelf, and Southeast Continental Shelf LMEs. The geographic analysis area captures the majority of movement ranges for marine mammal populations that could occur within or near the Offshore Project area and provides a practical boundary for assessing impacts, including cumulative effects, resulting from the development of offshore wind energy infrastructure on the Atlantic OCS. As many marine mammals are transboundary, this area is likely to capture the majority of the movement range for most species and cumulative impacts can be expressed over broad areas. Due to the size of the geographic analysis area, the analysis of IPFs of the proposed Project focuses on marine mammals that would likely occur in and near the proposed Offshore Project area and have the potential to be affected by the Proposed Action. The Offshore Project area includes the Mayflower Wind Lease Area (OCS-A-0521) and the offshore export cable corridors shown on Figure 1-1 (Section 1.2, *Purpose and Need of the Proposed Action*).

3.5.6.1 Description of the Affected Environment and Future Baseline Conditions

The geographic analysis area and Offshore Project area are used by a variety of marine mammal species for a range of life-sustaining activities, including foraging, mating, and migration, which directly affects species distribution (Madsen et al. 2006; Weilgart 2007). Some species occur in all seasons (e.g., harbor porpoise [*Phocoena phocoena*], gray seal [*Halichoerus grypus*], harbor seal [*Phoca vitulina*], fin whale [*Balaenoptera physalus*]), and North Atlantic right whale [NARW] [*Eubalaena glacialis*], while others are seasonal visitors to the area (e.g., sperm whale [*Physeter macrocephalus*], common bottlenose dolphin [*Tursiops truncatus*], and humpback whale [*Megaptera novaeangliae*]). Prey distribution can influence the distribution of marine mammals and is highly dependent on oceanographic properties and processes. Therefore, impacts on prey items must also be considered when assessing impacts on marine mammals. Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, of this EIS summarizes the effects on fish, invertebrates, and EFH.

Marine mammal composition in the Northwest Atlantic OCS region includes 38 species, comprising 6 mysticetes (baleen whales), 28 odontocetes (toothed whales and dolphins), and 4 pinnipeds (seals; BOEM 2014). Details for many of the species that may be affected by offshore wind development in the geographic analysis area can be found in the COP Volume 2, Section 3.8.1., Table 6-62 (Mayflower Wind 2022).

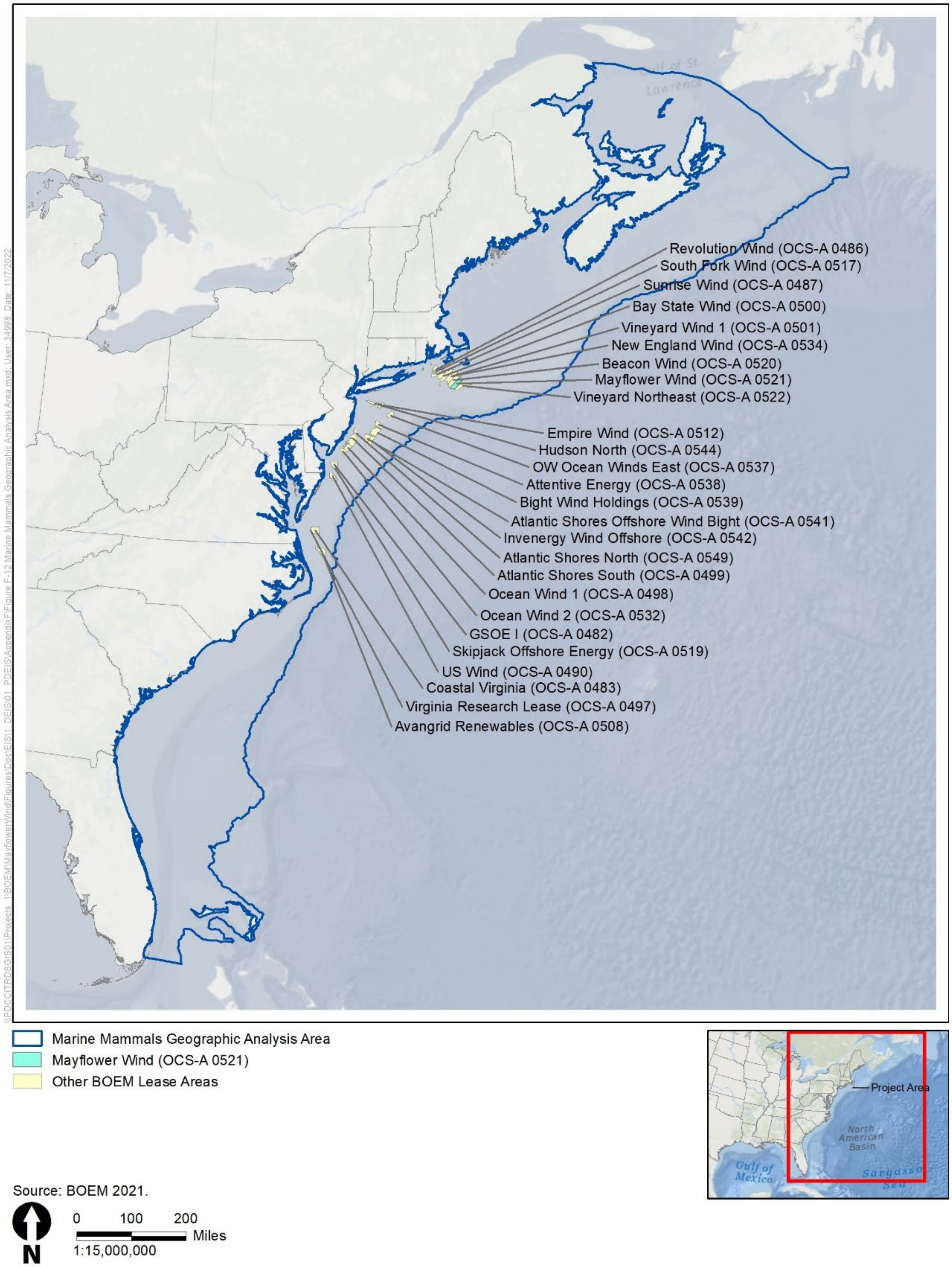


Figure 3.5.6-1. Marine mammals geographic analysis area

The analysis of the Proposed Action includes 31 species of marine mammals that have been documented or are considered likely to occur in the Offshore Project area and that would likely overlap with the Proposed Action including construction, operation, and decommissioning activities (COP Volume 2, Table 6-62; Mayflower Wind 2022). The West Indian manatee (*Trichechus manatus*) is considered extralimital and rare and is not expected to occur in the Project area; thus, this species is not considered further. In addition, six species within the toothed whales and dolphins group were considered to have "hypothetical" occurrence and were excluded from the assessment of the Proposed Action (BOEM 2014). A summary table of species included in the analysis can be found in Appendix B, *Supplemental Information and Additional Figures and Tables*.

Species occurrence, seasonality, habitat use, and density were determined based on the best available literature, government databases, and site-specific analyses conducted for the proposed Project (see COP Volume 2, Table 6-61; Mayflower Wind 2022 for a complete list of all marine mammal literature, guidelines, reports, and data sources used). Several studies of marine mammal occurrence and distribution have been conducted in or near the Offshore Project area. Aerial high-definition (aerial HD) surveys were conducted as project-specific surveys for the Lease Area monthly from November 2019 through October 2020 (Mayflower-APEM 2020a–i). The Northeast Large Pelagic Survey (NLPS), beginning in 2011, collects visual and acoustic data on the abundance, distribution, and temporal occurrence patterns of marine mammals in the Massachusetts and Rhode Island lease areas (Kraus et al. 2016). Survey efforts are directed toward large whales but also include information on small marine mammals (Kraus et al. 2016). The New England Aquarium has been contracted by the Massachusetts Clean Energy Center with funding provided by BOEM to conduct North Atlantic right whale surveys in support of offshore wind development (MCEC n.d.). The Massachusetts Clean Energy Center, in collaboration with Mayflower Wind and other developers in the Massachusetts and Rhode Island lease areas, jointly funded a continuation of these digital aerial surveys from October 2018 to August 2019 (O'Brien et al. 2020) and continuing in March and October 2020 (O'Brien et al. 2021). Further, acoustic and visual Protected Species Observer (PSO) data were collected for the proposed Project during 2019 (AIS Inc. 2020; RPS 2019).

The Atlantic Marine Assessment Program for Protected Species (AMAPPS) coordinates data collection and analysis to assess the abundance, distribution, ecology, and behavior of marine mammals in the U.S. Atlantic. These include both ship and aerial surveys conducted between 2010 and 2019. Although most of the AMAPPS survey has been focused on offshore areas outside the Offshore Project area, a portion was relevant to the assessment of the proposed Project (Palka et al. 2017, 2021). Abundance and density estimates for several marine mammal species were derived using the AMAPPS survey data collected from 2010 to 2014 (Palka et al. 2017). In addition, a habitat-based cetacean density model for the U.S. Exclusive Economic Zone of the East Coast (eastern U.S.) and Gulf of Mexico was developed by the Duke University Marine Geospatial Ecology Laboratory in 2016 (Roberts et al. 2016, Roberts et al. 2022a–m) These models were subsequently updated to include more recently available data in 2017, 2018, 2019, and 2020 (Roberts et al. 2017, 2018, 2020; Curtice et al. 2019, Roberts et al. 2022a–m). Collectively, these estimates are considered the best information currently available for marine mammal densities in the U.S. Atlantic. The general findings of these surveys are presented in the following paragraphs.

Threatened and Endangered Marine Mammals

The ESA (16 USC 1531 et seq.) classifies certain species as threatened or endangered based on the species' overall population status and health. Five marine mammals known to occur in the geographic analysis area are classified as endangered: the blue whale (*Balaenoptera musculus*), fin whale, NARW, sei whale (*Balaenoptera borealis*), and sperm whale (COP Volume 2, Section 6.8, Table 6-62; Mayflower Wind 2022). Blue whales are considered rare migrants to the Project area, but have been sighted during the winter in the Project area (Stone et al. 2017; Kraus et al. 2016) and recorded during the 2010–2013 AMAPPS summer/fall shipboard surveys (Palka et al. 2017). There are less than 10 records of occurrence of the blue whale in the Offshore Project area before 2010 (BOEM 2014). The mean abundance of blue whales in the Offshore Project area from 1998 to 2020 is estimated at less than one individual (0.000-0.016/ 29.15 nm^2 [100 km^2]) (Roberts et al. 2022a).

The fin whale, NARW, sei whale, and sperm whale have relatively common occurrence (more than 100 records of occurrence). Fin whales are common/regular year-round residents in the Project area and were recorded during the NLPS (i.e., detected visually or acoustically) in the Massachusetts and Rhode Island lease areas and the Project area with peak occurrences during the late spring and summer (Kraus et al. 2016) and were observed during the 2010–2013 AMAPPS summer/fall shipboard and aerial surveys (Palka et al. 2017). Additionally, fin whales were observed moving through the Project area during visual surveys (AIS Inc. 2020; RPS 2019). Modeled fin whale abundance from 1998 to 2020 shows peak abundances in the Offshore Project area occurring from April to August, at approximately 0.40-0.63 fin whales/29.15 nm^2 (100 km^2) (Roberts et al. 2022b). Fin whales also use the nearby Nantucket shoals, with modeled density peaks in June and July at approximately 1 to 1.6 fin whales/29.15 nm^2 (100 km^2) (Roberts et al. 2022b). Sei whales may potentially occur in the Project area and were observed in the Massachusetts and Rhode Island lease areas during the NLPS from March to June (Kraus et al. 2016) and recorded during the 2010–2013 AMAPPS summer/fall shipboard and aerial surveys (Palka et al. 2017). Sei whale modeled density from 1999 to 2020 showed a peak in abundance from April to June, with highest densities in May at approximately 0.16 to 0.25 sei whales/ 29.15 nm^2 (100 km^2) (Roberts et al. 2022c). Sei whale modeled density in the Nantucket shoals was highest from April to May at 0.040 to 0.63 sei whales/29.15 nm^2 (100 km^2), but also peaked, to a lesser degree, in November and December (Roberts et al. 2022c). Sperm whales are primarily expected to occur in the Lease Area during the summer and fall and were sighted there during the NLPS and observed during the 2010–2013 AMAPPS summer/fall shipboard and aerial surveys (Palka et al. 2017). Modeled density of sperm whales from 1998 to 2019 peaked in August and September at approximately 0.16 to 0.25 sperm whale/29.15 nm^2 (100 km^2) (Roberts et al. 2022d). Modeled density of sperm whales peaked in October at 0.63 to 1 sperm whale/29.15 nm^2 (100 km^2) (Roberts et al. 2022d).

NARWs are considered common visitors to the Project area with hotspots consistently observed along the northeastern boundary of the Lease Area, adjacent to the Nantucket Shoals, during spring 2011–2015, spring 2017–2019, and winter 2017–2019 (Quintana-Rizzo et al. 2021). From 2015 to 2019, Palka et al. (2021) had acoustic detections of NARWs in all seasons in the northeastern portion of the Lease Area, with the highest number of days of acoustic detections in the winter and spring; with 22 to 67 days of acoustic detections from November to February and again from March to April. Generally, the highest densities of whales occur east of the Lease Area over Nantucket Shoals but may occur in any season in the Project area. There is also the potential for NARW occurrence year-round in the proposed ECCs, with a greater likelihood of occurrence during spring and winter months. Specifically, NARWs may occur along the Brayton Point ECC while foraging during the spring breeding period.

During 2018–2020 New England Aquarium (NEAq) aerial survey activities (Campaign 5 and Campaign 6a), NARWs were the third most observed whale species. In total, 175 sightings of 321 NARWs were recorded during Campaign 5. During Campaign 5 the majority of sightings occurred in the Nantucket Shoals, within 20 nm of offshore wind lease areas, with just one NARW sighted on the boundary of the Mayflower Wind and Beacon Wind Lease Areas (O'Brien et al. 2020). During Campaign 6a, 10 sightings of 15 whales were recorded, all sightings were outside of the Lease Area, but within 15 nm of the Massachusetts lease areas (O'Brien et al. 2021). Across 2 years of survey effort in 2021 and 2022, there were 10 confirmed sightings of NARW by plane in the Lease Area (Johnson et al. 2021a). During each sighting, one whale was observed; there were no acoustic detections in the Lease Area during this time (Johnson et al. 2021a). In winter 2021, two to five NARW were observed in the northeastern portion of the Lease Area, and in spring 2021, two to five NARW were observed in the southwest portion of the Lease Area (Johnson et al. 2021a). The highest monthly acoustic presence detected was during the late winter and early spring months (Kraus et al. 2016). Modeled density of NARW from 2011 to 2020 peaked in the winter and spring months. From January to May abundance peaked at 0.63 to 1 NARW/29.15 nm^2 (100 km^2), and in November to December abundance ranged from 0.16 to 1 NARW/29.15 nm^2 (100 km^2) (Roberts et al. 2022e).

Using data as of September 7, 2021, the latest Pace model (Pace et al. 2017) estimate for the size of the remaining NARW population in 2020 is 336 individuals (95% confidence range +/-14) (NOAA 2022e; Pettis et al. 2022). The draft 2022 NMFS stock assessment report gives a population estimate of 365 NARWs (Hayes et al. 2022). In 2017, an Unusual Mortality Event (UME) began for NARW, totaling 34 dead stranded whales: 21 in Canada and 13 in the United States (NOAA Fisheries 2022a). Entanglement in fishing gear and ship strikes were the causes of mortality during the UME. In addition, 21 live free-swimming non-stranded whales have been documented with serious injuries from entanglements or vessel strikes since 2017, and another 37 individuals have experienced morbidity (sublethal injury or illness) bringing the preliminary cumulative total number of animals in the NAWR UME up to 92 individuals, which represents a substantial loss considering the total NARW population size of fewer than 350 individuals (NOAA Fisheries 2023).

Of the marine mammal species listed under the ESA, critical habitat has only been designated for the NARW. The NARW critical habitat within the marine mammal geographic analysis area includes the feeding areas in Cape Cod Bay, Stellwagen Bank, and the Great South Channel, as well as the calving grounds that stretch from off Cape Canaveral, Florida to Cape Fear, North Carolina. The NARW is also a Massachusetts state-listed endangered species, and the Massachusetts Ocean Management Plan established a core habitat Special, Sensitive, or Unique resource area for NARW 0.5 mile (0.8 kilometer) west of the central portion of the Falmouth export cable corridor based on data that identified statistically significant use for feeding by NARW (COP Appendix L1, Figure 3-3; Mayflower Wind 2022). These critical and core habitat areas do not directly overlap with the Offshore Project area. The northeast critical habitat area is located to the north and east of the Massachusetts and Rhode Island lease areas, but vessel operations associated with offshore wind development may occur through these areas. Additionally, the Brayton Point ECC runs through approximately 18 miles (29 kilometers) of the corner of the NARW Seasonal Management Area, off the west coast of Martha's Vineyard. This area encompasses NARW migratory routes and feeding grounds and indicates where all vessels 65 feet (19.8 meters) or longer must reduce speed to no more than 10 nautical miles per hour from November 1 through April 30 (COP Appendix L1, Figure 3-1; Mayflower Wind 2022). Finally, a Biological Important Area for NARW migration runs along the eastern U.S. coastline and includes the Massachusetts and Rhode Island lease areas.

While the Offshore Project area does not occur in any designated critical habitat areas for NARW, the Lease Area is adjacent to Nantucket Shoals, which is a recently identified foraging area for NARWs. The physical oceanographic and bathymetric features provide for year-round high phytoplankton biomass, likely contributing to increased availability of zooplankton prey for NARWs (Quintana-Rizzo et al. 2021). Waters from the Gulf of Maine, the Great South Channel, and Nantucket Sound mix in the shallow dune-like Nantucket Shoals. The convergence of these waters creates a well-mixed water column throughout the year (Limeburner and Beardsley 1982), making the Nantucket Shoals the only known winter foraging ground for NARWs (Quintana-Rizzo et al. 2021). Modeled NARW abundance in the Nantucket Shoals from 2011 to 2020 peaked in the winter and early spring months, with densities from January to May peaking at 4 to 6.3 NARW/29.15 nm^2 (100 km^2) and again in November and December (Roberts et al. 2022e).

Thus, NARW observations made outside the Lease Area consistently occurred in the nearby Nantucket Shoals and portions of the Massachusetts and Rhode Island lease areas year-round, with abundances peaking from winter through early spring (Quintana-Rizzo 2021; O'Brien et al. 2022). Recently, the presence of NARWs has also increased in the summer and fall, which overlaps with the current schedule for pile driving for projects in the Rhode Island and Massachusetts wind energy areas (Quintana-Rizzo et al. 2021). In earlier years (2012–2015), NARW sighting rates were zero from May through November, but in more recent years (2017–2019) NARWs were sighted in all months except October (Quintana-Rizzo 2021). Southern New England is not a new habitat for NARWs; small numbers have been historically documented here since the beginning of modern survey effort in the late 1970s (O'Brien et al. 2022). However, NARW presence within southern New England has become more common, particularly during winter and spring, but with the potential to occur year-round within this habitat (O'Brien et al. 2022). Their increased presence could be in response to a decline in prey in abandoned feeding habitats or as a result of prey items shifting to more favorable conditions within Nantucket Shoals.

Non-Endangered Marine Mammals

Pursuant to the MMPA (16 USC 1361 et seq.), all marine mammals are protected, and their populations are monitored by NOAA and USFWS. Baleen whales (mysticetes) that are not federally listed and regularly occur near or in the Offshore Project area and Massachusetts and Rhode Island lease areas include the humpback whale and the minke whale (*Balaenoptera acutorostrata*). Humpback whales in the western North Atlantic belong to the West Indies distinct population segment, which is not listed under the ESA; however, this species is listed as endangered under the MESA and listed as a SGCN in Rhode Island. Humpback whales are considered regular year-round residents with sightings expected in the spring and summer months in the Lease Area and in the ECCs during winter migrations. Humpback whales were observed in the Massachusetts and Rhode Island lease areas during the NLPS (Kraus et al. 2016) with sightings mainly during spring and summer and the species noted as nearly absent during the fall and winter (Stone et al. 2017). During Campaign 5, O'Brien et al. (2020) recorded two sightings, each of one humpback whale, in the Lease Area. During Campaign 6a, O'Brien et al. (2021) recorded 22 sightings of 44 humpback whales, with one whale sighted in the northeastern portion of the Lease Area. Humpback whales were also observed during the AMAPPS I and II shipboard and aerial surveys (Palka et al. 2017, 2021) and recorded visually and acoustically during surveys of the Project area (AIS Inc. 2020; RPS 2019). Modeled density for humpback whales, from 2010 to 2020, in the Offshore Project area are highest from April to November, peaking in June at 0.40 to 0.63 humpback whales/29.15 nm^2 (100 km^2) (Roberts et al. 2022f). Humpback whale modeled density in the Nantucket Shoals was highest from April to November, peaking in October at 0.40 to 0.63 humpback whales/29.15 nm^2 (100 km^2). A UME was declared for this species in January 2016, and since then, 32 humpback whales have stranded in Massachusetts, with 158 along the Atlantic Coast (NOAA Fisheries 2022b). About half of the whales examined in the UME showed evidence of vessel strikes or entanglement in fishing gear.

Minke whales can occur in the Offshore Project area and have been observed in and near the Lease Area, with most sightings occurring in the spring and summer (O'Brien et al. 2020, 2021, 2022). Modeled density for the minke whale in the Offshore Project area from 1999 to 2019 peaked from April to September with peak densities in June at 1.6 to 2.5 minke whales/ 29.15 nm^2 (100 km^2) (Roberts et al. 2022i). Minke whale density is relatively high throughout the year in the Nantucket Shoals, peaking in the spring and summer months with the highest density in June at 2.5 to 4.0 whales/ 29.15 nm^2 (100 km^2). Both the humpback whale and minke whale have been sighted along the Brayton Point ECC, through the Sakonnet River (Schwartz 2021). A UME was also declared for the minke whale in January 2017 (NOAA Fisheries 2022c). A total of 122 individuals stranded from Maine to South Carolina, with 44 occurring in Massachusetts and 9 in Rhode Island. Preliminary results of necropsy examinations indicate evidence of human interactions or infectious disease; however, these results are not conclusive (NOAA Fisheries 2022b).

There are 19 odontocetes known to occur near or in the Offshore Project area and Massachusetts and Rhode Island lease areas, 4 may commonly occur and include Atlantic white-sided dolphin (*Lagenohynchus acutus*), common bottlenose dolphin, short-beaked common dolphin (*Delphinus delphis*), and harbor porpoise, and 15 that are considered rare or uncommon include Atlantic spotted dolphin (*Stenella frontalis*), pantropical spotted dolphin (*Stenella attenuata*), white-beaked dolphin

(*Lagenorhynchus albirostris*), Risso's dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*), pilot whale (long finned and short finned) (*Globicephala melas*, *Globicephala macrorhynchus*), dwarf and pygmy sperm whale (*Kogia sima, Kogia breviceps)*, killer whale (*Orcinus orca*), Cuvier's beaked whale (*Ziphius cavirostris*), Mesoplodon beaked whales (Blainsville's (*Mesoplodon densirostris*), Gervais' (*M. europaeus*), Sowerby's (*M. bidens*), and True's (*M. mirus*). During the NLPS, the short-beaked common dolphin, common bottlenose dolphin, and harbor porpoise were all commonly identified while the Atlantic white-sides dolphin, Risso's dolphin, and pilot whale were occasionally recorded in the Massachusetts and Rhode Island lease areas (Kraus et al. 2016).

Modeled density for short-beaked common dolphin in the Offshore Project area from 1998 to 2019 was highest from May to December with peak densities in June and July at approximately 16 to 25 individuals/29.15 nm^2 (100 km^2) (Roberts et al. 2022h). Short-beaked common dolphin modeled density in the Nantucket Shoals peaked in November and December at 25 to 40 individuals/29.15 nm^2 (100 km^2) (Roberts et al. 2022h). Modeled density for common bottlenose dolphin in the Offshore Project area from 1998 to 2019 was highest in July at 1.6 to 2.5 individuals/29.15 nm^2 (100 km^2); in all months density was higher farther offshore (Roberts et al. 2022j). Common bottlenose dolphins occurred in greater density in the eastern portions of Nantucket Shoals relative to the Offshore Project area; modeled density peaked in July and August at 6.3 to 10 individuals/29.15 nm^2 (100 km^2). Modeled density of harbor porpoise from 1999 to 2020 was highest in the winter months with density peaking in March at 16 to 25 porpoises/29.15 nm^2 (100 km^2) (Roberts et al. 2022k). Harbor porpoise occur year-around in the Nantucket Shoals with densities peaking in May at 16 to 25 individuals/29.15 nm^2 (100 km^2). Modeled density for Risso's dolphin in the Offshore Project area and the Nantucket Shoals from 1998 to 2019 was relatively low throughout each year with densities concentrated further offshore; densities peaked in the Offshore Project area in December at 0.25 to 0.40 dolphins/29.15 nm^2 (100 km^2) (Roberts et al. 2022l). Modeled density for pilot whales from 1998 to 2019, with less than 20 sightings in the Offshore Project Area, was predicted at 0.63 to 1 individuals/29.15 nm^2 (100 km^2) (Roberts et al. 2022m).

Atlantic white-sided dolphin, Risso's dolphin, and short-beaked common dolphin were observed during acoustic and visual surveys during the summer and fall of 2019 and geotechnical surveys conducted in the Project area in 2020 (AIS Inc. 2020; RPS 2019). Additionally, dwarf sperm whale, long-finned pilot whale, Risso's dolphin, Atlantic white-sided dolphin, bottlenose dolphin, striped dolphin, and harbor porpoise have all been sighted along the Brayton Point ECC, through the Sakonnet River (Schwartz 2021).

Pinniped species which may commonly occur in the Offshore Project area include the harbor and gray seal. The size of the region harbor seal populations and haul out sites have been increasing in recent years and these seals are routinely sited from fall through spring with known haul outs at Brenten Point, Rome Point, Citing Rock, Cold Spring Rock, Seal Rock, and Cormorant Cove (Schwartz 2021). During aerial surveys of the Project area conducted in November and December of 2019, one gray seal and several unidentified pinniped species were recorded (Mayflower-APEM 2020a; 2020b) and during acoustic surveys conducted in the Project area in summer and fall of 2019 and geotechnical surveys conducted in the Project area in 2020, gray seal and harbor seal were both observed (AIS Inc. 2020; RPS 2019). See COP Volume 2, Figure 6-40 (Mayflower Wind 2022) for the locations of seal observations recorded during the 2019 PSO surveys (AIS Inc. 2020; RPS 2019) and aerial surveys (Mayflower-APEM

2020a–m). The gray, harp, and hooded seal have also been sighted along the Brayton Point ECC through the Sakonnet River (Schwartz 2021). Harp seals, however, are highly migratory and considered annual vagrants in the Massachusetts and Rhode Island lease areas and are generally found in the U.S. waters from January to May (Harris et al. 2002). Modeled density of all seal species from 1999 to 2020 peaked in May in the Offshore Project area at approximately 10 to 16 seals/ 29.15 nm^2 (100 km^2); however, at the proposed cable landfall in Falmouth, density peaked in June at approximately 63 to 100 seals/29.15 nm^2 (100 km^2) (Roberts et al. 2022g). Further, seal density in the nearby Nantucket Shoals was relatively high throughout the year, with density peaking in June at 250 to 400 individuals/29.15 nm^2 (100 km^2). Since July 2018, increased numbers of gray seal and harbor seal mortalities have been recorded across Maine, New Hampshire, and Massachusetts (NOAA Fisheries 2022d). This event was declared a UME by NMFS and encompassed 3,152 seal strandings from Maine to Virginia. Between July 2018 and March 2020, 1,113 seals stranded off of the Massachusetts, Rhode Island, and Connecticut coastlines. The pathogen phocine distemper virus was found in the majority of deceased seals and was identified as the cause of the UME. As of this writing, the UME is considered nonactive with closure pending (NOAA Fisheries 2022d).

Overview of Sound and Marine Mammal Hearing

Underwater noise is a particular concern for marine mammals. Underwater noise can be described through a source-path-receiver model. An acoustic source emits sound energy that radiates outward and travels through the water and the seafloor as pressure waves. The sound level decreases with increasing distance from the acoustic source as the sound pressure waves spread out under the influence of the surrounding environment. The amount by which the sound levels decrease between a source and receiver is called transmission loss (Richardson et al. 1995). The amount of transmission loss that occurs depends on the source receiver separation, frequency of the sound, properties of the water column, and properties of the seafloor layers. Underwater sound levels are expressed in dB, using a logarithmic ratio relative to a fixed reference pressure of 1 μPa (equal to 10^{-6} Pa or 10^{-11} bar).

The efficiency of underwater sound propagation allows marine mammals to use underwater sound as a primary method of communication, navigation, prey detection (i.e., foraging), and predator avoidance (Richardson et al. 1995; Southall et al. 2007; OSPAR Commission 2009). Anthropogenic (i.e., human-introduced) noise has gained recognition as an important stressor for marine mammals because of their reliance on underwater hearing (Richardson et al. 1995; Ketten 1998). Underwater sound can be produced by biological and physical oceanographic sources, as well as anthropogenic sources. Biological sounds include vocalizations made by marine mammals and physical oceanographic sounds, including wind and wave activity, rain, sea ice, and undersea earthquakes. Anthropogenic sounds include vessel traffic, military activities, marine construction, and oil and gas exploration. Some of these natural and anthropogenic sounds are present everywhere in the ocean all of the time; therefore, background sound in the ocean is commonly referred to as “ambient noise” (DOSITS 2019). Underwater noise generated by human activities can often be detected by marine mammals many kilometers from the source. Depending on the level of exposure and type of sound, potential acoustic impacts can range from physiological injury to permanent or temporary hearing loss, behavioral changes, and acoustic masking. All of these effects have the potential to induce stress on marine mammals (OSPAR Commission 2009; Erbe 2013).

Marine mammals are acoustically diverse, with wide variations in ear anatomy and hearing ability (Ketten 1991). An animal's physical sensitivity to sound likely depends on the presence and level of sound in certain frequency bands and the range of frequencies to which the animal is most sensitive (Richardson et al. 1995). In general, larger species, such as baleen whales, hear better at lower frequency ranges than smaller species, such as porpoises and dolphins. Hearing abilities are generally only well understood for smaller species for which audiograms (plots of hearing threshold at different sound frequencies) have been developed based on captive behavioral response studies (reactions to sound) and electrophysiological experiments (measuring auditory evoked potentials) (Erbe et al. 2012). Auditory evoked potentials have been measured in some toothed whale (odontocetes) and pinniped species (Southall et al. 2007; Finneran 2015; Tougaard et al. 2022), while direct measurements of baleen whale (mysticetes) hearing are lacking (Ridgway and Carder 2001). Baleen whale hearing sensitivities have, therefore, been estimated based on anatomy, modeling, vocalizations, taxonomy, and behavioral response studies (Houser et al. 2001; Ketten and Mountain 2011, 2014 in Southall et al. 2019; Cranford and Krysl 2015; Richardson et al. 1995; Wartzok and Ketten 1999; Au and Hastings 2008; Reichmuth 2007).

Auditory Criteria for Injury and Disturbance

For the purposes of evaluating underwater noise impacts, NMFS organized marine mammals into functional hearing groups based on their hearing physiology and sensitivity (NMFS 2018): low-, mid-, and high-frequency cetaceans, and pinnipeds. Generalized hearing ranges for each of these groups are provided in Table 3.5.6-1. Additional details on marine mammal acoustic threshold criteria, functional hearing groups, and auditory weighting functions applied to thresholds are provided in COP Volume 2, Section 6.8.2.1, Table 6-66, and Appendices O, and U2 (Mayflower Wind 2022).

Table 3.5.6-1. Marine mammal functional hearing groups

Hearing Group	Taxonomic Group	Generalized Hearing Range
Low-Frequency Cetaceans	Baleen whales (e.g., humpback whale, blue whale)	7 Hz to 35 kHz
Mid-Frequency Cetaceans	Most dolphin species, beaked whales, sperm whale	150 Hz to 160 kHz
High-Frequency Cetaceans	True porpoise, river dolphins, *Cephalorhynchus* dolphins)	275 Hz to 160 kHz
Phocid Pinnipeds	Phocid or true seals (e.g., harbor seal)	50 Hz to 86 kHz

Source: NMFS 2018
Hz = hertz; kHz = kilohertz

Table 3.5.6-2 outlines the acoustic thresholds for onset of acoustic impacts (permanent threshold shift [PTS] and temporary threshold shift [TTS]) for marine mammals for both impulsive and continuous noise sources. Impulsive noise sources considered in this assessment include impact pile driving, some HRG equipment, and explosion of UXO. Continuous noise sources include vibratory pile driving, vessel traffic, some HRG surveys, turbine operations, and dredging.

Table 3.5.6-2. Acoustic marine mammal injury (TTS and PTS) thresholds based on NMFS (2018)

Marine Mammal Functional Hearing Group	Effect	Impulsive Source		Continuous Source
		PK (dB re 1 µPa)	Weighted SEL_{24h} (dB re 1 µPa²s)	Weighted SEL_{24h} (dB re 1 µPa²s)
Low-frequency cetaceans	PTS	219	183	199
	TTS	213	168	179
Mid-frequency cetaceans	PTS	230	185	198
	TTS	224	170	178
High-frequency cetaceans	PTS	202	155	173
	TTS	196	140	153
Phocid pinnipeds underwater	PTS	218	185	201
	TTS	212	170	181

Note: Peak sound pressure (PK) values are flat weighted or unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 kilohertz): Values presented for SEL_{cum} use a 24-hour cumulative analysis unless stated otherwise. dB re 1 µPa = decibels relative to 1 micropascal; dB re 1 µPa^{2}s = decibels relative to 1 micropascal squared second

Non-auditory Injury Criteria for Explosives (Unexploded Ordnance)

Shock waves associated with underwater detonations can induce both auditory effects (PTS and TTS; see Table 3.5.6-2) and non-auditory physiological effects, including direct tissue damage (mortality, slight lung injury, and gastrointestinal injury) known as primary blast injury. The magnitude of the acoustic impulse (which is the integral of the instantaneous sound pressure) of the underwater blast causes the most common injuries and, therefore, its value is used to determine if mortality, slight lung injuries, and gastrointestinal injuries occur (Finneran et al. 2017). Mortality and slight lung injury are the primary non-auditory effects considered; the threshold for each depends upon an animal's mass and depth. Table 3.5.6-3 provides an estimate of mass of the different marine mammal species considered in this assessment. Finneran et al. (2017) summarize criteria and thresholds used by the U.S. Navy to assess the potential for mortality and slight lung and gastrointestinal injury from explosive sources (Table 3.5.6-4 and Table 3.5.6-5). Table 3.5.6-4 lists equations used to calculate thresholds based on effects observed in 1 percent of exposed animals, and Table 3.5.6-5 lists equations used to calculate thresholds based on effects observed in 50 percent of exposed animals. Note that with respect to the assessment, the more conservative 1-percent thresholds have been applied.

Table 3.5.6-3. Representative calf/pup and adult mass estimates used for assessing impulse-based onset of lung injury and mortality threshold exceedance distances

Impulse Animal Group	Representative Species	Calf/Pup Mass (kilograms)	Adult Mass (kilograms)
Baleen whales and Sperm whale	Sei whale (*Balaenoptera borealis*) Sperm whale (*Physeter macrocephalus*)	650	16,000
Pilot and minke whales	Minke whale (*Balaenoptera acutorostrata*)	200	4,000
Beaked whales	Gervais' beaked whale (*Mesoplodon europaeus*)	49	366

Impulse Animal Group	Representative Species	Calf/Pup Mass (kilograms)	Adult Mass (kilograms)
Dolphins, Kogia, Pinnipeds, and Sea Turtles	Harbor seal (*Phoca vitulina*)	8	60
Porpoises	Harbor porpoise (*Phocoena phocoena*)	5	40

Note: These values are based on the smallest expected animals for the species.

Table 3.5.6-4 Thresholds for onset of non-auditory injury based on observed effects on 1 percent of exposed animals

Non-auditory Effect	Threshold
Onset of Mortality: Impulse	$103M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Impulse (slight lung injury)	$47.5M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Peak Pressure (gastrointestinal injury)	237 dB re 1 µPa - SPL_{peak}

Source: Hannay and Zykov 2022.
Note: Thresholds based on impulse depend on the animal's mass, M, in kilograms and depth, D, in meters.
dB re 1 µPa - SPL_{peak} = decibels relative to 1 micropascal peak sound pressure level

Table 3.5.6-5 Thresholds for onset of non-auditory injury based on observed effects on 50 percent of exposed animals

Non-auditory Effect	Threshold
Onset of Mortality: Impulse	$144M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Impulse (slight lung injury)	$65.8M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Peak Pressure (gastrointestinal injury)	243 dB re 1 µPa - SPL_{peak}

Source: Hannay and Zykov 2022.
Note: Thresholds based on impulse depend on the animal's mass, M, in kilograms and depth, D, in meters.
dB re 1 µPa - SPL_{peak} = decibels relative to 1 micropascal peak sound pressure level

Single blast events within a 24-hour period are not presently considered by NMFS to produce behavioral effects if they are below the onset of TTS thresholds for frequency-weighted SEL and peak pressure level (Table 3.5.6-2). Therefore, the effective disturbance threshold for single events in each 24-hour period is the TTS onset.

3.5.6.2 Impact Level Definitions for Marine Mammals

Impact level definitions for marine mammals are provided in Table 3.5.6-6. Impact levels are intended to serve NEPA purposes only and they are not intended to incorporate similar terms used in other statutory or regulatory reviews. For example, the term "negligible" is used for NEPA purposes as defined here and is not necessarily intended to indicate a negligible impact or effect under the MMPA. Similarly, the use of "detectable" or "measurable" in the NEPA significance criteria is not necessarily intended to indicate whether an effect is "insignificant" or "adverse" for purposes of ESA Section 7 consultation.

Table 3.5.6-6. Impact level definitions for marine mammals

Impact Level	Impact Type	Definition
Negligible	Adverse	The impacts on individual marine mammals or their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.
	Beneficial	Impacts on species or habitat would be beneficial but so small as to be unmeasurable.
Minor	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals or their habitat would not lead to population-level effects.
	Beneficial	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals or their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.
	Beneficial	Beneficial impacts on species would not result in population-level effects. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of severe intensity, can be long lasting or permanent, and would be extensive. Impacts on individuals and their habitat would have severe population-level effects and compromise the viability of the species.
	Beneficial	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

3.5.6.3 Impacts of Alternative A – No Action on Marine Mammals

When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for marine mammals. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for marine mammals described in Section 3.5.6.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Global climate change is an ongoing risk for marine mammal species in the geographic analysis area. Warming and sea level rise could affect marine mammals through increased storm frequency and severity, altered habitat/ecology, altered migration patterns, increased disease incidence, and increased erosion and sediment deposition (Evans and Bjørge 2013; Evans and Waggitt 2020; Learmonth et al. 2006). Increased temperatures can alter habitat, modify species' use of existing habitats, change precipitation patterns, and increase storm intensity (USEPA 2016; NASA 2019; Love et al. 2013). Increase of the ocean's acidity has numerous effects on ecosystems including reducing available carbon that organisms use to build shells and causing a shift in food webs offshore (USEPA 2016; NASA 2019; Love et al. 2013). This has the potential to affect the distribution and abundance of marine mammal prey. Warming is also expected to influence the frequency of marine mammal diseases, particularly for pinnipeds. Warming and sea level rise, with their associated consequences, and ocean acidification could lead to long-term, high-consequence, population-level impacts on marine mammals, especially mammal populations already stressed by other factors (e.g., NARWs).

Marine mammals in the geographic analysis area are currently subject to a variety of IPFs from ongoing non-offshore wind and offshore wind activities. The main known contributors to mortality events include collisions with vessels (ship strikes), entanglement with fishing gear, and fisheries bycatch. Other important IPFs considered include underwater noise from anthropogenic sources, disturbance of marine and coastal environments, disturbance of benthic habitats, and accidental and intentional release of hazardous substances. Many marine mammal migrations cover long distances, and these factors individually and in combination can have impacts on individuals over broad geographical and temporal scales. Vessel strike and fisheries interactions could have population-level implications for some at-risk species. IPFs with the greatest potential impact on marine mammals from ongoing and planned non-offshore wind activities (i.e., vessel strike and fisheries interactions) within the geographic analysis area are briefly discussed below.

Studies indicate that maritime activities can have adverse effects on marine mammals due to vessel strikes (Laist et al. 2001; Moore and Clarke 2002) and have been identified as one of the primary causes of death to NARWs during the current and ongoing UME for the species (NOAA Fisheries 2022a). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world (Dolman et al. 2006). Vessel speed and size are important factors for determining the probability and severity of vessel strikes. Vessels more than 80 meters in length or longer are more likely to cause lethal or severe injury to large whales (Laist et al. 2001). Vanderlaan and Taggart (2007) reported that the probability of whale mortality increased with vessel speed, with greatest increases occurring between 8.6 and 15 knots, and that the probability of death declined by 50 percent at speeds less than 11.8 knots. As a result of the impacts of vessel strikes on NARW, NMFS implemented a seasonal, mandatory vessel speed rule in certain areas along the U.S. East Coast to reduce the risk of vessel collisions with NARW. Seasonal Management Areas require vessels 65 feet (19.8 meters) or larger to maintain speeds of 10 knots or less and to avoid Seasonal Management Areas when possible. Additional voluntary 10-knot speed restrictions are implemented for areas with aggregating NARWs outside of established

Seasonal Management Areas in the form of Dynamic Management Areas and Slow Zones. In August 2022, NMFS proposed amendments to the vessel speed rule that could modify the spatial and temporal boundaries of the Seasonal Management Areas, restrict speeds to 10 knots for most vessels 35 feet (19.8 meters) or larger, create a Dynamic Speed Zone framework that would implement mandatory speed restrictions when whales are known to be present in areas outside of Seasonal Management Areas, and update the safety deviation provision (50 CFR 224).

Fisheries interactions can have adverse effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands of individuals each year (Read et al. 2006). Entanglement in fishing gear is listed as a threat to humpback whales, NARWs, blue whales, fin whales, sei whales, common bottlenose dolphins, and gray seals (Hayes et al. 2020; Hayes et al. 2022). There is limited information regarding entanglements of blue, fin, sei, and minke whales; however, evidence of fishery interactions causing injury or mortality has been noted for each of these species in the Greater Atlantic Regional Fisheries Office/NMFS entanglement/stranding database (Hayes et al. 2022). 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). Marine mammals can also ingest or become entangled in marine debris (e.g., ropes, plastic) that is lost (i.e., ghost gear) from fishing vessels and other offshore activities. Bycatch occurs in various commercial, recreational, and subsistence fisheries with hotspots driven by marine mammal density and fishing intensity (Lewiston et al. 2014). Small cetaceans and seals are at most risk of being caught as bycatch in various commercial, recreational, and subsistence fisheries due to their small body size that allows them to be taken up in fishing gear. Additionally, bottom trawling and benthic disruption have the potential to result in impacts on prey availability and distribution.

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on marine mammals.

- Continued O&M of the Block Island project (five WTGs) installed in state waters.
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing offshore wind activities, including site assessments for future offshore wind projects, would affect marine mammals primarily through the IPFs of noise, presence of structures, and vessel traffic. Ongoing offshore wind activities would have the same types of impacts that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned non-offshore wind activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar), marine transportation, and NMFS research initiatives (see Appendix D, *Planned Activities Scenario,* Section D.2 for a description of planned activities). These activities could result in temporary or permanent displacement and injury to or mortality of individual marine mammals, but population-level effects would not be expected.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on marine mammals during construction, O&M, and decommissioning of the projects. Other offshore wind activities in the geographic analysis area for marine mammals include the construction, O&M, and decommissioning of approximately 34 offshore wind projects (Appendix D, Table D2-1).

Noise

Underwater sound is a pervasive issue throughout the world's oceans and can adversely affect marine mammals. Within the geographic analysis area, offshore wind activities that could generate underwater noise include pile driving, vessels associated with planned offshore wind activities, aircrafts, geophysical surveys (HRG surveys and geotechnical drilling surveys), turbine operation, and dredging. Anthropogenic noise sources can be categorized generally as impulsive or non-impulsive and as intermittent or continuous. For the No Action Alternative, underwater noise generated by pile-driving activities and some geophysical surveys (HRG) associated with offshore wind projects are considered intermittent impulsive noise sources. Underwater noise generated from vessel traffic, aircraft, some geophysical surveys (geotechnical drilling), turbine operation, vibratory pile driving, and dredging are non-impulsive continuous noise sources. Impulsive noises are characterized by broad frequencies, fast rise-times, short durations, and high peak sound pressures (Finneran 2016). Impulsive sounds can be transient in nature and variable in temporal scale.

Underwater noise associated with offshore wind activities has the potential to generate underwater noise that could result in the following adverse effects on marine mammals.

- Physiological effects, such as injury and mortality, TTS, and PTS.
- Disturbance (behavioral effects).
- Acoustic masking.

Section 101(a) of the MMPA (16 USC 1361) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 USC 1372(a) (l), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give NMFS (and USFWS) the authority to authorize the incidental but not intentional take of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. Under Section 3 of the MMPA, "take" of marine mammals is defined as "harass, capture, hunt, kill, or attempt to harass, capture, hunt, or kill any marine mammal." The incidental take of a marine mammal falls under three categories: mortality, serious injury, and harassment. Take authorizations divide underwater noise effects on marine mammals into

Level A and Level B harassment categories. This act requires that an incidental take authorization be obtained for the unintentional take of marine mammals incidental to specified activities other than commercial fishing. The MMPA defines Level A or Level B harassment as follows.

- Level A: Any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild.
- Level B: Any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but that does not have the potential to injure a marine mammal or marine mammal stock in the wild (16 USC 1362).

Level A harassment associated with offshore wind include physiological impacts associated with PTS (auditory injury not leading to serious injury or mortality), whereas Level B harassment includes physiological impacts associated with TTS and behavioral effects. Incidental take authorizations may be issued as either (1) regulations and the associated Letter of Authorization, or (2) an Incidental Harassment Authorization. Letters of Authorization may be issued for up to a maximum period of 5 years and Incidental Harassment Authorizations may be issued for a maximum period of 1 year. Detailed information about the MMPA and 50 CFR 216 is available at https://www.fisheries.noaa.gov/topic/laws-policies#marine-mammal-protection-act.

The potential for underwater noise to result in injury, mortality, or disturbance of marine mammals depends on the received sound level, frequency of the sound relative to the hearing ability of the animal, and level of natural background (or ambient) noise. Potential effects range from subtle changes in behavior at low received levels to strong disturbance effects or potential injury or mortality at high received levels (Southall et al. 2007, 2019).

Physiological effects: Sound reaching the receiver with ample duration and sound pressure level can result in a loss of hearing sensitivity in marine mammals, termed a noise-induced threshold shift. Auditory thresholds for underwater noise are expressed using three common metrics: root-mean-square sound pressure level (SPL or L_{rms}), and peak sound pressure (L_{pk}), both measured in dB re 1 µPa; and sound pressure level (SEL or L_E), a measure of energy in dB re 1 $\mu Pa^2 s$. L_{pk} is an instantaneous value, whereas SEL is the total noise energy of an event or number of events (e.g., over a period of 24 hours, SEL_{24h}), and L_{rms} is that total energy to which an animal is exposed normalized to 1 second.

A noise-induced threshold shift may consist of a TTS or PTS. TTS is a relatively short-term, reversible loss of hearing following noise exposure (Southall et al. 2007), often resulting from cellular fatigue and metabolic changes (Saunders et al. 1985). While experiencing either TTS, the hearing threshold rises, and a sound must be louder to be detected. PTS is an irreversible loss of hearing (permanent damage) following noise exposure that commonly results from inner ear hair cell loss or severe damage or other structural damage to auditory tissues (Saunders et al. 1985; Henderson et al. 2008). There have not been any field studies that have examined TTS or permanent hearing damage (i.e., PTS) in free-ranging marine mammals exposed to anthropogenic sounds. TTS has been demonstrated in mid-frequency cetaceans (MFC) (dolphins, beaked whales), high-frequency cetaceans (HFC) (harbor porpoise), and pinnipeds (harbor seal, California sea lion, northern elephant seal) in response to exposure to impulsive and non-impulsive noise sources (a review is provided in Southall et al. 2007, NOAA 2013, Finneran 2015). Prolonged or repeated exposure to sound levels sufficient to induce TTS without recovery time can lead to PTS (Southall et al. 2007). A PTS of 7-10 dB was demonstrated in an individual harbor seal after 2 exposures to an underwater 4.1 kHz pure tone fatiguing stimulus gradually increased to a maximum received sound pressure of 184 dB re 1 µPa with a duration of 60 seconds (Kastak et al. 2008).

TTS effects are temporary at the individual level, with recovery occurring over a short period of time (e.g., within several days) after the completion of the activities causing the effect. Effects on populations are dependent on the potential for individuals of the population to be affected (e.g., spatial overlap) or the health of the population being able to withstand temporary or permanent physiological effects associated with individuals experiencing TTS, PTS, or other physiological effects.

Disturbance (behavioral effects): Marine mammals show varying levels of disturbance to underwater noise sources and behavioral responses can range from minor to severe, depending on a suite of variables including season, location, species, life-history stage, and the type of noise. Observed behavioral responses include displacement, avoidance, increases or decreases in vocal activity and habituation, as well as changes to or cessation of biologically important behaviors which include breeding, calving, foraging, resting or socializing; changes in diving behavior (e.g., reduced or prolonged dive times, changes in swimming speed and direction); aggressive behavior (e.g., jaw clapping or tail/fluke slapping); and changes in historical migration routes. Behavioral responses can ultimately cause disruption in foraging patterns, increases in physiological stress and alertness, reduced breeding opportunities, increased swim speed and dive times, and changes to group association patterns (e.g., tighter groups). In response to underwater noise, if a marine mammal changes its behavior or moves to avoid the noise, impacts may not be important to the individual, stock, or population as a whole. However, if marine mammals were to be displaced from a breeding area or foraging ground, impacts among the individuals and population could be significant (Booth et al. 2020). Studies have found that in species such as the blue whale, call production was increased amidst received sound exposure levels of 131 dB re 1 µPa2-s, potentially indicating the species attempt to “compensate” for increases in background noise levels (Di Lorio and Clark 2010). However, other studies have shown that in species such as the bowhead whale, calling rates increased at low received levels of airgun sounds, but then decreased when received levels exceeded a certain threshold (Blackwell et al. 2015). Available studies show variation in response to underwater sound and further support how the degree of impact depends on many factors (e.g., behavioral state, reproductive state, distance to the sound source).

To better understand and categorize the potential effects of behavioral responses, Southall et al. (2007) developed a behavioral response severity scale of low, moderate, or high (Southall et al. 2007; Finneran et al. 2017). This scale was recently updated (Southall et al. 2021). The revised report updated the single severity response criteria defined in Southall et al. 2007 into three parallel severity tracks that score behavioral responses from 0 to 9. The three severity tracks are survival, reproduction, and foraging. This approach is acknowledged as being relevant to vital rates, defining behaviors that may affect individual fitness, which may ultimately affect population parameters. It is noted that not all the responses within a given category need to be observed but that a score is assigned for a severity category if any of the responses in that category are displayed. To be conservative, the highest (or most severe) score is to be assigned for instances where several responses are observed from different categories. In addition, the authors acknowledge that it is no longer appropriate to relate "simple all-or-nothing thresholds" to specific received sound levels and behavioral responses across broad taxonomic groupings and sound types due to the high degree of variability within and between species and noise types. The new criteria also move away from distinguishing noise impacts from impulsive versus non-impulsive sound types into considering the specific type of noise (e.g., pile driving, seismic, vessels).

The study also noted that mysticetes and odontocetes should be considered separately given their different life history strategies. Mysticetes are known to be capital breeders, accumulating energy on feeding grounds and transferring energy to calves in breeding grounds, whereas odontocetes are generally considered income breeders with less discrete feeding and breeding periods occurring throughout the year. Given that anthropogenic activities generally focus on specific habitats within an animal's home range (e.g., feeding or breeding grounds), this may affect their ability to compensate for disturbances.

Acoustic masking: Auditory masking occurs when sound signals used by marine mammals overlap in time, space, and frequency with another sound source (Richardson et al. 1995). Masking can reduce communication space, limit the detection of relevant biological cues, and reduce echolocation effectiveness. If little or no overlap occurs between the introduced sound and the frequencies used by the species, listening and communication are not expected to be disrupted. Similarly, if the introduced sound is present only infrequently, very little to no masking would occur. In addition to the frequency and duration of the masking sound, strength, temporal pattern, and location of the introduced sound also play a role in the extent of the masking (Madsen et al. 2002; Branstetter et al. 2013a; Branstetter et al. 2013b; Branstetter et al. 2016; Erbe et al. 2016; Sills et al. 2017).

A growing body of literature is focused on improving the framework for assessing the potential for masking of animal communication by anthropogenic noise and understanding the resulting effects. More research is needed to understand the process of masking, the risk of masking by anthropogenic activities, the ecological significance of masking, and what anti-masking strategies are used by marine animals and their degree of effectiveness before masking can be incorporated into regulation strategies or mitigation approaches (Erbe et al. 2016). As a result, this assessment considered the potential for masking qualitatively by comparing the frequencies of anthropogenic sources with the frequencies at which marine mammal vocalizations are made and the functional hearing ranges of marine mammal species.

Pile Driving

The installation of WTG foundations into the seabed involves pile driving, which can produce high SPLs in the underwater environment and may affect marine mammals. The construction of up to 2,945 new WTG and offshore substation platform foundations in the geographic analysis area would create underwater noise and may affect marine mammal species in the area. Construction of offshore wind facilities is expected to occur intermittently over an 8-year period in lease areas that are anticipated to be developed in the geographic analysis area. The generation of underwater noise during pile driving and the probability of impact are dependent on the type of pile being driven, type of hammer, substrate type, water depth, and species' auditory capabilities (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009). These impacts would vary in extent and intensity based on the scale and design of each project, as well as the schedule of project activities. Over the 8-year period, concurrent pile-driving days could occur. Concurrent pile driving involving two or more piles driven during a 24-hour period has the potential to extend the duration of exposure or result in a larger impact area. However, non-concurrent pile driving increases the number of days over which pile driving would occur, potentially increasing the number of exposures an individual may experience. Individual animals may be exposed to anywhere from a single pile-driving event (i.e., foundation installation over a 24-hour period) to intermittent events over a period of weeks if an individual travels through the larger geographic area where pile driving may be occurring. Given anticipated construction schedules, BOEM expects that marine mammals could be intermittently exposed to pile-driving noise for up to 8 consecutive years, from one or more projects, with additional potential exposure possible beyond 2030.

Pile-driving activities from other offshore wind development projects are likely to exceed PTS and TTS thresholds for all marine mammal functional hearing groups. Depending on mitigations applied (single versus double bubble curtain and the use of exclusion zones), these effects could be reduced. However, due to the observed avoidance behavior of several marine mammal species during impact pile-driving activities, certain marine mammal species (MFC, HFC, and pinnipeds) are less likely to be exposed to underwater noise for sufficient duration to cause PTS and TTS. For example, toothed whales and baleen whales show varying levels of sensitivity to mid-frequency impulsive noise sources, with observed responses ranging from displacement (Maybaum 1993) to avoidance behavior (animals moving rapidly away from the source) (Hayama et al. 1995; Watkins et al. 1993); thus, behavioral responses may reduce incidences of exceeding PTS and TTS thresholds.

Brandt et al. (2011) measured harbor porpoise acoustic activity during impact pile driving of 91 monopile foundations in the offshore North Sea at a wind farm construction site. At 0.447 mile (720 meters) during one pile-driving event, maximum values were measured at 196 dB re 1 μPa (L_{pk}), 176 dB re 1 $\mu Pa^2 s$ (SEL), and 170 dB re 1 $\mu Pa^2 s$. At a distance of 1.43 miles (2,300 meters) from pile driving, maximum levels reached 184 dB re 1 μPa (L_{pk}), 164 dB re 1 $\mu Pa^2 s$ (SEL), and 157 dB re 1 $\mu Pa^2 s$. Porpoise vocal activity was demonstrated to completely cease up to one hour after pile driving and remained below average levels for 24 to 72 hours at distances up to 1.6 miles (2.6 kilometers) from the pile-driving site. Reduced vocal activity was evident up to 11.1 miles (17.8 kilometers) from the site, although increased vocal activity was shown to temporarily increase at 14 miles (22 kilometers) distance during pile driving, which could be explained by animals moving to this area to avoid the area of potential noise disturbance. Results from Brandt et al. 2011 indicate an overall reduced abundance of harbor porpoise during the 5-month installation period of the piles, with the authors postulating that this was either a direct (e.g., sensory disturbance, communication masking) or indirect (reduced prey availability) effect of pile-driving noise.

A more recent analysis from eight offshore wind facility projects by Brandt et al. (2016) suggests harbor porpoises actively avoid pile-driving activities during the construction and installation phase. Across the eight projects, a gradient decline in porpoise detections at different distances from pile-driving activities was observed. During pile-driving activities, porpoise detections declined by 68 percent within 3.1 miles (5 kilometers) of the noise source, declined by 26 percent between 6.2 and 9.3 miles (10 and 15 kilometers), but showed no further declines beyond 10.6 to 12.4 miles (17 to 20 kilometers). Within 20 to 31 hours post-pile driving, porpoise detections increased in the 0- to 3.1-mile (0- to 5-kilometer) range. Further, little to no habituation was found (i.e., over the course of installation, porpoises stayed away from pile-driving activities and these responses did not wane) and there was no indication of the presence of temporal overall effects from construction of the eight wind facilities.

Würsig et al. (2000) studied the response of Indo-Pacific hump-backed dolphins (*Sousa chinensis*) to impact pile driving in the seabed in water depths of 6 to 8 meters. No overt behavioral changes were observed in response to the pile-driving activities, but the animals' speed of travel increased, and some dolphins remained in the vicinity, while others temporarily abandoned the area. Once pile driving had ceased, dolphin abundance and behavioral activities returned to pre-pile-driving numbers and behaviors. Southall et al. 2021 evaluated four observational studies of harbor porpoise responses to pile driving (Brandt et al. 2009; Brandt et al. 2011; Thompson et al. 2010; Tougaard et al. 2009a). In each study, group vocal responses (changes in clicking behavior) were reported, but it was difficult to distinguish whether the reported reductions in clicks could represent a reduction in foraging or avoidance in disturbed areas or both. The evaluation determined that harbor porpoises responded to pile driving with minor reductions in vocal output, possible sustained avoidance, reduced vocal mechanisms, and habitat avoidance (Southall et al. 2021).

A telemetry study conducted off the east coast of England showed that harbor seals may temporarily leave an area affected by pile-driving noise. Seal abundance was reduced by 19 to 83 percent up to 15.5 miles (25 kilometers) away during the installation of impact pile driving of WTG monopiles but found no significant displacement within 2 hours of cessation of pile-driving activities (Russell et al. 2016). Monitoring studies in the Dutch North Sea showed that harbor seals may avoid large areas (24.8 miles [39.9 kilometers]) during pile driving and other construction activities. However, seals returned to the area following construction activities, indicating that avoidance was temporary (Lindeboom et al. 2011). These findings are consistent with the best available information on noise and marine mammals, which predicts a spectrum of effects depending on duration and intensity of exposure, as well as species and behavior of the animal (e.g., migrating, foraging). Southall et al. (2021) evaluated an observational study (Blackwell et al. 2004) of responses in ringed seals (*Phoca hispida*) to underwater pile-driving noise. They concluded that observed responses ranked zero (no response detected with methods sufficient to identify responses relevant to survival, feeding, or reproduction) to one (mild orientation responses) (Southall et al. 2021: Table 3). Based on the available literature, it is expected that seals are likely to exhibit no detectable response or mild orientation responses to impact pile-driving activities.

Studies that examine the behavioral responses of baleen whales to pile driving are absent from the literature. Behavioral avoidance of other impulsive noise sources have been documented and could be used as a proxy for impact pile driving. Malme et al. (1986) observed the responses of migrating gray whales to seismic exploration.[1] At average peak pressure (L_{pk}) of about 173 dB re 1 µPa, feeding gray whales had a 50 percent probability of stopping feeding and leaving the area. Some whales stopped feeding at peak levels (L_{pk}) of 163 dB re 1 µPa. Individual responses were highly variable. Most whales resumed foraging activities once the airgun activities stopped. Dunlop et al. (2017) observed that migrating humpback whales would avoid airgun arrays[2] less than 3 kilometers away when received SELs were over 140 dB re 1 μPa^2s (Dunlop et al. 2017). Controlled exposure experiments with simulated military sonar and other mid-frequency sounds showed decreased vocal activity and disruption in foraging patterns for deep feeding blue whales (Goldbogen et al. 2013).

Acoustic masking can occur if the frequencies of the activity overlap with the communication frequencies used by marine mammals. The dominant frequencies emitted from impact pile-driving activities are dependent on the type of pile being driven, type of hammer, substrate type, and water depth (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009). JASCO Applied Sciences modeled impact pile-driving activities for the Proposed Action in COP Appendix U2 (Mayflower Wind 2022), which can be used to estimate the potential for masking to occur during other offshore wind activities. Modeling results indicate that dominant frequencies of impact pile-driving activities for the proposed Project were concentrated below 1 kilohertz. Based on these results, low-frequency cetaceans (LFC) and pinnipeds are more likely to experience acoustic masking than MFC and HFC.

The short-term consequences of masking from pile-driving activities range from temporary changes in vocal patterns to avoidance of important areas. Longer-term consequences include permanent changes to vocal patterns; reductions in fitness, survivorship, and recruitment; and abandonment of important habitat areas. Most marine mammal species use a range of frequencies to communicate. Pile-driving activities would not overlap with the vocalization of all marine mammal communications. As a result, a complete masking of marine mammal communications from the No Action Alternative would not be expected. In addition, the duty cycle of sound sources is also important when considering masking effects. Low-duty-cycle sound sources such as impact pile driving are less likely to mask marine mammal communications, as the sound transmits less frequently with pauses or breaks between impacts, providing opportunities for communications to be heard.

Considering the number and extent of projects planned in the geographic analysis area, some individual fitness-level impacts are expected to result from impact pile-driving activities. These impacts would be further reduced with the implementation of project-specific applicant AMMs required by BOEM as conditions of compliance with the ESA and MMPA and other federal regulations. These measures would reduce the potential for PTS and TTS effects from pile driving on marine mammals. Some behavioral avoidance and masking effects are still considered likely; however, those effects are not expected to result in significant behavioral responses leading to longer-term consequences to individuals or populations.

[1] 20-cubic-inch airgun.
[2] 20- and 140-cubic-inch airgun.

Vessel Traffic

In general, vessel noise increases with ship size, power/speed, propeller blade size, number of blades, and rotations per minute, with the majority of underwater noise generated by propeller cavitation and singing (Gray and Greeley 1980; JASCO 2011; Mitson 1995). Large ships generate broadband, continuous noise with sound energy concentrated in the lower frequency range (less than 1 kilohertz) (McKenna et al. 2012). SPL Source levels for large vessels range from 177 to 188 dB re 1 μPa-m (McKenna et al. 2012). SPL Source levels for dynamically positioned vessels range from 150 to 180 dB re 1 μPa-m (BOEM 2014). Smaller vessels typically produce higher-frequency sound concentrated in the 1,000- to 5,000-hertz range, with SPL source levels ranging from 150 and 180 dB re 1 μPa-m (Kipple 2002; Kipple and Gabriele 2003).

A comprehensive review of the literature indicates no direct evidence of hearing impairment (either PTS or TTS) occurring in marine mammals as a consequence of exposure to vessel-generated sound. Adverse effects are more likely to be linked to behavior and acoustic communication. Research has demonstrated that vessel sound can elicit behavioral reactions in marine mammals and potentially result in masking of their communication space (Richardson et al. 1995). Acoustic responses to vessel sound include alteration of the composition of call types, rate and duration of call production, and actual acoustic structure of the calls. Observed behavioral responses include changes in respiration rates, dive patterns, and swim velocities. These responses have, in certain cases, been correlated with numbers of vessels and their proximity, speed, and directional changes. Responses have been shown to vary by gender and by individual.

While individual marine mammals may be exposed to underwater noise from vessel activity sufficient to cause behavioral effects, those effects are unlikely to result in longer-term consequences to individuals or populations.

Aircraft

Other offshore wind activities would also employ helicopters and fixed-wing aircraft. Noise generated from aircraft associated with projects in the geographic analysis area could affect marine mammals. In general, marine mammal behavioral responses to aircraft most commonly occur at distances of less than 1,000 feet (less than 305 meters) (Patenaude et al. 2002). BOEM would require all aircraft operations to comply with current approach regulations for NARWs or unidentified large whales (50 CFR 222.32). These include the prohibition of aircraft from approaching within 1,500 feet (457 meters). This EIS anticipates that most aircraft operations would occur above this altitude except under specific circumstances (e.g., helicopter landings on the service operations vessel or visual inspections of WTGs). Aircraft operations could result in temporary, minor behavioral responses, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002).

Geophysical Surveys (HRG Surveys and Geotechnical Drilling Activities)

Recently, BOEM (2021a) reviewed underwater noise levels produced by equipment used for HRG surveys as part of a programmatic Biological Assessment. The report noted that sound levels generated by HRG survey equipment are relatively low. As a result, individual marine mammals would have to remain close to the sound source for extended periods of time to be exposed to noise of sufficient intensity to cause TTS or PTS, which is considered unlikely. BOEM also requires applicants to develop mitigation plans such as those outlined in COP Appendix O (e.g., protected species observers, clearance zones), which would further minimize exposure risk. There are project design criteria and BMPs that are laid out in a recent Programmatic Letter of Concurrence (BOEM 2021c) that, if followed, would result in insignificant behavioral effects and very unlikely physiological effects on marine mammals. Therefore, the cumulative effects of offshore wind geophysical survey noises (without the Proposed Action) are likely similar to those described in Section 3.5.6.5.

Turbine Operation

Sound is generated by operating WTGs due to pressure differentials across the airfoils of moving turbine blades and from mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by the airfoils, like aircraft, is produced in the air and enters the water through the air-water interface. Mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. Both airfoil sound and mechanical vibration may result in long-term, continuous noise in the offshore environment. Field measurements have documented that during offshore wind operations, sound levels are much lower than during construction activities. SPLs measured 164 feet (50 meters) from a BIWF turbine on average were 119 dB re 1 µPa and tonal peaks were observed at 30, 60, 70, and 120 Hz (Elliott et al.2019). The turbines at the BIWF are 6 megawatt, direct-drive, 4-legged jacket-pile structures. During the winter, a 71 Hz constant tone was recorded 328 feet (100 meters) from a BIWF turbine, and during the summer, sound levels increased between 70 Hz and 120 Hz. During operations, the maximum particle velocity (as measured 328 feet [100 meters] from the turbine, just above the seabed) during winter was 40 dB re 1 nanometer per second. While in summer it was closer to 90 dB re 1 nanometer per second, most of the energy was below 25 Hz (Elliott et al. 2019). Overall, the results from this study indicated that there is a correlation between underwater sound levels and increasing wind speed, but this is not clearly predominantly influenced by turbine machinery; rather it may be the natural effects that wind and sea state have on underwater sound (Elliott et al. 2019; Urick 1983).

Furthermore, a compilation of the operational noise from several wind farms with turbines up to 6.15 megawatts in size showed that operational noise generally attenuates rapidly with distance from the turbines, falling below normal ocean ambient noise within 0.6 mile (1 kilometer) from the source. In addition, the combined noise levels from several turbines is lower or comparable to that generated by a small cargo ship (Tougaard et al. 2020). Higher levels of operational noise are produced by larger turbines, and the least squares fit of that dataset would predict that an SPL measured 328 feet (100 meters) from a hypothetical 15 MW turbine in operation in 22 mph (10 meters per second) wind would be 125 dB re 1 µPa. However, all of the turbines in the dataset, apart from the BIWF, were operated with gear boxes of various designs that did not use newer direct-drive technology that is expected to lower noise levels significantly. Stöber and Thomsen (2021) noted that the BIWF, using direct drive, is expected to be approximately 10 dB quieter than other equivalent sized jacket-pile turbines. Based on the Tougaard et al. (2020) dataset, operational noise from jacket piles could be louder than from monopiles due to more surface area for the foundation to interact with the water; however, the study does point out that received level differences among different pile types could be confounded by differences due to water depth and turbine size. Additional data is needed to fully understand the effects of size, foundation type, and drive type on the amount of sound produced during turbine operation.

Based on the current available data, underwater noise from turbine operations is unlikely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects. It is expected that these effects would occur at relatively short distances from the foundations, and operational noise could reach ambient underwater noise levels within 164 feet (50 meters) of the foundations (Miller and Potty 2017; Tougaard et al. 2009b). While individual marine mammals may be exposed to underwater noise from WTG operations sufficient to cause masking and behavioral effects, those effects are unlikely to result in longer-term consequences to individuals or populations and, thus, are minor.

Dredging

Dredging is used in offshore wind projects to remove materials from the seafloor in preparation for construction of the foundation and ECCs. Underwater noise generated by dredging depends on the type of dredge equipment used. The two most common types of dredge equipment used for offshore wind projects are mechanical and hydraulic. Mechanical dredging uses crane-operated buckets, grabs (clamshell), or backhoes, and hydraulic (suction) and controlled-flow excavation dredging uses suction. SPL source levels for suction dredges range from 172 to 190 dB re 1 µPa-m with frequencies between 1 and 2 kilohertz (Robinson et al. 2011; Todd et al. 2015; McQueen et al. 2019; Zykov et al. 2007). Source levels for mechanical clamshell dredging have been estimated as 176 dB re 1 µPa-m (BC MoTI 2016). As a result, PTS effects are considered unlikely (Todd et al. 2015), but temporary hearing loss could occur if receivers are close to dredging activities over a sustained period. Behavioral reactions and masking of low-frequency calls in baleen whales and seals are considered more likely to occur from dredging noise from either type of dredging.

Unexploded Ordnances

Other offshore wind activities may encounter UXO on the seabed in the lease areas or along export cable routes. While non-explosive methods may be employed to lift and move these objects, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to marine mammals. The number and location of detonations that may be required for other projects are relatively unknown. Therefore, the potential for overlapping UXO detonations from nearby projects is unlikely. If overlapping detonations were to occur, they would be instantaneous and limited in the zone of impact. Therefore, impacts associated with UXO detonations would be minor and similar to those described for the Proposed Action.

Summary Statement for Noise

Considering the extent of offshore wind projects planned in the geographic analysis area (Appendix D), it is likely that underwater noise impacts sufficient to cause adverse effects on marine mammals could occur from other offshore wind projects. Noise generated from ongoing non-offshore wind activities include impulsive (e.g., seismic surveys, sonar) and non-impulsive (e.g., vessels, aircraft, dredging) sources. Impact pile driving, seismic exploration, and sonar surveys can lead to PTS/injury-level effects in marine mammals. In addition, high-intensity sonar activities not associated with offshore wind development have been linked to stranding events (Fernandez et al. 2005; Cox et al. 2006; Balcolmb and Claridge 2001; Jepson et al. 2003; Wang and Yang 2006; Parsons et al. 2008; D'Amico et al. 2009; Dolman et al. 2010). All noise sources have the potential to cause behavior-level effects and some may also cause PTS and TTS in certain species. The frequency and number of noise-generating anthropogenic activities in the marine mammal geographic analysis area are relatively unknown. If marine mammal populations are subjected to multiple anthropogenic noise stressors throughout their lifetimes that disrupt critical life stages (e.g., feeding, breeding, calving) and throughout their ranges, then additional impacts from noise from ongoing non-offshore wind activities could be major. However, there is no evidence ocean noise would result in population declines in the geographic analysis area for any marine mammal species. Additionally, all projects are expected to comply with a suite of mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

Noise impacts from the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible to minor as a result of aircraft noise, WTG operation noise, and vessel noise. Pile driving will result in negligible to moderate impacts on mid-frequency cetaceans (MFC), HFC, and pinnipeds; minor impacts for NARW; and moderate impacts for all other marine mammals in the low-frequency hearing group (BOEM 2021a, 2021b).

Presence of Structures

An estimated 2,945 WTG and offshore substation platform foundations could be built in the geographic analysis area for future offshore wind activities. Installation of WTGs, offshore substation platforms, and scour protection could result in reduced atmospheric energy, hydrodynamic changes, secondary entanglement in or ingestion of lost fishing gear that becomes tangled on structures, long-term habitat conversion and prey aggregation, artificial reef effects, avoidance or displacement, and behavioral disruption.

The presence of WTGs and offshore substation platforms could cause hydrodynamic effects that influence the amount of mixing in the water column. As described in Section 3.4.2, *Water Quality*, model outputs of impacts on the water column from the presence of structures are quite variable. Water column impacts are heavily dependent on factors such as the hub height of the turbine, foundation type, and oceanographic conditions (e.g., currents, well-mixed to stratified waters, and depth). Many of the modeling studies conducted to date note that there is uncertainty in whether impacts observed in the models would be distinguishable relative to natural variability in oceanographic conditions (Christiansen et al. 2022; Floeter et al. 2022; Schultze et al. 2020).

A study of atmospheric wake effects by Daewel et al. (2022) contains model results of a hypothetical build out of 24,000 5 MW WTGs at a hub height of 90 meters in the North Sea (compared to the 2,945 WTGs and offshore substation platform foundations in the geographic analysis area). The modeling results showed that extremely large clusters of offshore wind turbines provoke large scale changes in annual primary productivity. The model demonstrated that an extremely large cluster of 24,000 WTGs could result in a relatively strong increase in biomass in stratified seas and in less stratified and mixed seas. Despite the modeled changes in primary productivity, the authors state that "it is difficult to conclude on the overall trophic response, since the average fractional change in biomass is very small and shows a large regional variation" (Daewel et al. 2022). Therefore, this model showed that although very large numbers of WTGs may result in impacts on the forces driving the mixing of surface waters, only small changes in primary productivity may occur that may not be discernable from natural variation observed in the North Sea. Although detectable changes to the atmospheric forces that could affect surface mixing may occur, the influence of these impacts on biological productivity are likely minor, especially considering the much lower number of WTGs in the geographic analysis area than were modeled by Daewel et al. (2022).

Another study of the potential impacts of atmospheric wind wakes of the larger-sized WTGs expected in U.S. waters (10–15 MW) (Golbazi et al. 2022) showed smaller surface effects from the wind wakes than other modeling efforts on smaller turbines (5 MW) in the North Sea (Daewel et al. 2022). The authors state that the higher turbine hub heights are "key" to this difference and the research concludes "the results of this study indicate that, on average, meteorological changes at the surface induced by next-generation extreme-scale (diameter and hub height greater than 150 and 100 meters, respectively) offshore wind turbines will be nearly imperceptible." These findings introduce uncertainty in interpretation of the scale of potential impacts reported from Daewel et al. (2022) on sea surface and stratification and, thus, on regional hydrodynamics due to the higher hub heights (130-150 meters) planned for use in U.S. projects than those studied in Europe (90 meters; Akhtar et al. 2022; Christiansen et al. 2022; Daewel et al. 2022).

The presence of a large number of smaller WTGs on the OCS could reduce forces responsible for mixing surface waters, but as shown by Daewel et al. (2022) impacts on primary productivity are not expected to be different than natural variability. Additionally, the taller WTGs anticipated to be built in U.S. waters may have nearly imperceptible impacts on surface waters.

It has been speculated that hydrodynamic effects from presence of structures could affect the distribution and abundance of fish and planktonic prey resources for marine mammals. Studies of the mechanisms that may result in these potential impacts, however, have produced variable results. Vertical structures in the water column could increase the anthropogenic mixing of seasonally stratified outer continental shelf seas. Dorrell et al. (2022) state that offshore wind growth may fundamentally change shelf sea systems, particularly in seasonally stratified seas, but enhanced mixing could positively affect some marine ecosystems. The presence of foundations could increase vertical mixing driven by currents flowing around the foundations (Christiansen et al. 2022; Carpenter et al. 2016; Schultze et al. 2020). During times of stratification (summer), increased mixing due to the presence of structures could alter marine ecosystem processes by possibly increasing pelagic primary productivity in local areas

(English et al. 2017; Degraer et al. 2020). That increased productivity could be partially offset by the formation of abundant colonies of filter feeders on the foundations (Maar et al. 2009).

In current shallow-water offshore wind farms, where levels of turbulence are high, wakes have been observed due to the presence of the monopiles as cylindrical structures that affect flow (Dorrell et al. 2022). Wakes from individual structures may persist for 100 meters to 1 kilometer downstream (Dorrell et al. 2022). However, biological changes in the demersal community have been observed over smaller distances of (<50 meters) due to increased local fecal pellet excretions from mussels on and around the structures (Maar et al. 2009). At a regional level, Johnson et al. (2021b) modeled the effects on larval transport from the full build out of the entire southern New England lease areas. This study showed that the changes to depth-averaged currents vary on the order of +11 percent to -8 percent, and many of the results on the higher ends of this range occurred in the regions north and south of the lease areas. Changes in currents east of the lease areas, in the region of Nantucket Shoals, were minor. Johnson et al. (2021b) also showed a relative deepening in the thermocline of approximately 1 to 2 meters and a retention of colder water inside the wind farm areas through the summer months compared to the situation where turbines were not present. This is somewhat contrary to some of the results in European studies that suggest a loss of stratification due to the introduction of turbulence by wind wakes. Chen et al. (2016) assessed how wind turbines would affect oceanographic processes during storm events. The results showed that there would not be a significant influence on southward larval transport from Georges Bank and Nantucket Shoals to the Mid-Atlantic Bight due to the presence of turbine structures, although it could cause increased cross-shelf larval dispersion. Thus, the potential effects on marine mammal prey species, and therefore marine mammals, from changes to hydrodynamic conditions caused by the presence of offshore structures are not fully understood at this time, but likely range from 100 meters to 1 kilometer (Dorrell et al. 2022) and likely to vary seasonally and regionally.

The long-term presence of WTG structures could displace marine mammals from preferred habitats or alter movement patterns. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbor porpoise from commercial wind farm areas in Denmark. Displacement effects remain a focus of ongoing study (Kraus et al. 2019). Other studies have documented apparent increases in marine mammal density around wind energy facilities. Russel et al. (2014) found clear evidence that seals were attracted to a European wind farm, apparently attracted by the abundant concentrations of prey created by the artificial reef effect.

In-water structures result in the conversion of open-water and soft-bottom habitat to hard-bottom habitat. This habitat conversion attracts and aggregates prey species (i.e., fish and decapod crustaceans) (Causon and Gill 2018; Taormina et al. 2018). The aggregation of prey at artificial reefs could result in increased foraging opportunities for some marine mammal species. Studies of artificial reefs have demonstrated potential increased biomass of larger predator species, including pelagic fish, birds, and marine mammals (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), and attraction of predatory species, including sea birds, sea turtles, and marine mammals, to offshore wind structures (Degraer et al. 2020). However, any increase in biomass is anticipated to be small and localized, and it is not expected that reef effect would result in an increase in species preyed on by NARWs, fin whales, or sei whales (NMFS 2021).

The presence of structures could result in fishing vessel displacement, thereby shifting potential vessel strike exposure risk, or a shift in fishing gear types. If a shift from mobile gear to fixed gear occurs, there would be a potential increase in the number of vertical lines, resulting in an increased risk of marine mammal interactions with fishing gear. Discarded or lost commercial fishing nets may also become entangled around WTG foundations, which could further increase the potential for marine mammal entanglement leading to injury and mortality due to infection, starvation, or drowning (Moore and van de Hoop 2012). Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and may be a limiting factor in the species' recovery (Knowlton et al. 2012). Johnson et al. (2005) reports that 72 percent of NARWs show evidence of past entanglements. Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021). Entanglement may also be responsible for high mortality rates in other large whale species (Read et al. 2006). Abandoned or lost fishing gear may become tangled with foundations, reducing the chance that abandoned gear would cause additional harm to marine mammals and other wildlife, although debris tangled with WTG foundations may still pose a hazard to marine mammals. These potential long-term, intermittent impacts would be low intensity and persist until decommissioning is complete and structures are removed.

Although effects from individual structures are highly localized, the presence of an estimated 2,945 structures could result in regional impacts. Depending on proximity and extent, hydrodynamic and reef effects from planned activities could influence the availability of prey and forage resources for marine mammals. Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant hydrodynamic effects and broader scales. An increase in offshore wind farms may weaken the regional thermocline and affect heat storage, atmospheric CO_2 uptake, and benthic resupply of oxygen gas (Dorrell et al. 2022). Broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020). This possible effect is primarily relevant to NARWs, as their planktonic prey (calanoid copepods) are the only listed species' prey in the region whose aggregations are primarily driven by hydrodynamic processes. As aggregations of plankton, which provide a dense food source for NARWs to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities. Potential effects of hydrodynamic changes in prey aggregations are specific to listed species that feed on plankton, whose movement is largely controlled by water flow, as opposed to other listed species that eat fish, cephalopods, crustaceans, and marine vegetation, which are either more stationary on the seafloor or are more able to move independent of typical ocean currents (NMFS 2021a). There is considerable uncertainty as to how these broader ecological changes will affect marine mammals in the future, and how those changes will interact with other human-caused impacts. The effect of the increased presence of structures on marine mammals and their habitats is likely to be negative, varying by species, and their significance is unknown. Given the uncertainty regarding marine mammal responses to the presence of offshore wind structures, BOEM cannot discount the possibility that the presence of structures could have long-term, intermittent impacts on foraging, migration, and other normal behaviors.

Impacts from the presence of structures from other offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds; although impacts on individuals would be detectable and measurable, they would not lead to population-level effects. Impacts on odontocetes and pinnipeds may result in slight beneficial effects due to increases in aggregations of prey species.

Traffic

Planned offshore wind activities would result in increased vessel traffic due to vessels transiting to and from individual lease areas during construction, operation, and decommissioning. Vessel strikes are a significant concern for marine mammals, particularly mysticetes, which are relatively slow swimmers, and calves, which spend considerably more time at or near the surface compared to older life stages. Vessel strikes are relatively common for marine mammals and are a known or suspected cause of UMEs in the geographic analysis area for cetaceans (e.g., NARW) (NOAA Fisheries 2022a). Marine mammals are expected to be most vulnerable to vessel strikes when within the vessel's draft and when not detectable by visual observers (e.g., animal below the surface or poor visibility conditions such as bad weather or low light), and probability of vessel strike increases with increasing vessel speed (Pace and Silber 2005; Vanderlaan and Taggart 2007). Serious injury to cetaceans due to vessel collision rarely occurs when vessels travel below 10 knots (18.5 kilometers per hour) (Laist et al. 2001). Average vessel speeds in the geographic analysis area may exceed 10 knots (18.5 kilometers per hour), indicating that vessel traffic associated with future offshore wind activities may pose a collision risk for marine mammals.

Based on the vessel traffic generated by the proposed Project, it is assumed that construction of each individual offshore wind project would generate between 15 and 35 vessels on average and up to a maximum of 50 simultaneous construction vessels operating in the geographic analysis area at any given time between 2023 and 2030. Vessel collision risk is expected to be highest during construction, when traffic volumes would be greatest; risk of collisions is expected to be highest when vessels are transiting to and from offshore wind lease areas. Within offshore wind lease areas, vessels are expected to be largely stationary and to travel at slow speeds when transiting between locations within the offshore wind lease area. The increase in traffic associated with future offshore wind activities would only be a small, incremental increase in overall traffic in the geographic analysis area. BOEM expects minimization measures for vessel impacts would be required for future offshore wind activities, further reducing the risk of injury or mortality for marine mammals. Impacts from traffic (vessel strikes) from ongoing and planned offshore wind activities would likely be moderate for mysticetes and odontocetes, except for NARW. Impacts from traffic (vessel strikes) would likely be major for NARW and have the potential to result in population-level effects. Impacts from traffic (vessel strikes) from other offshore wind activities would likely be minor for pinnipeds and are unlikely to lead to population-level effects.

Accidental Releases

Accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase as a result of offshore wind activities. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present, but also during operations and decommissioning of offshore wind facilities. There would be a low risk of a leak of fuel, fluids, or hazardous materials from any one of approximately 2,945 WTGs and offshore substation platforms. Total fuel, fluids, or hazardous materials in the geographic analysis area is estimated at about 25 million gallons (95 million liters) (Appendix D, Table D2-3). BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons (484,533 liters) is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on individual fitness, including adrenal effects, hematological effects, liver effects, lung disease, poor body condition, skin lesions, and several other health effects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). In addition to direct effects on marine mammals, accidental releases of fuels, fluids, and hazardous materials can indirectly affect these species through impacts on prey species. Given the volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the long-term increase in accidental releases associated with future offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

Increased vessel traffic would also increase the risk of accidental releases of trash and debris during construction, operation, and decommissioning of offshore wind facilities. About half of all marine mammal species worldwide have been documented to ingest trash and debris (Werner et al. 2016). Based on stranding data, mortality rates associated with debris ingestion range from 0 to 22 percent. Ingestion may also result in sublethal effects, including digestive track blockage, disease, injury, and malnutrition (Baulch and Perry 2014). Linkages between impacts on individual marine mammals associated with debris ingestion and population-level effects are difficult to establish (Browne et al. 2015). BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects that such releases would be small and infrequent. The amount of trash and debris accidentally released long term during future offshore wind activities would likely be negligible compared to other ongoing trash releases.

Intakes and discharges related to cooling offshore wind HVDC converter offshore substation platforms are possible for planned offshore wind projects. Potential effects resulting from intake and discharge use include altered micro-climates of warm water surrounding outfalls, altered hydrodynamics around intakes/discharges, prey entrainment, and association with intakes if prey are aggregated on intake screens from which marine mammals scavenge. The number of offshore substation platforms per project is likely small; therefore, these impacts, though long term, would be low in intensity and localized.

Impacts from accidental release and discharges from other offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds, except for NARW. Impacts from accidental release and discharges from other offshore wind activities would likely be moderate for NARW and have the potential to result in population-level effects, but the population should sufficiently recover.

EMF and Cable Heat

Planned offshore wind activities would install approximately 10,000 miles (16,000 kilometers) of export and interarray cables, increasing the production of EMF in the geographic analysis area. Marine mammals appear to detect EMF intensity as low as 50 milligauss (Normandeau et al. 2011); however, scientific evidence is limited. As such, marine mammals may be sensitive to minor changes in EMFs, and it is theoretically possible that they could detect EMF from export and interarray cables (Walker et al. 2003). However, to be exposed to EMF above this 50 milligauss detection threshold, an individual would have to be within 3 feet (0.9 meter) of a cable that is lying on the surface of the sediment. There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs, including a temporary change in swim direction following exposure to EMFs (Gill et al. 2005). These effects are more likely with exposure to HVDC cables versus HVAC cables (Normandeau et al. 2011). However, no EMF impacts on marine mammals associated with underwater cables have been documented. EMF effects would be reduced by cable burial to an appropriate depth and the use of shielding, if necessary. Additionally, submarine cables typically maintain a minimum separation of at least 330 feet (101 meters), which ensures that there would be no additive EMF effects from adjacent cables. Therefore, BOEM anticipates EMF effects on marine mammals would be negligible.

Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters (Taormina et al. 2018). There are no data on cable heat effects on marine mammals (Taormina et al. 2018), but it is expected that the localized heating along a cable would not have any detectable impacts on marine mammals. Although increased heat in the sediment could affect benthic organisms that serve as prey for fish species that forage in the benthos that piscivorous marine mammals forage upon, there is expected to be ample available resources nearby that would not affect the availability of forage fish for marine mammals. Based on the narrowness of cable corridors and expected weakness of thermal radiation, impacts on benthic organisms are not expected to be significant (Taormina et al. 2018) and would be limited to a small area around the cable. Given the expected cable burial depths, thermal effects would not occur at the surface of the seabed where marine mammals would forage. Therefore, any effects on marine mammal prey availability would be too small to be detected or meaningfully measured.

Cable Emplacement and Maintenance

Other offshore wind projects could disturb approximately 181,822 acres (73,581 hectares) of seabed while installing interarray and export cables, causing an increase in suspended sediment. Those effects would be similar to those observed during construction of the Block Island Wind Farm (Elliot et al. 2017). While suspended sediment impacts would vary in extent and intensity depending on project- and site-specific conditions, measurable impacts are likely to be 500 mg/L or lower; short term, lasting for minutes to hours; and limited in extent to within a few feet vertically and a few hundred feet horizontally from the point of disturbance. There are no data on physiological effects of suspended sediment on marine mammals or marine mammal avoidance of sediment plumes. Some marine mammal species live in high-turbidity waters or employ foraging techniques that generate sediment plumes, suggesting that some species may tolerate increased suspended sediment concentrations (Todd et al. 2015). There is also evidence that some pinniped species may not rely exclusively on visual cues to forage (McConnell et al. 1999). Elevated suspended sediment concentrations may cause marine mammals to alter their normal movements and behaviors to avoid the area of elevated suspended sediment. Suspended sediment is most likely to affect these species if the area of elevated concentrations acts as a barrier to normal behaviors. However, no adverse effects are anticipated due to marine mammals swimming through the area of elevated suspended sediment or avoiding the area. Impacts from cable emplacement and maintenance from other offshore wind activities would likely be minor.

Port Utilization

The development of an offshore wind industry in the geographic analysis area may incentivize the expansion or improvement of regional ports to support planned projects. Several port expansion and improvement projects are proposed in New England and along the East Coast (see Appendix D for further details on port improvement and expansion projects). However, port expansion associated with future offshore wind activities is expected to be only a minor component of port expansion activities associated with all future activities. Increased port utilization and expansion would result in increased vessel traffic and noise (see *Traffic* and *Noise* IPFs) during construction, O&M, and decommissioning activities. Impacts from port utilization from other offshore wind activities on mysticetes, odontocetes, and pinnipeds would likely be moderate, except the NARW. Impacts from port utilization from other offshore wind activities would likely be major for NARW and have the potential to result in population-level effects. Any future port expansion and associated increase in vessel traffic would be subject to independent regulatory analysis, requiring full consideration of potential effects on marine mammals regionwide.

Lighting

The addition of up to 2,945 new offshore structures in the geographic analysis area with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities on marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented. BOEM would require wind farm developers to comply with the current design guidance for avoiding and minimizing artificial lighting effects; however, artificial light could aggregate prey species at night. Impacts from lighting from ongoing and planned offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds and are likely to be of the lowest level of detection and barely measurable, with no perceptible consequences to individuals or the population.

Gear Utilization (Biological/Fisheries Monitoring Surveys)

Planned offshore wind projects are likely to include surveys that monitor biological resources in and nearby associated project areas throughout various stages of development, similar to the Proposed Action. These could include acoustic, trawl, and trap and pot surveys, as well as other methods of sampling the biota in the area. Benthic monitoring and video surveys could include ROVs to capture still or live video images of the subsurface. Moored passive acoustic monitoring (PAM) systems or mobile PAM platforms such as towed PAM, autonomous surface vehicles, or autonomous underwater vehicles may be used prior to, during, and following construction. The presence of monitoring gear could affect marine mammals by entrapment or entanglement, especially through vertical lines; however, it is expected that monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts such that population-level effects would not occur. Impacts from gear utilization from planned offshore wind activities on mysticetes, odontocetes, and pinnipeds are likely to be negligible and are expected to occur at short-term, regular intervals over the lifetime of the projects and to have no perceptible consequences to individuals or the population. However, the potential extent and number of animals potentially exposed cannot be determined without project-specific information.

Impacts of Alternative A on ESA-Listed Species

Impacts of Alternative A on ESA-listed species would be the same as the IPFs discussed above. The ESA-listed species that are common in the Lease Area are NARW (peak abundance in late winter and early spring), fin whale (peak abundance late spring and summer) and sei whale (peak abundance spring and summer). The blue whale and sperm whale are rare and uncommon, respectively, in the Lease Area.

The three common ESA-listed whales, however, are also some of the most susceptible to vessel collisions in the region, and it is known that high traffic areas alter marine mammal distribution and behavior (COP Volume 2, Section 6.8.2.2, Table 6-67; Mayflower Wind 2022). From 2013 to 2017, the minimum rates of human-caused mortality for sei whales, fin whales, and NARWs were calculated at 1, 2.35, and 6.9 individuals per year, respectively. Further, NARWs are susceptible to vessel strikes across the entire region. Given the breadth of their range, the scope of work for the construction phase of each lease area and other ongoing and planned activities, the timing of construction activities and implementation and adherence to mitigation plans for each lease area would be critical in reducing harmful interactions with NARW and other ESA-listed species. Current and ongoing activities and offshore wind development other than the proposed Project would all effect ESA-listed species occurring along the Atlantic OCS and transiting and foraging through various wind energy lease areas.

Adverse impacts on the commonly occurring ESA-Listed whales would have a disproportionate impact on their respective populations compared to non-listed marine mammal populations, as a function of decreased genetic diversity. Genetic bottlenecks are more likely in breeding populations with few reproductive individuals—about 100 breeding female NARWs of a population of fewer than 350 whales (NOAA 2022e; Pettis et al. 2022), giving birth every 6 to 10 years (NOAA 2022e)—and bottlenecks may be further exacerbated from the proposed Project. From an evolutionary perspective, this makes individuals less genetically fit, increasing the probability of inbreeding and decreasing the ability for individuals to successfully adapt to changing environmental conditions due to decreased genetic diversity and fitness.

Any future federal or private activities that could affect federally listed marine mammals in the geographic analysis area would need to comply with ESA Section 7 or Section 10, respectively, to ensure that the proposed activities would not jeopardize the continued existence of the species.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, ongoing activities including non-offshore wind and offshore wind activities would result in a range of temporary to long-term impacts (disturbance, displacement, injury, mortality, and reduced foraging success) on marine mammals, primarily from exposure to construction-related underwater noise, vessel activity (vessel collisions), port utilization, changes in habitat from presence of new structures acting as artificial reefs and altering hydrodynamics, and climate change. Ongoing activities under the No Action Alternative would result in **minor** impacts on marine mammals because although impacts on individual marine mammals and their habitat are anticipated, impacts would likely not lead to population-level effects.

Cumulative Impacts of the No Action Alternative: For the No Action Alternative, BOEM anticipates that the combined ongoing and planned activities would result in moderate impacts on marine mammals primarily because of pile-driving noise, increased vessel traffic, and port utilization. Additionally, the presence of structures could contribute to adverse impacts with potentially beneficial impacts on some marine mammal species. Offshore wind activities would be responsible for a majority of the impacts associated with pile-driving noise, which could lead to moderate impacts on marine mammals in the geographic analysis area. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of the No Action Alternative would result in **moderate** impacts on marine mammals, with the exception of the NARW, on which impacts could be **major**. Impacts are magnified in severity for the NARW due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual. Habitat conversion and prey aggregation associated with the presence of structures could result in **minor beneficial** impacts due to increased foraging opportunities for marine mammals.

3.5.6.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on marine mammals.

- The number, size, foundation type, and location of WTGs and offshore substation platforms.
- The number and location of interarray cables, offshore substation platform cables, and offshore export cables.
- The number of simultaneous vessels, number of trips, and size of the vessels.

- The number, size, and location of WTGs as they relate to hardened structure.
- The vessels and gear utilized to sample environmental parameters in the Project area through HRG surveys, fisheries, and biological monitoring plans.

Variability of the proposed Project design exists as outlined in Appendix C. A summary of potential variances in impacts is provided below.

- The number, size, and location of WTGs and offshore substation platforms installed by pile driving, which are factors that contribute to the intensity and duration of noise resulting in behavioral and physiological effects (TTS), or cause auditory injury (PTS) to marine mammals.
- Variability in installation methods of offshore substation platforms and cables.
- Number, size, and location of UXO detonations.
- The number of simultaneous vessels, number of trips, and size of the vessels could affect vessel collision risk to marine mammals due to vessels transiting to and from the Wind Farm Area during construction, operations, and decommissioning, and increased recreational fishing vessels.
- The number, size, and location of WTGs as they relate to hardened structure, which could cause both beneficial and adverse impacts on marine mammals through localized changes to hydrodynamic features, prey aggregation and associated increase or decrease in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.

Mayflower Wind has committed to measures to minimize impacts on marine mammals, as included in COP Volume 2 Table 16-1, COP Appendix O, and Mayflower Wind's MMPA Incidental Take Regulations Application (these measures are compiled in Appendix G, *Mitigation and Monitoring*). Applicant committed measures are considered part of the Proposed Action and applicable action alternatives and are assessed within each IPF. These measures include PSO visual monitoring, passive acoustic monitoring, vessel speed restrictions, pile driving time-of-year restrictions, HRG surveys, UXO detonation monitoring, post-pile monitoring, and varied species reporting. When possible, Mayflower Wind would employ pre-start clearance, ramp-up, and soft-start procedures for HRG surveys and construction activities. Ramp-up activities would be not activated until the PSO has reported no marine mammals in the respective shutdown zone. Vessels would stay more than 500 meters away from NARWs or an unidentified large marine mammal, more than 100 meters away from sperm whales and other baleen whales, and more than 50 meters from all other marine mammals, with the exception of animals approaching the vessel (e.g., delphinids and pinnipeds), in which case the vessel operator must avoid excessive speed or abrupt changes in direction. Further, vessels greater than 65 feet in length would operate at speeds ≤10 knots from November 1 through April 30, and all vessel speeds would be reduced to ≤ 10 knots when mother/calf pairs, pods, or large assemblages of marine mammals are observed.

Combinations of noise-attenuation systems (e.g., double big bubble curtain, hydrodsound damper plus single big bubble curtain) potentially achieve much higher attenuation than the 10-15 dB of small, single bubble curtains (Buehler et al. 2015). The type and number of noise-attenuation systems to be used during construction have not yet been determined, and impact pile driving 24 hours per day was deemed necessary to complete installation within as few years as possible. However, additional measures to protect NARWs include concentrating construction between May 1 and December 31 when NARWs are present in lower numbers, avoiding pile driving activity between January 1 and April 30, as well as developing specific monitoring tools through the Incidental Take Regulations Application process, which may include the use of advanced infrared systems, real-time PAM, autonomous underwater vehicles, autonomous aerial vehicles, or other advanced technologies that could improve the probability of detecting marine mammals at night.

3.5.6.5 Impacts of Alternative B – Proposed Action on Marine Mammals

The analysis of impacts under the No Action Alternative, and references therein, applies to the following discussion of the Proposed Action. The most impactful IPFs associated with the Proposed Action are underwater noise from impact pile driving and the presence of structures, which would lead to permanent impacts that may be either adverse or beneficial.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on marine mammals are impact pile driving (installation of WTGs and OSS), vibratory pile driving (if used), geophysical surveys (HRG surveys), geotechnical drilling surveys, detonations of UXO, vessel traffic, aircraft, cable laying or trenching, and dredging during construction and WTG operation. Effects of noise on marine mammals can include physiological effects including injury (PTS) and temporary hearing impairment (TTS), disturbance (behavioral effects and stress), and acoustic masking. Underwater noise from these activities may also affect the distribution and abundance of prey items. Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, summarizes the effects of impact pile driving on fish, which are expected to be negligible to moderate.

Assessment of the potential for underwater noise to injure or disturb a marine mammal requires acoustic thresholds against which received sound levels can be compared. Noises are less likely to disturb or injure an animal if they are at frequencies at which the animal cannot hear well. Regulatory thresholds used for the purpose of predicting the extent of potential noise impacts on marine mammals and subsequent management of these impacts aim to account for the duration of exposure and the differences in hearing acuity among marine mammal hearing groups (Finneran 2016; NMFS 2018). Auditory thresholds for underwater noise are expressed using three common metrics: SPL (or L_{rms}) and L_{pk}, both measured in dB re 1 µPa, and SEL, a measure of cumulative energy in dB re 1 $\mu Pa^2 s$.

The most widely accepted thresholds are provided by NMFS (NMFS 2018). To assess the potential for Level A and Level B harassment, NMFS (NMFS 2018) recommends using dual criterion: an unweighted peak SPL metric and a cumulative SEL metric with frequency weighting. The onset of PTS considers both duration of exposure and species-dependent hearing acuity. The thresholds used to assess the potential for Project-generated underwater noise to cause PTS and behavioral disturbance in marine mammals are outlined in COP Appendix U2, Table 8 (Mayflower Wind 2022).

Noise from impact pile driving for the installation of WTGs and offshore substation platform foundations would occur intermittently during the installation of offshore structures. Up to 147 WTGs and up to 5 offshore substation platforms at a maximum of 149 WTG/offshore substation platform positions are anticipated for the Proposed Action. Each WTG requires 1 monopile or 4 to 8 pin piles for jacket foundations, and each offshore substation platform requires 1 monopile or up to 27 pin piles, with each pin pile or monopile requiring 4 or 2 hours of driving to install, respectively. This would occur over a maximum-case scenario of a total of 146 days for WTGs and 7 days for offshore substation platforms.

Acoustic propagation modeling of the impact pile-driving activities for the Proposed Action was undertaken by JASCO Applied Sciences to determine distances to the established PTS and disturbance thresholds for marine mammals for both a realistic and maximum-case scenario (COP Appendix U2; Mayflower Wind 2022). Two types of piles were considered under the maximum-case scenario: 52-foot (16-meter) monopiles and 15-foot (4.5-meter) pin piles as part of the four-legged jacket foundations. Under the realistic scenario, two types of piles were considered: 36-foot (11-meter) monopiles and 9.5-foot (2.9-meter) pin piles as part of the three-legged jacket foundations. Modeling was done for 146 WTGs and three offshore substation platforms. Sound fields from monopiles and pin piles were modeled at two representative locations in the Offshore Project area representing the variation in water depth in the Lease Area using a Menck MHU 3500S impact hammer for the pin piles and theoretical 6,600-kilojule impact hammer for the monopiles. The modeling also applied 0 dB, 6 dB, 10 dB, and 15 dB noise attenuation to incorporate the use of a noise-abatement system (e.g., one or multiple bubble curtain[s]). This attenuation is considered achievable with currently available technologies (Bellmann et al. 2020). The resulting values represent a radius extending around each pile where potential injurious-level or behavioral effects could occur. Additionally, the definitions for the abbreviations used in the impact estimates are presented in Table 3.5.6-7.

Table 3.5.6-7. Abbreviations and definitions used for acoustic impact analysis

Abbreviation	Term
SEL	Sound Exposure Level
L_{rms}	Root-mean-square sound pressure level
L_{pK}	Peak sound pressure level

The single-strike L_{pk} PTS distances represent how close a marine mammal would have to be to the source to be instantly injured by a single pile strike. SEL-based thresholds consider total estimated daily sound exposure. One range that can be reported for this threshold is the distance at which a marine mammal would have to remain for the entire period of daily installation to experience temporary or permanent auditory changes in hearing. L_{rms} behavioral effects thresholds can be met without prolonged exposure, meaning that any animal within the range of that threshold is assumed to have experienced behavioral effects.

Furthermore, the dual threshold criteria of SEL and L_{pk} are used to calculate marine mammal exposures. To estimate the radial distance to PTS thresholds for impact pile driving (NMFS 2018) dual-metric thresholds for impulsive noise were used and can be found in COP Appendix U2, Table 8 (Mayflower

Wind 2022). The estimates of the radial distances to PTS thresholds for the maximum-case scenarios can be found in COP Appendix U2, Tables F-120 through F-124 and for the realistic scenario in Tables F-117 through F-119.

Traditional acoustic modeling methods used to estimate monitoring and mitigation zones assume that marine mammals remain stationary for the duration of the sound event. However, the pathway a marine mammal takes through the sound field determines the cumulative sound exposure (SEL); therefore, treating marine mammals as stationary may not produce realistic estimates for the monitoring zones. For the Project, animal movement modeling was used to estimate the distance to the closest point of approach for each of the species-specific "animats" (i.e., simulated animals) during a simulation. The range of the closest point of approach (CPA) for each of the species-specific animats during a simulation was documented and then the CPA range that accounts for 95 percent of the animats that exceed an acoustic impact threshold was determined. The ER_{max} (maximum exposure range) accounts for the farthest CPA of an animat that exceeded threshold and $ER_{95\%}$ is the horizontal distance at which 95 percent of the CPAs of animats exceed the threshold. Table 3.5.6-8 through Table 3.5.6-10 display the maximum-case and Table 3.5.6-11 though Table 3.5.6-13 display realistic case species-specific ER95% in kilometers, the closest points of approach accounting for 95 percent of exposures above Level A (NMFS 2018) and Level B (NOAA 2005; Wood et al. 2012).

Table 3.5.6-8. Marine mammal hearing group ER95% exposure ranges (kilometers) to behavioral thresholds for max case WTG monopile foundation with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	L_{rms}	L_{pk}	SEL	L_{rms}
LFC	0.11	14.84	14.12	0.00	4.92	6.80
MFC	0.00	0.02	13.91	0.00	0.00	6.79
HFC	0.81	4.11	13.76	0.24	1.04	6.53
Phocid pinnipeds	0.10	2.64	13.79	0.00	0.37	6.78

Source: COP Appendix U2, Table 21; Mayflower Wind 2022

Table 3.5.6-9. Marine mammal hearing group ER95% exposure ranges (kilometers) to behavioral thresholds for max case offshore substation platform jacket foundation with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	L_{rms}	L_{pk}	SEL	L_{rms}
LFC	0.03	12.83	9.45	0.00	3.41	3.60
MFC	0.00	0.32	9.59	0.00	0.00	3.70
HFC	0.51	5.21	8.81	0.09	1.73	3.45
Phocid pinnipeds	0.06	3.27	9.33	0.00	0.43	3.62

Source: COP Appendix U2, Table 20; Mayflower Wind 2022

Table 3.5.6-10. Marine mammal hearing group ER95% exposure ranges (kilometers) to behavioral thresholds for max case WTG jacket foundation with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	L_{rms}	L_{pk}	SEL	L_{rms}
LFC	0.03	10.26	7.89	0.00	0.11	3.15
MFC	0.00	0.11	7.92	0.00	0.00	3.31
HFC	0.42	4.33	7.40	0.09	1.25	3.12
Phocid pinnipeds	0.02	1.95	7.77	0.00	0.18	3.28

Source: COP Appendix U2, Table 19; Mayflower Wind 2022

Table 3.5.6-11. Marine mammal hearing group ER95% exposure ranges (kilometers) to behavioral thresholds for realistic case WTG monopile foundation with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	L_{rms}	L_{pk}	SEL	L_{rms}
LFC	0.06	9.69	10.87	0.00	2.44	4.62
MFC	0.00	0.02	10.65	0.00	0.00	4.66
HFC	0.71	3.00	10.51	0.25	0.52	4.54
Phocid pinnipeds	0.08	1.38	10.78	0.00	0.01	4.68

Source: COP Appendix U2, Table 18; Mayflower Wind 2022

Table 3.5.6-12. Marine mammal hearing group ER95% exposure ranges (kilometers) to behavioral thresholds for realistic case offshore substation platform jacket foundation with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	L_{rms}	L_{pk}	SEL	L_{rms}
LFC	0.07	18.49	11.47	0.00	3.69	4.61
MFC	0.00	0.82	11.45	0.00	0.02	4.82
HFC	0.65	7.37	10.92	0.16	2.85	4.54
Phocid pinnipeds	0.09	5.27	11.42	0.00	1.03	4.64

Source: COP Appendix U2, Table 17; Mayflower Wind 2022

Table 3.5.6-13. Marine mammal hearing group ER95% exposure ranges (kilometers) to behavioral thresholds for realistic case WTG jacket foundation with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	L_{rms}	L_{pk}	SEL	L_{rms}
LFC	0.02	9.04	8.87	0.00	2.02	3.23
MFC	0.00	0.07	9.27	0.00	0.02	3.29
HFC	0.40	4.76	8.29	0.09	1.65	3.06
Phocid pinnipeds	0.06	2.10	8.89	<0.01	0.21	3.27

Source: COP Appendix U2, Table 16; Mayflower Wind 2022

Considering the results of the underwater noise modeling and extent of large radial distances to PTS and behavioral thresholds, individual fitness-level impacts are expected to result from the Project activities. These effects are considered moderate for LFC, HFC, and pinnipeds and minor for MFC. As noted earlier, the reason for some shorter ranges to behavioral impact than PTS is that the sound causing PTS accumulates over a 24-hour period, so a low L_{rms} that may not induce a behavioral change may eventually cause physical damage over the period of installation.

Mayflower Wind has proposed measures to minimize or avoid impacts of pile-driving noise and has developed a Protected Species Mitigation and Monitoring Plan for the Proposed Action (COP Appendix O; Mayflower Wind 2022). Measures being considered for this plan include but are not limited to exclusion and monitoring zones, ramp-up/soft-start procedures, shutdown procedures, qualified and NMFS-approved protected species observers, noise-attenuation technologies, passive acoustic monitoring systems (fixed and mobile), reduced-visibility monitoring tools/technologies (e.g., night vision, infrared, thermal cameras), and use of software to share visual and acoustic detection data among platforms in real time. The southern extent of the Gulf of Maine critical habitat for the NARW (Northeastern U.S. Foraging Area Unit 1) is approximately 44 miles (70 kilometers) east of the northeast corner of the Lease Area and approximately 30 miles (48 kilometers) from the Falmouth ECC. Due to these distances, no displacement or avoidance of the critical habitat areas is anticipated as a result of impact pile driving.

Mitigation would reduce PTS from impact pile driving on marine mammals; however, behavioral and masking effects are still considered likely for activities with large acoustic disturbance areas. Based on the analysis conducted by Southall et al. (2021), it is expected that pinnipeds are likely to leave the area during pile-driving activities, and more severe responses are likely for harbor porpoises including minor reductions in vocal output, possible sustained avoidance, reduced vocal mechanisms, and habitat avoidance (Southall et al. 2021). Effects of behavioral responses of pinnipeds to impact pile-driving noise are considered minor. For harbor porpoise, behavioral effects are considered moderate. Due to the lack of behavioral data for many species likely present in the Offshore Project area, a conservative approach was implemented when determining the magnitude of the effects. As a result, for species where behavioral data are lacking (e.g., all other species), behavioral effects are considered moderate.

Vibratory pile installation noise could cause underwater noise effects on marine mammals. Vibratory pile driving produces non-impulsive and continuous sounds with lower peak sound pressure levels (Guan and Miner 2020) which are typically less than impact hammering. However, due to the lower disturbance threshold for behavioral harassment (120 dB re 1 µPa) for continuous sounds, vibratory pile driving may result in a larger area ensonified above that threshold and result in more Level B harassment. Currently four types of foundations are under consideration for the WTGs and offshore substation platforms. Impact and/or vibratory pile driving would be used for the installation of monopiles and piled jacket foundation types and would add sound into the marine environment.

Acoustic and animal exposure modeling was conducted for two construction scenarios, Scenario 1 and Scenario 2, for the Draft Request for Incidental Take Regulations for the Construction and Operations of the Mayflower Wind Project (September 2022). Both scenarios incorporate vibratory and impact pile driving and assume that foundation installations would occur over approximately 5 months of the year, across 2 separate years. Modeling was conducted assuming installation from January through December; however, Mayflower Wind does not intend to conduct pile driving activity from January 1 through April 30 to reduce impacts on NARW and other marine mammals (COP Volume 2, Table 16-1, Mayflower Wind 2022). The following describes these scenarios and their assumptions in greater detail.

- Scenario 1: WTG monopiles, vibratory and impact piling with concurrent offshore substation platform installations. Consecutive installation of most WTG monopile foundations using vibratory and impact piling (108 monopiles); concurrent installation of offshore substation platform jacket foundations (32, 4.5-meter pin piles) and 16 monopiles using only impact pile driving; and consecutive installation of the remaining 22 WTG monopile foundations using only impact piling.
- Scenario 2: WTG piled jackets, vibratory and impact piling with concurrent offshore substation platform installations. Consecutive installation of most (120) WTG jacket foundations (four 4.5-meter pin piles per jacket) using vibratory and impact piling; concurrent installation of offshore substation platform jacket foundations (32, 4.5-meter pin piles) and eight WTG jacket foundations using only impact pile driving; and consecutive installation of the remaining 19 WTG jacket foundations using only impact piling. Results of the modeling are presented in Tables 14 through 24 of the Request for Incidental Take Regulations for the Construction and Operations of the Mayflower Wind Project (September 2022) and include estimated PTS exposures to marine mammal species assuming a 10 dB broadband noise attenuation in the summer and winter.

Mayflower Wind is requesting Level A and Level B take from Scenarios 1 and 2 assuming 10 dB of noise attenuation. Level A takes assume no implementation of monitoring and mitigation measures while Level B exposure modeling take estimates are based on distances to the unweighted 160 dB threshold. Take estimates under Scenarios 1 and 2 are in the Request for Incidental Take Regulations for the Construction and Operations of the Mayflower Wind Project (September 2022), Tables 25 and Table 26, respectively.

Acoustic signals produced by HRG sources can be subdivided into impulsive signals used for sub-bottom profiling (e.g., boomers, bubble guns, airguns, sparkers, chirp sub-bottom profilers) or non-impulsive signals used for bottom mapping (e.g., multi-beam echosounders, side-scan sonar) (Crocker and

Fratantonio 2016). Many side-scan sonar and multi-beam echosounder systems operate at frequencies above the generalized hearing ranges of marine mammals (greater than 180 kHz) so are not expected to result in impacts (BOEM 2021d). Impulsive HRG sources that operate at lower frequencies within the established hearing range of marine mammals have the potential to cause temporary behavioral disturbance. Generally, HRG surveys, even using the loudest equipment, are unlikely to impair hearing of marine mammals due to the relatively low source levels and very short pulses and durations of sound (BOEM 2021b). In addition, masking is unlikely to occur due to the directionality of the signals for most HRG survey equipment and the brief period when an individual mammal may be within its beam (NOAA 2021). For equipment that operates within the functional hearing ranges of marine mammals, whales could be disturbed by sound sources that ensonify larger areas (sparkers and boomers), but the disturbance is expected to be brief and temporary because both the sound source and the individual marine mammal would likely be moving, and any effects would be insignificant (BOEM 2021d; NMFS 2021b).

Animal exposure modeling was not conducted for cofferdam installation and removal because Mayflower Wind's construction activities may include either a temporary gravity-based structure (i.e., gravity cell or gravity-based cofferdam) and/or a dredged exit pit. Installation of both the temporary gravity-based structure and/or a dredged exit pit would not require pile driving or hammering.

Mayflower Wind may encounter UXO on the seabed in the Offshore Project area. The Falmouth ECC does not overlap any UXO areas or former defense sites, while Brayton Point ECC intersects one formerly used defense site. The Lease Area does not coincide with any UXO sites and the nearest site is 10 miles west of the Massachusetts and Rhode Island lease areas (COP Volume 2, Section 14.1.1; Mayflower Wind 2022). A desktop study by Mayflower Wind of UXO in the Offshore Project area concluded that there is a varying Low to Moderate risk from encountering UXO on site. The risk is Moderate throughout all of the Lease Area, and a relatively equal ratio between Low and Moderate within the ECCs (COP Appendix E.7; Mayflower Wind 2022).

UXO detonations have the potential to result in mortality or serious injury (PTS) and behavioral disturbance of marine mammals. To reduce possible exposures, Mayflower Wind has committed to using a noise mitigation system (e.g., bubble curtain system) when introducing sounds into the environment (COP Volume 2, Table 16-1; Mayflower Wind 2022). Attenuation of 10 dB can be sufficiently achieved using sound mitigation such as bubble curtains (Bellmann et al. 2020). Impacts associated with UXO detonation for the Proposed Action are expected to be minor for the following reasons: any required detonations will be timed to occur no more than once per day, the number of UXOs identified in the Offshore Project area is expected to be low, and the implementation of applicant-committed AMMs (Appendix G) will reduce or eliminate potential Level A harassment. Adverse effects are therefore not anticipated on marine mammal stocks or populations.

The short-term consequences of masking from Project activities range from temporary changes in vocalizations to avoidance. Longer-term consequences include permanent changes to vocal patterns; reductions in fitness, survivorship, and recruitment; and abandonment of important habitat areas. Most marine mammal species use a range of frequencies to communicate. The most affected cetaceans would be LFC (COP Volume 2, Section 6.8.2.1; Mayflower 2022). Modeling results indicate that dominant frequencies of impact pile-driving activities for the Proposed Action were concentrated below 1 kilohertz (COP Appendix U2, Figures 13 through 22; Mayflower Wind 2022). Because of this, LFCs and pinnipeds are more likely to experience acoustic masking than MFC and HFC. As a result, masking effects from impact pile driving are considered minor for MFC and HFC and moderate for LFC and pinnipeds. For UXO detonation, masking is not anticipated to be an issue due to the short time frame over which the effect would occur. For vibratory pile driving, masking effects are possible and could be greater than for impact pile driving due to the continuous nature of the sound. However, the activity would occur for a short duration, reducing the impact to minor for all species groups.

For HRG surveys, masking of communications would depend on the frequency at which the survey is completed. During HRG surveys, 1,640-foot (500-meter) monitoring zones for NARWs, and 328-foot (100-meter) monitoring zones for other marine mammals would be used 30 minutes prior to noise-producing survey activities. Any marine mammals observed in these zones would pause the 30-minute observation period, which would resume only after confirmation from the observer that the animal has left the area. If the animal dives or visual contact is lost, the 30-minute observation period is reset (BOEM 2021c). During survey activities, 656-foot (500-meter) shutdown zones for NARW for use of impulsive acoustic sources (e.g., boomers and/or sparkers) and non-impulsive nonparametric sub-bottom profilers; and 328-foot (100-meter) shutdown zones for all other marine mammals would be established (except for delphinids when approaching the vessel or towed acoustic sources, shutdown is not required). Observed animals occurring within these ranges would prompt a shutdown of boomers, sparkers, or bubble gun categories of equipment, until the animal leaves the area (BOEM 2021d). Due to the range of frequencies emitted during HRG surveys, masking is considered possible in all functional hearing groups. However, masking is unlikely to occur due to the directionality of the signals for most HRG survey equipment and the brief period when an individual mammal may be within survey activities (NOAA 2021). Masking of LFC communications is considered more likely due to the overlap of survey signals with the lower-frequency signals produced by these species. Masking of high-frequency echolocation clicks used by MFCs and HFCs is not anticipated; however, some masking of other communication used by these species is possible. Despite this, due to the small number of survey days expected for the Proposed Action and the fact the sound exposure would be brief and temporary, masking is considered negligible (NMFS 2021b).

As discussed in Section 3.5.6.3, *Impacts of Alternative A,* operating WTGs generate non-impulsive, underwater noise that is audible to marine mammals. Operational noise effects are anticipated to attenuate to ambient levels within a close range of each foundation (Kraus et al. 2016; Thomsen et al. 2015). WTGs associated with the Proposed Action are expected to be larger than previously reported on WTGs operating currently (as described in Section 3.5.6.3) and may therefore produce higher noise levels, which may result in minor impacts on marine mammals (Tougaard et al. 2020).

Accidental releases: The Proposed Action may increase accidental releases of fuels, fluids, and hazardous materials and trash and debris during construction and installation, O&M, and decommissioning activities. However, accidental releases are considered unlikely. All Project vessels would comply with USCG regulations for the prevention and control of oil spills (33 CFR Part 155), further reducing the likelihood of an accidental release. Mayflower Wind would be required to develop an OSRP with measures to prevent accidental releases and a protocol to respond to such a release. The incremental impacts of the Proposed Action would not increase the risk of accidental releases beyond that described under the No Action Alternative. Potential impacts on marine mammals from exposure to accidental releases are expected to be sublethal due to quick dispersion, evaporation, and emulsification, which would limit the amount and duration of exposure.

During operation, there would be increased intake and discharge from the HVDC converter offshore substation platform in the Lease Area, which requires continuous cooling water withdrawals and subsequent discharge of heated effluent back into receiving waters. Marine mammals could experience indirect effects during water withdrawals if prey species become entrained in very large numbers. Marine mammal prey may be affected further due to thermal impacts from subsequent heated discharge effluent released back into receiving waters. To minimize potential impacts on zooplankton from entrainment, Mayflower Wind has committed to siting the northernmost HVDC converter offshore substation platform outside of a 10-kilometer buffer of the 30-meter isobath from Nantucket Shoals, an area of high productivity and foraging value for several marine species (COP Volume 2, Table 16-1; Mayflower Wind 2022). Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, and Section 3.5.3, *Benthic Resources*, details the impact of the HVDC converter offshore substation platform on marine mammal prey species based on NPDES permit application modeling. Because impacts would be localized to the nearby area around the offshore substation platform and the design of the offshore substation platform would minimize entrainment risks, BOEM anticipates indirect impacts on marine mammals from the HVDC converter offshore substation platform would be long-term but minor.

Traffic: The Proposed Action would result in increased vessel traffic due to vessels transiting to and from the Project area during construction and installation, O&M, and decommissioning. As described in Section 3.5.6.3, vessel strikes are a significant concern for marine mammals and could result in injury or death. Mayflower Wind expects on average 15 to 35 vessels (with a maximum peak of 50 vessels) to be used during construction and installation of the Project. During O&M, Mayflower Wind generally expects one to three vessels to operate at a given time. The increase in traffic associated with the Proposed Action would only be a small incremental increase in overall traffic in the geographic analysis area. Mayflower Wind has committed to a range of AMMs to avoid vessel collisions with marine mammals (Appendix G). Specific AMMs pertaining to vessel traffic include speed restriction in accordance with NOAA requirements when assemblages of cetaceans are observed, the maintenance of a reasonable distance from whales and small cetaceans (specifics to be added based on consultation), adherence to NMFS Regional Viewing Guidelines for vessel strike avoidance to minimize the risk of collision, vessel operator training on guidelines, and monitoring of the NMFS NARW reporting systems (COP Appendix O, Table 1; Mayflower Wind 2022). With implementation of AMMs, the impact from vessel strikes is considered negligible for pinnipeds and odontocetes and minor for non-listed mysticetes. As the death of a single NARW could lead to population-level consequences and the application of AMMs cannot rule out the potential for this effect to occur, this impact is considered major for NARW and moderate for all other listed mysticetes.

Cable emplacement and maintenance: The Proposed Action's contribution of up to 3,888 acres (1,573 hectares) of seafloor disturbance by cable installation would result in turbidity effects with the potential to have temporary impacts on marine mammals, as described in Section 3.5.6.3. Project-specific sediment dispersion modeling was completed using proposed cable installation methods, site-specific sediment grain size and bathymetric data, and a high-resolution wave and current model for each ECC and interarray cables (COP Appendices F1 and F3; Mayflower 2022). Results showed that redeposition of suspended sediments occurs quickly before being transported long distances. TSS concentrations above 100 mg/L (0.0008 lb/gal) extended a maximum of 1,214 feet (370 meters) for any scenario except for nearshore areas of the Brayton Point corridor where they extended to just over 0.62 mile (1 kilometer). The maximum TSS level dropped below 10 mg/l (0.00008 lb/gal) within 2 hours for all simulated scenarios and dropped below 1 mg/l (0.000008 lb/gal) within 4 hours for any scenario except for nearshore areas of the Brayton Point corridor where 100mg/L and 10 mg/L concentrations lasted for less than 5 hours and a little over 2 days, respectively. Deposition thicknesses exceeding 5 millimeters (0.20 inch) were generally limited to a corridor with a maximum width of 79 feet (24 meters) around the cable routes but reached a maximum of 590 feet (180 meters) from the centerline for the interarray cables (COP Appendices F1 and F3; Mayflower 2022).

Based on these modeling results, BOEM anticipates short-term and localized water quality impacts from interarray cable installation and 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 generate additional impacts. However, individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased sedimentation, and only non-measurable, negligible impacts, if any, on individuals would be expected given the localized and temporary nature of the potential impacts.

EMF and cable heat: During operations, the Proposed Action would result in the production of EMF, which may be detectable by marine mammals, as described in Section 3.5.6.3. Studies documented electric or magnetic sensitivity up to 0.05 microTesla (0.5 milligauss) for fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-fin pilot whale, Atlantic white-sided dolphin, Risso's dolphin, and harbor porpoise (Tricas and Gill 2011). However, evidence used to make the determinations was only observed behaviorally/physiologically for bottlenose dolphins, and the remaining species were concluded based on theory or anatomical details. Recent reviews by Bilinski (2021) of the effects of EMF on marine organisms concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. Exponent Engineering, P.C. (2018) modeled EMF levels that could be generated by the South Fork Wind Farm export cable and interarray cable. The model estimated induced magnetic field levels ranging from 13.7 to 76.6 milligauss on the bed surface above the buried and exposed South Fork Wind Farm export cable and 9.1 to 65.3 milligauss above the interarray cable, respectively. Induced field strength would decrease effectively to 0 milligauss within 25 feet (7.6 meters) of each cable.

BOEM performed literature reviews and analyses of potential EMF effects from offshore renewable energy projects (CSA Ocean Sciences Inc. 2021; Inspire Environmental 2019; Normandeau et al. 2011). These and other available reviews and studies (Gill et al. 2005; Kilfoyle et al. 2018) suggest that most marine species cannot sense low-intensity EMF generated by the HVAC power transmission cables commonly used in offshore wind energy projects. Normandeau et al. (2011) concluded that marine mammals are unlikely to detect magnetic field intensities below 50 milligauss, suggesting that these species would be insensitive to EMF effects from the Project's electrical cables. Mayflower Wind modeled EMF levels that could be generated by the Project's submarine cables. The model estimated induced magnetic field levels ranging from 85 milligauss (6.6-foot [2-meter] burial depth) to 1,859 milligauss (unburied, covered with 1-foot-thick [0.3-meter-thick] concrete mattress) directly above the cable centerline (COP Appendix P1, Table ES.1; Mayflower Wind 2022). The modeled EMF levels are greater than the 50 milligauss detection threshold for marine mammals identified by Normandeau et al. (2011), indicating that marine mammals may be able to detect elevated EMF levels in proximity to the Proposed Action cables. However, EMF levels attenuate rapidly with distance, and at 10 feet, the modeled magnetic field levels would be below 50 milligauss. Marine mammal species that are more likely to forage near the benthic organisms, such as certain delphinids, have more potential to experience EMF above baseline levels (Tricas and Gill 2011). The 50-milligauss detection threshold is theoretical and an order of magnitude lower than the lowest observed magnetic field strength resulting in observed behavioral responses (Normandeau et al. 2011). These factors indicate that the likelihood of marine mammals encountering detectable EMF effects is low, and any exposure would be below levels associated with measurable biological effects. Therefore, EMF effects on marine mammals would be negligible.

While considered a localized phenomenon, electricity produced during operation may further increase temperatures within the surrounding sediment and water where benthic resources that serve as prey for marine mammals may reside (Riefolo et al. 2016; Tabassum-Abbasi et al. 2014). Thermal impacts are expected to result in a slight increase in temperature a few centimeters from the cable, and benthic resources within the general vicinity may experience negative effects from the increased temperature (Tabassum-Abbasi et al. 2014). An increase in temperature near the cable has been shown to modify the chemical and physical properties of the substratum resulting in spatial changes in benthic community structure, physiological changes to benthic organisms, and an alteration of the oxygen concentration profile, which could then indirectly impact the development of microorganisms (Taormina et al. 2018). The heat emissions produced would be higher in HVAC cables than compared to HVDC cables at an equal transmission rate (Taormina et al. 2018). Further studies need to be completed to accurately assess long-term impacts of EMFs on the surrounding ecosystem as *in-situ* investigations are lacking.

Presence of structures: As described in Section 3.5.6.3, the installation of 149 WTGs and offshore substation platforms could result in hydrodynamic changes, avoidance or displacement, behavioral disruption, entanglement or ingestion of lost fishing gear, habitat conversion, and prey aggregation. The presence of 149 WTGs and offshore substation platforms could alter local hydrodynamic patterns, which could have localized impacts on prey distribution and abundance around each structure. When considered relative to the broader, regional oceanographic factors that determine primary and secondary productivity in the region, localized impacts on zooplankton abundance and distribution from hydrodynamic effects are not likely to measurably affect the availability of prey resources for marine mammals. Hydrodynamic effects resulting from the Proposed Action could result in minor beneficial effects on fish-eating marine mammals like dolphins and seals that benefit from increased prey abundance around the structures and negligible effects on marine mammals that forage on plankton and forage fish.

Impacts from Proposed Action structures on hydrodynamic patterns in the nearby Nantucket Shoals are an important consideration for marine mammals and especially NARWs, which are known to forage in Nantucket Shoals. O'Brien et al. (2021) found that NARWs occurred in the greatest numbers in southern New England between December and February although they also occur in other months in lower numbers. The tidal currents on Nantucket Shoals are intense and the water column remains well mixed throughout the year (O'Brien et al. 2021), preventing the formation of thin, vertically compressed layers of copepods that allow for efficient NARW feeding (Baumgartner and Mate 2003; Baumgartner et al. 2017). NARWs do feed on copepods in well-mixed waters during winter, but during other times of the year when the larger and more nutritious *Calanus finmarchicus* is available, NARWs need to maximize their energy intake. To explain NARW presence near Nantucket Shoals when their preferred prey may be available elsewhere in more stratified waters, O'Brien et al. (2021) speculated NARWs are either feeding inefficiently on smaller copepod species or that they are feeding on a different non-copepod prey species that are more nutritious or can be ingested efficiently despite the strong tidal currents (e.g., a large-bodied bottom associated/clinging amphipod). Gammarid amphipods occur in abundant patches on the western edge of Nantucket Shoals where NARWs are also found (White and Veit 2020).

Presence of structures could theoretically cause indirect effects on marine mammals by changing the distribution and abundance of preferred prey and forage species, which has been noted as a particular concern for NARWs; but as the research in southern New England waters shows, NARWs are currently feeding at what is generally considered sub-optimal times in terms of prey type and prey density. This research makes it difficult to draw conclusions about how downstream turbulence from wind turbines may affect prey densities year-round, but especially in the winter when the water column is well mixed. In addition, conclusions are difficult to draw because those studies are based in different geographic regions, use differing offshore wind development scenarios, and the individual studies use varying methodology and models. Further research is required, including validation through field observations, to determine the significance of impacts to hydrodynamics due to offshore wind facilities in the United States. The presence of offshore wind facility structures could result in avoidance and displacement of marine mammals, which could potentially move marine mammals into areas with lower habitat value or with higher risk of vessel collision or fisheries interactions. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or result in gear shifts. Gear shifts that result in an increased number of vertical lines in the water would increase the risk of marine mammal interaction with fishing gear, which is a significant threat to some species.

Foundations and scour protection would create an artificial reef effect (Degraer et al. 2020), likely leading to enhanced biological productivity and increased abundance and concentration of fish and invertebrate resources (Hutchison et al. 2020). This could alter predator–prey interactions in and around the facility, with uncertain and potentially beneficial or adverse effects on marine mammals. For example, fish predators like seals and porpoises could benefit from increased biological productivity and abundant concentrations of prey generated. However, long-term, minor, adverse impacts could also occur as a result of increased interaction with active or abandoned fishing gear encountered near the structures. Mayflower Wind has committed to several AMMs that would alleviate potential impacts on marine mammals, including a requirement for annual remotely operated underwater vehicle surveys, reporting, monofilament, and other fishing gear cleanup efforts around WTG foundations, resulting in overall minor impacts.

Lighting: The Proposed Action would introduce stationary artificial light sources in the form of navigation, safety, and work lighting. Orr et al. (2013) summarized available research on potential operational lighting effects from offshore wind energy facilities and developed design guidance for avoiding and minimizing lighting impacts on aquatic life, including marine mammals. BOEM concluded that the operational lighting effects on marine mammal distribution, behavior, and habitat use were negligible if recommended design and operating practices are implemented. Therefore, BOEM anticipates that operational lighting effects on marine mammals would be negligible.

Gear Utilization: The presence of gear used for fisheries and benthic monitoring surveys under the Proposed Action could affect marine mammals by entrapment or entanglement. Trawl nets pose a negligible threat to mysticetes (NMFS 2016), and the slow speed of mobile gear and the short tow times (20 minutes) further reduce the potential for entanglements or other interactions. Monitoring devices, such as moored or mobile passive acoustic monitoring devices, may be used to monitor marine mammals and fish in the Lease Area. In addition to specific requirements for monitoring surrounding the construction period, periodic PAM deployments may occur over the life of the Project for other scientific monitoring needs. As it pertains to mitigation and monitoring, the use of mobile or moored PAM systems is considered in the BA as a mitigation measure for avoiding and minimizing impacts on ESA-listed species.

Mayflower Wind has proposed a variety of survey methods to evaluate the effect of construction and operations on benthic habitat structure and composition and economically valuable fish and invertebrate species. The survey methods are explained in more detail in Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*. Impacts on marine mammals from video trawl surveys used to assess abundance and distribution of target fish and invertebrate species within the Offshore Project area would be greatly reduced as these would be open cod-end video surveys, ideally resulting in no mortality of sampled organisms. However, if traditional trawl surveys are proposed, marine mammals may become entangled or unintentionally caught, which has the potential to result in injury and mortality. However, these risks would be mitigated by proposed impact avoidance and minimization measures.

Benthic habitat surveys using sonar, video, and photographic imaging are used to evaluate changes in benthic habitat structure and invertebrate community composition. These surveys involve similar methods to, and would complement other survey efforts conducted by, various state, federal, and university entities supporting regional fisheries research and management. The equipment used in these surveys would pose no risk to marine mammals. Mayflower Wind has additionally proposed PAM to collect baseline data and to evaluate hanged to abundance and distribution of fish around offshore structures. Equipment may pose an entanglement risk to marine mammals. However, if moored passive acoustic monitoring systems are proposed, the risk of entanglement would be reduced. Given the short-term, low-intensity, and localized nature of the impacts of gear utilization for the Proposed Action, as well as the proposed mitigation and minimization measures, it is likely that effects on mysticetes, odontocetes, and pinnipeds would be negligible.

Impacts of Alternative B on ESA-Listed Species

Impacts of Alternative B on ESA-listed species would be the same as the IPFs discussed above. The ESA-listed species that are common in the area are the NARW (peak abundance in winter, spring), fin whale (late-spring, summer) and sei whale (peak abundance spring and summer). The blue whale and sperm whale are rare and uncommon respectively in the Offshore Project area. The three common ESA-listed whales are also the most susceptible to vessel collisions in the region, and it is known that high traffic areas alter marine mammal distribution and behavior (COP Volume 2, Section 6.8.2.2, Table 6-67; Mayflower Wind 2022). As described for the No Action Alternative, adverse impacts on the commonly occurring ESA-listed whales would have a disproportionate impact on their respective populations, compared to non-listed marine mammal populations, as a function of decreased genetic diversity.

BOEM is in the process of assessing the impacts of the Proposed Action on ESA-listed marine mammals and marine mammal critical habitat. Based on this preliminary assessment, BOEM determined that the Proposed Action was not likely to adversely affect blue whale, sperm whale, or West Indian manatee given that their rarity means effects on these species would be extremely unlikely to occur. The Proposed Action may affect and is likely to adversely affect fin whale, sei whale, and NARW. BOEM also concluded that vessel transits through NARW critical habitat would not affect any essential physical and biological features and that vessels transiting along the Atlantic coast between North Carolina and Florida could use routes offshore of the designated critical habitat. Therefore, the Proposed Action is expected to have no effect on designated critical habitat for NARW. BOEM will continue to consult with NMFS under the ESA and results of consultation will be included in the Final EIS.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Planned non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar), marine transportation, and NMFS research initiatives.

The incremental impacts from vessel traffic and accidental releases contributed by the Proposed Action would be small when compared to the number of vessel trips associated with offshore wind development and existing vessel traffic in the region. BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely, and impacts from small-scale releases would be localized and short term. The cumulative accidental releases impacts would be minor for mysticetes, odontocetes, and pinnipeds, and moderate for NARW. The cumulative vessel traffic impacts would be minor for pinnipeds, moderate for mysticetes and odontocetes, and major for NARW.

Planned offshore wind activities would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving followed by vessels. The 149 structures for the Proposed Action represent only 5 percent of the 3,094 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action, although some foundations from the Proposed Action and other wind farms may be installed without pile driving. Project vessels would represent only a small fraction of the large volume of existing traffic in the geographic analysis area. On balance, any operational noise effects from the offshore wind activities are likely to be of low intensity and highly localized. In context of reasonably foreseeable environmental trends, the cumulative noise impacts of the Proposed Action with other ongoing and planned activities on marine mammals would be moderate.

Export and interarray cables from the Proposed Action and planned offshore wind development would add an estimated 11,646 miles (18,742 kilometers) of buried cable to the geographic analysis area of which the Proposed Action represents 14 percent. In context of ongoing and planned activities, the cumulative impacts of the Proposed Action in combination with other ongoing and planned activities from cable emplacement would be minor, while the cumulative impacts from EMF and heat would be negligible, given the small area that would be affected by the projects compared to the remaining area of open ocean in the geographic analysis area.

The 149 structures for the Proposed Action represent only 5 percent of the 3,094 offshore wind structures that would add to the presence of offshore structures and sources of lighting on the OCS from existing and planned offshore wind farms. In context of reasonably foreseeable environmental trends, the Proposed Action would incrementally contribute to cumulative lighting impacts from ongoing and planned activities, which would be negligible as offshore lighting is anticipated to have minimal effect on marine mammals. The cumulative impacts from the presence of structures from other offshore wind activities would likely be minor, mostly associated with the increased potential for fishing gear entanglement, with some minor beneficial effects from the potential for increased prey aggregation around the structures.

Conclusions

Impacts of the Proposed Action: Project construction and installation, O&M, and conceptual decommissioning would result in habitat disturbance (presence of structures and new cable emplacement), underwater and airborne noise, vessel traffic (strikes and noise), and potential discharges/spills and trash. BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **major** adverse impacts and could include potentially **beneficial** impacts. Adverse impacts are expected to result mainly from underwater noise (e.g., UXO detonations and impact pile-driving). Beneficial impacts are expected to result from the presence of structures.

Cumulative Impacts of the Proposed Action: Considering all of the IPFs together, the cumulative impact on marine mammals would range from **negligible** to **major** and could include **minor beneficial** impacts. BOEM anticipates that the overall impacts from the Proposed Action when combined with ongoing and planned activities would be moderate on marine mammals in the geographic analysis area, with the exception of NARW, on which impacts could be major. Impacts are magnified in severity for NARW due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual. Although a measurable impact is anticipated, most other marine mammals would likely recover completely when IPF stressors are removed or remedial or mitigating actions are taken.

3.5.6.6 Impacts of Alternative C and Alternative F on Marine Mammals

Impacts of Alternatives C and F: Under Alternative C, the Brayton Point offshore export cable would be routed onshore to avoid fisheries impacts in the Sakonnet River. Alternatives C-1 and C-2 would reduce the offshore portion of the Brayton Point ECC by 9 miles and 12 miles (14 and 19 kilometers), respectively, which would avoid impacts on marine mammals occurring in the Sakonnet River. Generally, marine mammal sightings in Narragansett Bay and nearshore Rhode Island are rare, but gray seal, harp seal, hooded seal, NARW, minke whale, dwarf sperm whale, long-finned pilot whale, Risso's dolphin, Atlantic white-side dolphin, bottlenose dolphin, striped dolphin, harbor porpoise, and West Indian manatee have all been observed in the Sakonnet River. Harbor seals are routinely sighted through the fall and spring at several haul out locations around Narragansett Bay. Because the presence of most marine mammals in the Sakonnet River is uncommon, and cable installation impacts outside of the river would still occur, BOEM anticipates impacts to be slightly reduced but not meaningfully different from the Proposed Action.

Under Alternative F, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use ±525kV HVDC cables connected to one HVDC converter offshore substation platform, instead of HVAC cables connected to one or more HVAC offshore substation platforms as proposed under the Proposed Action. During operation, there would be increased intake and discharge from the additional HVDC converter offshore substation platform, which could result in increased entrainment of marine mammal prey compared to the Proposed Action. However, impacts would remain localized near the offshore substation platform locations, and the overall impact magnitude would be the same.

Additionally, the Falmouth offshore export cable route would include up to three HVDC cables compared to up to five HVAC cables under the Proposed Action, which would reduce seafloor disturbance by approximately 700 acres (2.8 km^2). The lesser number of cables would also reduce potential EMF effects compared to the Proposed Action. Offshore impacts on marine mammal prey from cable emplacement and anchoring may be reduced under Alternative F due to the lesser number of cables installed. Because impacts associated with cable installation and maintenance would still occur in the same corridor, the impacts on marine mammals under Alternative F would be slightly reduced but not materially different than those described for the Proposed Action.

Cumulative Impacts of Alternatives C and F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives C and F would be similar to those described under the Proposed Action.

Impacts of Alternative C and F on ESA-Listed Species

Impacts of Alternatives C and F on ESA-listed species would be the same as the Proposed Action.

Conclusions

Impacts of Alternatives C and F: Impacts of Alternatives C and F may be reduced compared to the impacts of the Proposed Action because of small reductions in installation impacts and reductions of bottom habitat disturbance affecting marine mammal prey. However, these reductions are not expected to be measurable. Therefore, construction and installation, O&M, and decommissioning of Alternative F would result in **negligible** to **major** adverse impacts and could include potentially **beneficial** impacts, as for the Proposed Action.

Cumulative Impacts of Alternatives C and F: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternatives C and F would be similar to the Proposed Action and result in **moderate** impacts on marine mammals in the geographic analysis area, with the exception of the NARW, on which impacts could be **major**. Impacts are magnified in severity for the NARW due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual.

3.5.6.7 Impacts of Alternative D on Marine Mammals

Impacts of Alternative D: Alternative D would eliminate up to six WTGs in the northeastern portion of the Lease Area to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals (Figure 3.5.6-2). Nantucket Shoals is relatively shallow (less than 50 meters) and an area of high biological productivity (Townsend et al. 2006). This broad area extends south, southeast, and east of Nantucket and contains complex, dunelike topography, which reflects the strong tidal currents (PCCS 2005). The shoals are known to be consistently colder than surrounding waters, as proven by satellite images of sea surface temperature, and are tidally well mixed (Townsend et al. 2006). A trend of higher near-surface chlorophyll is greater inshore than offshore (refer to Chapter 2, *Alternatives,* Figure 2-7; Townsend et al. 2006). The year-round productivity of Nantucket Shoals is known to attract primarily NARWs, seals, humpback whales, fin whales, and Atlantic white-sided dolphins, which may use the area for congregation, feeding, or passing through (PCCS 2005). The removal of six WTGs in this area may lessen the impacts on marine mammals by providing more area of open ocean nearest to Nantucket Shoals foraging habitat.

Noise: The roughly 4 percent reduction in the number of WTGs for Alternative D would reduce the overall number of impact pile-driving hours required for installation from 588–882 hours to 564–846 hours. Overall, the number of pile-driving hours under Alternative D would be reduced by 24–36 hours in comparison to the Proposed Action. The specific effects are likely to remain the same for marine mammals including masking, disturbance, TTS, and PTS. However, by limiting the duration of the effect, the number of marine mammals exposed to underwater sound in excess of acoustic thresholds could be reduced. This could be important for species who are sensitive to impact pile-driving activities including the harbor porpoise, or baleen whales and seals, which are low-frequency specialists with known sensitivity to the low frequencies of pile-driving noise. For other marine mammal species that are more commonly observed in deeper waters along the shelf edge and slope (e.g., blue whales), or other species that have larger home ranges (e.g., most species of dolphins listed in Appendix B), this action alternative is unlikely to result in a change to the impact determinations for the Proposed Action.

A reduction of WTGs under Alternative D would result in a reduction in the number of construction vessels or the duration of vessels in the Offshore Project area during construction activities that would be required for installation. The magnitude of the effects of underwater noise from Project vessels during construction would remain the same, but the duration of the effects would be reduced.

The reduction in WTGs under Alternative D would additionally result in a reduced behavioral disturbance footprint around each monopile during operation. The specific level of noise generated by the proposed WTGs is not known, but a reduction in the number of WTGs would reduce the underwater noise footprint and limit the extent of the disturbance of marine mammals.

EMF: Under Alternative D, a reduction in WTGs would result in a reduction of interarray cable, which would limit the footprint of potential EMF exposure, especially for odontocetes and other marine mammals that forage on benthic prey species near the cable. A roughly 4 percent reduction in WTGs under Alternative D would result in approximately 20 miles (32 kilometers) less interarray cable length within the Lease Area.

Presence of structures: The removal of up to six WTGs near Nantucket Shoals may lessen the impacts on marine mammals by providing more area of open ocean nearest to Nantucket Shoals foraging habitat. Conversely, the removal of WTGs may reduce reef and hydrodynamic effects in this area, thereby reducing foraging opportunities for some marine mammal species compared to the Proposed Action. As described in Section 3.5.6.3, the presence of vertical structures in the water column may influence productivity and the distribution and abundance of invertebrate and fish community structures within and near Project footprints; however, modeling of the full build out of the entire southern New England lease areas indicate that only minor, local changes to the physical hydrodynamic features may occur on the western side of Nantucket Shoals adjacent to the Massachusetts and Rhode Island offshore wind lease areas (Johnson et al. 2021b). There is a lack of conclusive evidence that removal of turbines in the northern portion of the Mayflower Wind Lease Area would measurably lessen these minor impacts on the hydrodynamic features associated with Nantucket Shoals.

Cable emplacement and maintenance: A reduction in WTGs would result in less interarray cable within the Project area footprint and a reduction in area over which the emplacement disturbance and resulting impacts could occur. This would additionally limit the amount of time waters in the Project area experience short-term elevated turbidity, reducing the number of marine mammals exposed to potentially adverse effects.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to those described under the Proposed Action.

Impacts of Alternative D on ESA-Listed Species

Impacts of Alternative D on ESA-listed species resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Project would be similar to those described under the Proposed Action for all marine mammals. Restrictions on development and construction activity in the northeast portion of the Lease Area near Nantucket Shoals under Alternative D would reduce impacts on NARW. As stated above, Nantucket Shoals exhibits high biological productivity. Tidal pumping driven by the tidal dissipation in Nantucket Shoals is the primary driver of high phytoplankton biomass throughout the year in Nantucket Shoals (Saba et al. 2015). The year-round productivity attracts NARWs presumably to feed on zooplankton (Quintana-Rizzo et al. 2021). Nantucket Shoals attracts a relatively high abundance of NARWs and provides high foraging value at different times of the year (Figure 3.5.6-2).

Although certain impacts may be minimally decreased in duration and geographic extent, the differences between Alternative D and the Proposed Action do not have the potential to significantly reduce or increase impacts on ESA-listed marine mammals from the analyzed IPFs. BOEM does not anticipate impacts to be measurably different from those described under the Proposed Action.

Conclusions

Impacts of Alternative D: Alternative D would reduce some of the impacts on marine mammals from construction, O&M, and decommissioning of the Project compared to the Proposed Action by eliminating six WTGs nearest to Nantucket Shoals, which provides important habitat for marine mammals. While BOEM expects small reductions in noise, EMF, vessel traffic, presence of structures, and cable emplacement impacts under Alternative D, impacts from the remaining 143 WTG/offshore substation platform foundations would still occur. Therefore, Alternative D would not change the overall impact magnitude of the Project compared to the Proposed Action. The expected **negligible** to **major** adverse impacts and potential **beneficial** impacts associated with the Proposed Action alone would not change under Alternative D.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative D would be similar to the Proposed Action and range from **negligible** to **major** and could also include **minor beneficial** impacts. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative D, would result in **moderate** impacts on marine mammals in the geographic analysis area. Although a measurable impact is anticipated, marine mammals would likely recover completely when IPF stressors are removed or remedial or mitigating actions are taken, with the exception of NARWs, on which impacts could be **major**. Impacts are magnified in severity for NARWs due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual.

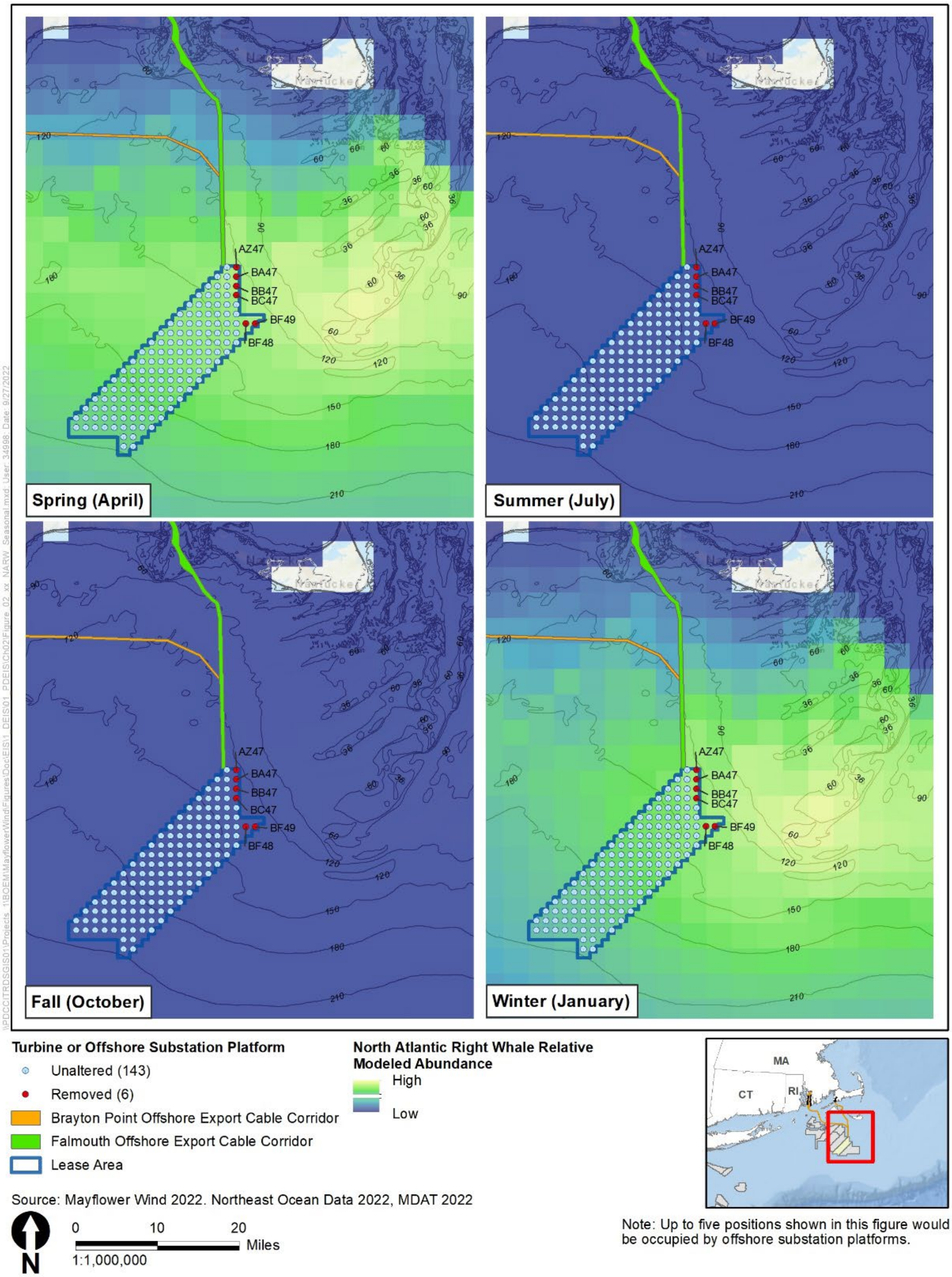


Figure 3.5.6-2. Alternative D and North Atlantic Right Whale modeled abundance

3.5.6.8 Impacts of Alternative E on Marine Mammals

Impacts of Alternative E: Alternative E includes the use of all piled (Alternative E-1), all suction bucket (Alternative E-2), or all GBS (Alternative E-3) foundations for WTGs and offshore substation platforms. Installation activities would not differ between the Proposed Action and Alternative E-1, which assumes pile driving would be used for all foundations with corresponding noise impacts. Under Alternatives E-2 and E-3, no pile driving would occur; therefore, there would be no underwater noise impacts on marine mammals due to pile driving. The avoidance of pile-driving noise impacts would reduce overall construction and installation impacts on marine mammals under Alternatives E-2 and E-3 compared to the Proposed Action. Offshore impacts under Alternatives E-1 and E-2 may be reduced compared to Alternative E-3 due to reductions in habitat conversion. Gravity-based foundations, under Alternative E-3, would result in the greatest area of habitat conversion due to foundation footprint and scour protection. Alternative E-1 would result in at least a 77 percent reduction in footprint and scour protection, and Alternative E-2 would result in at least a 58 percent reduction in footprint and scour protection, compared to Alternative E-3. Less scour protection would result in loss of less soft bottom habitat. It would also result in a lower artificial reef effect, which may reduce foraging opportunities for some marine mammal species compared to the Proposed Action and Alternative E-1. Given that Alternatives E-1, E-2, and E-3 would result in reductions in both adverse and beneficial impacts, O&M impacts on marine mammals under these alternatives are not expected to be measurably different from those anticipated under the Proposed Action.

Cumulative Impacts of Alternative E: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative E would be similar to those described under the Proposed Action.

Impacts of Alternative E on ESA-Listed Species

Impacts of Alternative E on ESA-listed species would be the same as the IPFs discussed above.

Conclusions

Impacts of Alternative E: Impacts of Alternative E-1 would not be measurably different than the impacts of the Proposed Action. Therefore, construction and installation, O&M, and decommissioning of Alternative E would result in **negligible** to **major** adverse impacts and could include potentially **beneficial** impacts.

Impacts of Alternatives E-2 and E-3 would be similar to impacts of the Proposed Action with the most notable difference the reduction in short-term impacts from avoidance of pile-driving noise and the increase in long-term impacts from larger foundation footprints. Construction, O&M, and decommissioning of Alternatives E-2 and E-3 would still result in **negligible** to **major** adverse impacts and could include potentially **beneficial** impacts.

Cumulative Impacts of Alternative E: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative E would result in **minor** to **moderate** impacts on marine mammals in the geographic analysis area. Although a measurable impact is anticipated, marine mammals would likely recover completely when IPF stressors are removed or remedial or mitigating actions are taken, with the exception of the NARW, on which impacts could be **major**. Impacts are magnified in severity for the NARW due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual.

3.5.6.9 Proposed Mitigation Measures

The following mitigation measures are proposed to minimize impacts on marine mammals (Appendix G, Table G-2). If the measures analyzed below are adopted by BOEM, some adverse impacts on marine mammals could be further reduced.

- **HVDC Open-Loop Cooling System Avoidance Area.** Precluding open-loop cooling systems in the enhanced mitigation area (see Appendix G, Figure G-1), which is the portion of the Lease Area nearest to Nantucket Shoals, would reduce the potential for entrainment of zooplankton, a prey species for marine mammals. This measure is anticipated to result in less mortality to prey species for higher trophic level animals than compared with the Proposed Action, which could include HVDC converter offshore substation platform locations closer to Nantucket Shoals and thus closer to higher densities of zooplankton.
- **Vessel-strike Avoidance.** Requiring a real-time detection and reporting PAM system during the construction period would help to detect the presence of marine mammals and avoid vessel strikes, minimizing the potential for impacts on marine mammals. Upon a confirmed detection of a NARW, all Project construction and crew transfer vessels of all sizes must travel at 10 knots or less in a 10-km^2 area around the location of the detection. Speed restriction must remain in place until there are no PAM detections within 48 hours of implementation of the speed restrictions, or daily aerial surveys result in no NARW sightings within 48 hours of implementation of the speed restrictions. This precautionary measure would be in place during offshore construction no matter the time of year when such work is being done. While NARW occurrence around Nantucket Shoals is greatest in the fall and winter, this measure addresses avoidance during offshore construction throughout the year to reduce the potential of any interaction between vessels and NARWs.
- **Pile Driving Time of Year Restriction and Pile Driving Shut Down Provisions.** Impacts on NARW would be minimized by only allowing pile driving to occur in the enhanced mitigation area between June 1 to October 31 when NARW presence is at its lowest. In addition, for the entire duration of pile driving activity, Mayflower Wind would be required to implement a real-time monitoring system (PAM or aerial imagery) capable of detecting and localizing the direction of NARW calls in the enhanced mitigation area, further minimizing impacts on NARW. This will further ensure that no NARW are exposed to injurious levels of noise from pile driving activity when combined with other measures such as protected species observers and acoustic attenuation devices.
- **Long-Term Passive Acoustic Monitoring.** The use of passive acoustic monitoring to record ambient noise and document presence of marine mammals during and after construction would improve accountability of the impact evaluations. While adoption of this measure would improve accountability, it would not alter impact determinations associated with construction activities for the Proposed Action.

- **BOEM-proposed Mitigation and Monitoring Measures included in the NMFS BA.** Implementation of these measures, as listed in Appendix G, Table G-2, would reduce impacts on ESA-listed species.

If these mitigation measures are adopted, they would minimize potential impacts on marine mammals but would not change the impact rating.

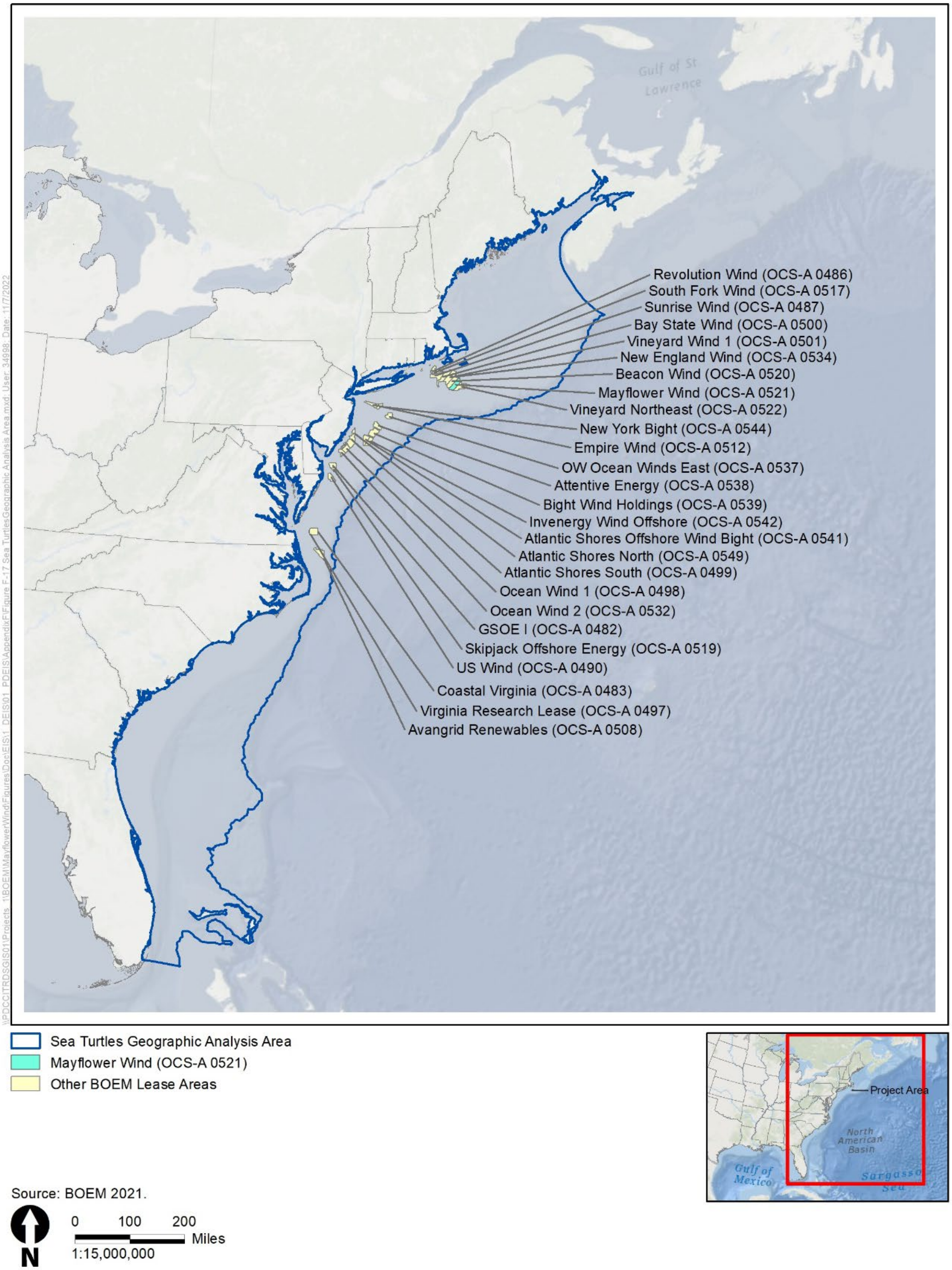
3.5 Biological Resources

3.5.7 Sea Turtles

This section discusses potential impacts on sea turtles from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area. The sea turtle geographic analysis area, as shown on Figure 3.5.7-1, encompasses two LMEs, namely the northeastern United States OCS and southeastern United States OCS LMEs. These LMEs capture the movement range for sea turtle species that could be affected by the Project in U.S. Atlantic Ocean waters. Due to the size of the geographic analysis area, the analysis of IPFs of the proposed Project focuses on sea turtles that would likely occur near the Offshore Project area and have the potential to be affected by the Proposed Action.

3.5.7.1 Description of the Affected Environment and Future Baseline Conditions

Four species of sea turtles are known to occur in or near the Project area, all of which are protected under the ESA (16 USC 1531 et seq.) and Massachusetts ESA and listed as a SGCN in Rhode Island. These include the leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and green sea turtle (*Chelonia mydas*). All four sea turtle species are highly migratory and are generally found in waters offshore southern Massachusetts and Rhode Island during the summer and fall (Kraus et al. 2016; Schwartz 2021). A fifth species of sea turtle, the hawksbill sea turtle (*Eretmochelys imbricata*), occurs in the larger geographic analysis area but is very unlikely to occur in the Project area because it typically inhabits tropical waters. While the hawksbill sea turtle has been recorded as far north as Massachusetts, hawksbills are exceedingly rare in the Offshore Project area and occur primarily in warmer waters to the south (NMFS and USFWS 1993; Kenney and Vigness-Raposa 2010). The individual hawksbill sea turtles that have occasionally been documented in and near the southern New England area have been stunned by exposure to unusual cold water events and subsequently transported northward into the region by the Gulf Stream. These occurrences are not representative of normal behaviors or distribution. Similarly, although this species does occur in the larger geographic analysis area, the Proposed Action is unlikely to contribute to any measurable cumulative effects and, therefore, this species is not considered further. Table 3.5.7-1 lists the four sea turtle species and DPS that could occur in the North Atlantic coastal waters offshore Massachusetts and Rhode Island and provides the listing status and likelihood of occurrence in the Project area.



Source: BOEM 2021.

Figure 3.5.7-1. Sea Turtle geographic analysis area

Table 3.5.7-1. Sea turtle species that may potentially occur in the Project area

Common Name	Scientific Name	DPS	ESA Status [a]	Frequency of Occurrence in Project Area	Seasonal Occurrence in Project Area
Leatherback sea turtle	*Dermochelys coriacea*	Not Applicable [b]	E	Common	June to November
Loggerhead sea turtle	*Caretta*	Northwest Atlantic	T	Common	May to November
Kemp's ridley sea turtle	*Lepidochelys kempii*	Not applicable	E	Possible	May to September
Green sea turtle	*Chelonia mydas*	North Atlantic	T	Possible	August to November

Sources: NMFS 2022; BOEM 2014
DPS = Distinct Population Segment, ESA = Endangered Species Act
[a] ESA status: E = Endangered, T = Threatened
[b] National Marine Fisheries Service and U.S. Fish and Wildlife Service have not designated DPSs for leatherback sea turtles because the species is listed as endangered throughout its global range (85 FR 48332).

Sea turtles inhabit tropical and subtropical seas throughout the world. In coastal U.S. Atlantic waters, sea turtles are highly migratory and seasonally distributed, migrating to and from habitats extending from Florida to New England, with overwintering concentrations in southern waters and nesting sites located on southern beaches from Virginia south through Florida. The four sea turtle species seasonally inhabit offshore waters in the Project area from May through November, including the area of direct effects. Green, leatherback, loggerhead, and Kemp's ridley sea turtles migrate north from warmer South Atlantic waters in the spring (May and June) to take advantage of abundant prey in warming northeastern embayments and estuaries, including Cape Cod Bay, when sea surface temperatures range from 61 to 79 degrees Fahrenheit (°F)(16 to 26 degrees Celsius[°C]) (CETAP 1982). Sea turtles return to southern waters as water temperatures decline in the fall and are unlikely to be present in the Project area after November 30. However, not all sea turtles leave the area during winter and there are occasional strandings of sea turtles that become incapacitated or "cold-stunned" at temperatures below 50°F (Still et al. 2005; Schwartz 1978).

Sea turtle nesting does not occur in Massachusetts or Rhode Island and there are no nesting beaches or other critical habitats in the vicinity of the Project (GARFO 2021). Individuals occurring in the Project area are either migrating or foraging and are likely to spend the majority of time below the surface. Sea turtles can remain underwater for extended periods, ranging from several minutes to several hours, depending on factors, such as daily and seasonal environmental conditions and specific behavioral activities associated with dive types (Hochscheid 2014). Such physiological traits and behavioral patterns allow them to spend as little as 3 to 6 percent of their time at the water's surface (Lutcavage and Lutz 1997). These adaptations are important because sea turtles often travel long distances between their feeding grounds and nesting beaches (Meylan 1995).

The combination of sightings, strandings, and bycatch data provides the best available information on sea turtle distribution in the Project area. This section summarizes data for each of the four sea turtle species from the most current sightings surveys of waters around the Massachusetts/Rhode Island offshore Wind Energy Area (Kraus et al. 2016; Palka et al. 2017; Palka et al. 2021), NMFS Sea Turtle

Stranding and Salvage Network (STSSN) (NMFS 2022), and recent and historic population or density estimates from NMFS and the U.S. Department of the Navy (U.S. Navy), where available. Population dynamics and habitat use of different sea turtle species along the Massachusetts and Rhode Island shore is still poorly understood. Sea turtles are wide-ranging and long-lived, making population estimates difficult, and survey methods vary depending on species (TEWG 2007; NMFS and USFWS 2013, 2015a, 2015b). Because sea turtles have large ranges and highly migratory behaviors, the current condition and trend of sea turtles are affected by factors outside of the proposed Project area.

The Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts (BOEM 2014) and COP Volume 2, Section 6.9.1 (Mayflower Wind 2022) provide further details about each species' range and distribution, population status, ecology and life history, and conservation and management, summarized in the following subsections.

Leatherback Sea Turtle

The leatherback sea turtle is the largest living and the most widely distributed sea turtle species, ranging broadly from tropical and subtropical to temperate regions of the world's oceans (NMFS and USFWS 2013). Individuals in the Project area belong to the Northwest Atlantic population, which is one of seven leatherback populations globally. The breeding population (total number of adults) estimated in the North Atlantic is 34,000 to 94,000 (NMFS and USFWS 2013; TEWG 2007). NMFS and USFWS (2020) concluded that the Northwest Atlantic population has a total index of nesting female abundance of 20,659 females with a decreasing nest trend at nesting beaches with the greatest known nesting female abundance. The species is listed as endangered under the ESA (35 Federal Register 8491). It is also listed as endangered under the MESA and is considered SGCN in the Rhode Island Wildlife Action Plan (RI WAP 2015; Commonwealth of Massachusetts 2020). They feed almost exclusively on jellyfish, siphonophores, and salps (Eckert et al. 2012; NMFS and USFWS 2020). In a study tracking 135 leatherbacks fitted with satellite tracking tags, turtles were identified to inhabit waters with sea surface temperatures ranging from 52°F to 89°F (Bailey et al. 2012). The leatherback sea turtle dives the deepest of all sea turtles to forage and is thought to be more tolerant of cooler oceanic temperatures than other sea turtles. The study also found that oceanographic features, such as mesoscale eddies, convergence zones, and areas of upwelling, attracted foraging leatherbacks because these features are often associated with aggregations of jelly fish. Unlike the other three species, the leatherback does not use shallow waters to prey on benthic invertebrates or sea grasses.

Leatherback sea turtles undergo extensive migrations in the western North Atlantic and usually start arriving along the southern New England coast in late spring/early summer (Shoop and Kenney 1992; James et al. 2006). Recent and historic data indicate leatherback sea turtles are the most frequently observed sea turtle species in the Massachusetts/Rhode Island Wind Energy Area and occur primarily in the summer and fall, with particularly heavy presence south of Nantucket and in Muskeget Channel (COP Volume 2, Section 6.9.1.1.3, Figure 6-52; Mayflower Wind 2022; Kraus et al. 2016; Kenney and Vingess-Raposa 2010; Whelchel and Clark 2010). From 2011 through 2021, STSSN reported 59 offshore and 242 inshore leatherback sea turtle strandings in Zone 41, which encompasses the Project area in

Sothern New England (NMFS 2022). Based on survey information collected in the region to date, BOEM expects leatherback sea turtles to be common in the Project area from June to November (Table 3.5.7-1). Modeled density estimates in the Project area by season can be found in COP Volume 2, Section 6.9.1.1.3, Figure 6-53 (Mayflower Wind 2022).

Leatherback sea turtles were the most frequently sighted species of turtle sighted in the Lease Area during aerial surveys from 2011 to 2015, and were mostly sighted during the summer and autumn, rarely in the spring, and not at all in winter (Kraus et al 2016). Only one leatherback turtle was observed in the Lease Area from aerial surveys from 2017 through 2018. Eight sea turtles from two species were identified during the Campaign 5 aerial surveys (O'Brien et al. 2021a). Six leatherback turtle sightings occurred in June and August of 2017 through 2019. Leatherback turtles were sighted on three separate days, all directly south of Nantucket and fairly close to shore (within 10 nm). During 2020 Campaign 6A aerial surveys, three leatherback sea turtles were observed during general surveys (O'Brien et al. 2021b). All leatherback turtle sightings except one were over the Nantucket Shoals.

Loggerhead Sea Turtle

Loggerhead sea turtles range widely and have been observed along the entire Atlantic Coast as far north as Canada (Brazner and McMillan 2008; Ceriani et al. 2014; Shoop and Kenney 1992). Sightings most often occur in surface waters with temperatures between 44°F and 86°F, or 7°C and 30°C (Shoop and Kenney 1992). They have a general omnivorous diet and are benthic feeders, consuming vegetation, zooplankton, crabs, mollusks, jellyfish, fish, and various other invertebrates (Dodd 1988; Seney and Musick 2007). The regional abundance estimate in the Northwest Atlantic OCS in 2010 was approximately 588,000 adults and juveniles of sufficient size to be identified during aerial surveys (interquartile range of 382,000 to 817,000 [NEFSC and SEFSC 2011]). The three largest nesting subpopulations responsible for most of the production in the western North Atlantic (peninsular Florida, northern United States, and Quintana Roo, Mexico) have all been declining since at least the late 1990s, thereby indicating a downward trend for this population (TEWG 2009). Loggerhead sea turtles in the Project area belong to the Northwest Atlantic DPS, which is listed as threatened under the ESA (76 Federal Register 58868). The species is also listed as threatened under the MESA and is considered SGCN in the Rhode Island Wildlife Action Plan (RI WAP 2015; Commonwealth of Massachusetts 2020). While some progress has been made since publication of the 2008 Loggerhead Sea Turtle Recovery Plan, the recovery units have not met most of the critical benchmark recovery criteria (NMFS and USFWS 2019). The Atlantic Marine Assessment Program for Protected Species turtle tagging data recorded limited loggerhead sea turtle observations in the Massachusetts/Rhode Island Wind Energy Area between 2009-2015; however, visual surveys conducted between 2010-2017 indicated regular presence in waters near the Project area in the summer and fall (COP Volume 2, Section 6.9.1.1.4, Figure 6-54, Mayflower Wind 2022; Palka et al. 2021; Palka et al. 2017). From 2011 through 2021, STSSN reported 68 offshore and 201 inshore loggerhead sea turtle strandings in Zone 41, which encompasses the Project area in Southern New England (NMFS 2022). Additionally, the U.S. Navy indicates that loggerhead sea turtles are expected to occur commonly as non-breeding adults, subadults, and juveniles from the late spring through fall, with the highest probability of occurrence from July through September (U.S. Navy 2017b). Based on this information, BOEM expects loggerhead sea turtles to be common in the

Massachusetts/Rhode Island Wind Energy Area and likely in the Project area from May to November (Table 3.5.7-1). Modeled density estimates in the Project area by season can be found in COP Volume 2, Section 6.9.1.1.4, Figure 6-54 (Mayflower Wind 2022).

Kemp's Ridley Sea Turtle

Kemp's ridley sea turtles are most commonly found in the Gulf of Mexico and along the U.S Atlantic Coast. Juvenile and subadult Kemp's ridley sea turtles are known to travel as far north as Cape Cod Bay during summer foraging (NMFS et al. 2011). All Kemp's ridley sea turtles belong to a single population that is endangered under the ESA (35 Federal Register 183290). The species is also listed as endangered under the MESA and is considered SGCN in the Rhode Island Wildlife Action Plan (RI WAP 2015; Commonwealth of Massachusetts 2020). The species is primarily associated with habitats on the OCS, with preferred habitats consisting of sheltered areas along the coastline, including estuaries, lagoons, and bays (Burke et al. 1994; NMFS 2019) and nearshore waters less than 120 feet deep (Shaver et al. 2005; Shaver and Rubio 2008), although they can also be found in deeper offshore waters. The population was severely reduced prior to 1985 due to intensive egg collection and fishery bycatch, with a low in 1985 of 702 nests counted from an estimated 250 nesting females on three primary nesting beaches in Mexico (NMFS and USFWS 2015a). Recent estimates of the total population of age 2 and older is 248,307 with a total of 12,179 nests documented in Mexico and Texas in 2014. The most recent estimates of abundance (age 2 and older) and number of nests indicate a stall in growth after over a decade of consistent increase, suggesting that the population is not currently recovering to historical levels (NMFS and USFWS 2015a). Kemp's ridley sea turtles regularly occur in inshore and nearshore waters of Rhode Island, including Narraganset Bay, in the summer and fall to forage for crabs in submerged aquatic vegetation (Schwartz 2021). In waters further offshore, visual sighting data are limited because this small species is difficult to observe using typical aerial survey methods; however, rare observations have been made in the Massachusetts/Rhode Island Wind Energy Area in the summer and fall (Kraus et al. 2016). From 2011 through 2021, STSSN reported 16 offshore and 172 inshore Kemp's ridley sea turtle strandings in Zone 41, which encompasses the Project area in southern New England (NMFS 2022). Based on this information, Kemp's ridley sea turtles could occur infrequently as juveniles and subadults from July through September, potentially occurring as late as November. The highest likelihood of occurrence is in coastal nearshore areas as they seek protected shallow-water habitats near Cape Cod Bay. BOEM expects Kemp's ridley sea turtles to be in the Project area from May to November, but its co-occurrence with Project activities is expected to be uncommon due to relatively low numbers in northeastern U.S. waters. Modeled density estimates in the Project area showing no differences by season can be found in Mayflower COP Volume 2, Section 6.9.1.1.2, Figure 6-51 (Mayflower Wind 2022).

Green Sea Turtle

Green sea turtles are found in tropical and subtropical waters around the globe; however, juveniles and subadults are occasionally observed in Atlantic coastal waters as far north as Massachusetts (Greene et al. 2010). They are most commonly observed feeding in the shallow waters of reefs, bays, inlets, lagoons, and shoals that are abundant in algae or marine grass (NMFS and USFWS 2007a). Green turtles do not nest on beaches in the Project area; their primary nesting beaches are in Costa Rica, Mexico, the United States (Florida), and Cuba. Green sea turtles in the Project area belong to the North Atlantic DPS, which is listed as threatened under the ESA (81 Federal Register 20057), while breeding populations in Florida are listed as endangered (81 Federal Register 20058, 2016). The species is also listed as threatened under the MESA and is considered SGCN in the Rhode Island Wildlife Action Plan (RI WAP 2015; Commonwealth of Massachusetts 2020). The most recent status review for the North Atlantic DPS estimates the number of female nesting turtles to be approximately 167,424 individuals (NMFS and USFWS 2015b). According to NMFS and USFWS (2015b), nesting trends are generally increasing for this population. Because of their association with warm waters, green turtles are relatively uncommon in Rhode Island and Massachusetts waters but have been observed on rare occasions in the summer (BOEM 2014). Green turtles are commonly associated with drift lines or surface current convergences, which commonly contain floating Sargassum capable of providing small turtles with shelter and sufficient buoyancy to raft upon (Thiel and Gutow 2005; Witherington et al. 2012). They rest underwater in coral recesses, the underside of ledges, and sand-bottom areas that are relatively free of strong currents and disturbance from natural predators and humans. From 2011 to 2021, STSSN reported four offshore and 75 inshore green sea turtle strandings in Zone 41, which encompasses the Project area in southern New England (NMFS 2022). Based on this information and a lack of sightings near the Massachusetts/Rhode Island Wind Energy Area (COP Volume 2, Section 6.9.1.1.1, Figure 6-50; Mayflower Wind 2022; Whelchel and Clark 2010), the occurrence of green sea turtles in the Project area is expected to be uncommon and limited to small numbers.

Sea turtles in the geographic analysis area are subject to a variety of ongoing human-caused impacts, including collisions with vessels, entanglement with fishing gear, fisheries bycatch, dredging, anthropogenic noise, pollution, disturbance of marine and coastal environments, effects on benthic habitat, accidental fuel leaks or spills, waste discharge, and climate change. Sea turtle migrations can cover long distances, and these factors can have impacts on individuals over broad geographical scales. Climate change has the potential to affect the distribution and abundance of prey due to changing water temperatures, ocean currents, and increased acidity.

3.5.7.2 Impact Level Definitions for Sea Turtles

Impact level definitions for sea turtles are provided in Table 3.5.7-2.

Table 3.5.7-2. Definitions of impact levels for sea turtles

Impact Level	Type of Impact	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
Minor	Adverse	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.
	Beneficial	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts could increase survival and fitness, but would not result in population-level effects.
Moderate	Adverse	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Adverse effects would likely be recoverable and would not affect population or DPS viability.
	Beneficial	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Impacts would be measurable at the population level.
Major	Adverse	Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level effects that are not recoverable, even with mitigation.
	Beneficial	Impacts would be significant and extensive and contribute to population or DPS recovery.

3.5.7.3 Impacts of Alternative A – No Action on Sea Turtles

When analyzing the impacts of the No Action Alternative on sea turtles, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for sea turtles. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for sea turtles described in Section 3.5.7.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on sea turtles are generally associated with coastal and offshore development, marine transport, fisheries use, and climate change. Coastal and offshore development, marine transport, and fisheries use and associated impacts are expected to continue at current trends and have the potential to affect sea turtles through accidental releases, which can have physiological effects on sea turtles; EMF and light, which can result in behavioral changes in sea turtles; new cable emplacement and maintenance and port utilization, which can disturb benthic habitats and affect water quality; noise, which can have physiological and behavioral effects on sea turtles; the presence of structures, which can result in behavioral changes in sea turtles, effects on prey species, and increased risk of interactions with fishing gear; and vessel traffic, which increases risk of vessel collision.

Global climate change is an ongoing risk for sea turtle species in the geographic analysis area and could result in population-level impacts on sea turtle species by displacement, impacts on prey species, altered population dynamics, and increased mortality. It is well established that climate change has the potential to affect the distribution and abundance of sea turtles and their prey due to changing water temperatures, ocean currents, and increased acidity. Furthermore, rising sea levels and increased storm intensity may negatively affect turtle nesting beaches. Increasing air temperatures can affect sea turtle population structure because temperature-dependent sex determination of embryos would result in a shift toward more female-biased sex ratios (Poloczanska et al. 2009). Patel et al. (2021) used global climate models to predict that the future distribution of suitable thermal habitat for loggerheads along the OCS will likely increase in northern regions. Sea turtle nesting could also shift northward on the U.S. Atlantic Coast. Because these changes may affect sea turtle reproduction, survival, and demography, the impacts of climate change on sea turtles are expected to be minor.

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on sea turtles.

- Continued O&M of the Block Island project (five WTGs) installed in state waters.
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect sea turtles through the primary IPFs of noise, presence of structures, and vessel traffic. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and vessel traffic that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned non-offshore wind activities that may contribute to impacts on sea turtles include commercial fisheries bycatch; marine transportation; military use; oil and gas activities; undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; dredging and port improvement; and marine minerals use and ocean dredged material disposal (see Appendix D, *Planned Activities Scenario*, Section D.2, for a description of planned activities). BOEM expects planned activities other than offshore wind to affect sea turtles through several primary IPFs, including accidental releases, EMF, light, new cable emplacement and maintenance, port utilization, noise, and the presence of structures.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on sea turtles during construction, O&M, and decommissioning of the projects. Other offshore wind activities in the geographic analysis area for sea turtles include the construction, O&M, and decommissioning of approximately 34 offshore wind projects (Appendix D, Table D-2).

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

Accidental releases: Accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase as a result of offshore wind activities. Marine pollution is an ongoing threat, as sea turtle ingestion of human trash and debris has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Ingestion often occurs when sea turtles mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Although the threat varies among species and life stages due to differing feeding, plastic ingestion is an issue for marine turtles from the earliest stages of life (Eastman et al. 2020) and the volume of debris ingested is related to the size of the turtles (Thomás et al. 2002). In addition to plastic debris, ingestion of tar, paper, Styrofoam, wood, reed, feathers, hooks, lines, and net fragments has also been documented in loggerhead sea turtles. Trash and debris may be released by vessels during construction, operations, and decommissioning of ongoing and planned offshore wind facilities. These sublethal effects would affect individual fitness, but mortality and sublethal effects associated with ingestion of trash and debris are not expected to have population-level effects. BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects that such releases would be small and infrequent. The amount of trash and debris accidentally released during planned offshore wind activities would likely be miniscule compared to trash releases associated with ongoing activities, including land-based activities and commercial and recreational fishing.

Planned offshore wind development would require large quantities of coolant fluids, oils and lubricants, and diesel fuel (see Appendix D, Table D2-3 for specific quantities). Accidental releases of fuel, fluids, and hazardous materials may increase as a result of both ongoing and planned offshore wind activities. The risk of any type of accidental release would be increased primarily during construction when Project vessels are present, and also during operations and decommissioning of offshore wind facilities. In the planned activities scenario, there would be a low risk of a leak of fuel/fluids/hazardous materials from any single one of approximately 2,945 WTGs and OSPs, each with on average 8,400 gallons (31,797 liters) stored. Total fuel/fluids/hazardous materials in the geographic analysis area would be approximately 24.7 million gallons (93.5 million liters; Appendix D, Table D2-3). According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons or less is likely to occur every 5 to 20 years. The likelihood of a spill occurring from multiple WTGs and OSP at the same time is very low; therefore, the potential impacts from a spill larger than 2,000 gallons are largely discountable.

Accidental releases of fuels, fluids, and hazardous materials can have both physical and chemical effects on sea turtles that negatively influence the health and survival of affected individuals (Shigenaka et al. 2021). Physical effects are typically observed at the surface and commonly involve hatchlings and juvenile turtles, who spend most of their time at the surface. These effects limit basic functionality for most turtles exposed because oil interferes with surface breathing, movement, and vision, which limits their ability to forage or evade predators (Shigenaka et al. 2021). Chemical effects are less apparent and, therefore, less understood; however, studies have observed skin lesions, dehydration, oxidative stress, failed weight gain in hatchlings, and inflammation of skin and organs (Shigenaka et al. 2021; Mitchelmore et al. 2015; Harms et al. 2014). Impacts resulting from accidental releases may pose a long-term risk to sea turtles and could potentially lead to mortality and sublethal impacts on individuals present in the vicinity of the spill, but the potential for exposure would be minor given the isolated and low-volume nature of potential accidental releases and the variable distribution of sea turtles in the geographic analysis area. Given the volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities. Impacts from accidental releases and discharges associated with ongoing and planned construction and operation of offshore wind projects have been previously analyzed and were found to be negligible because of the low probability, short-term duration, and highly localized nature of accidental releases (BOEM 2021a, 2021b). Offshore wind projects will comply with their Oil Spill Response Plan and USCG requirements for the prevention and control of oil and fuel spills.

EMF: Ongoing and planned offshore wind activities would install export and interarray cables, increasing the production of EMF and heat in the geographic analysis area. EMF and heat effects would be reduced by cable burial to an appropriate depth and shielding, if necessary. Cables are also expected to be separated by a minimum distance of 330 feet (100 meters), avoiding additive effects from adjacent cables. Sea turtles are capable of detecting magnetic fields (e.g., Lohmann and Lohmann 1996; Normandeau et al. 2011; Putman et al. 2015), and behavioral responses to such fields have been documented (e.g., Luschi et al. 2007). The threshold for behavioral responses varies somewhat among species. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4,000 microteslas (µT) for loggerhead turtles, and 29.3 to 200 µT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). In the planned activities scenario, up to 9,970 miles (16,045 kilometers) of offshore export cable and interarray cable would be added in the geographic analysis area for sea turtles, producing EMFs in the vicinity of each cable during operations (Appendix D, Table D2-1). Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce a potential EMF from cable operation to low levels.

Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on EMF impacts on sea turtles associated with underwater cables. Migratory disruptions have been documented in sea turtles with magnets attached to their heads (Luschi et al. 2007), but evidence that EMF associated with future offshore wind activities would likely result in some deviations from direct migration routes is lacking (Snoek et al. 2016). Any deviations are expected to be minor (Normandeau et al. 2011), and any increased energy expenditure due to these deviations would not be biologically significant.

Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters (Taormina et al. 2018). There are no data on cable heat effects on sea turtles (Taormina et al. 2018). However, increased heat in the sediment could affect benthic organisms that serve as prey for sea turtles that forage in the benthos. Based on the narrowness of cable corridors and expected weakness of thermal radiation, impacts on benthic organisms are not expected to be significant (Taormina et al. 2018) and would be limited to a small area around the cable. Given the expected cable burial depths, thermal effects would not occur at the surface of the seabed where sea turtles would forage. Therefore, any effects on sea turtle prey availability would be too small to be detected or meaningfully measured.

Lighting: The impacts of coastal development affects sea turtles primarily through habitat loss from development and artificial lighting near sea turtle nesting areas. Although lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles, artificial lighting on the OCS does not appear to have the same potential for effects. In spite of increasing human population growth and associated coastal development, and negative correlation between sea turtle nest numbers and the presence of artificial light (Mazor et al. 2013), Weishampel et al. (2016) found that nighttime light levels decreased for more than two-thirds of Florida’s surveyed sea turtle nesting beaches despite coastal urbanization trends. It is anticipated that there will be increasing adoption of state and local lighting ordinances in places where sea turtles nest. However, within the geographic analysis area, lighting impacts related to wind activities on nesting beaches would be limited to onshore areas in Virginia and North Carolina as sea turtle nesting beaches do not occur north of Virginia (CETAP 1982). Therefore, the majority of sea turtle nesting beaches are not within range to receive any impacts from lighting effects related to offshore wind activities.

Vessels and offshore structures associated with ongoing and planned offshore wind activities produce light at night. Lighting on vessels and offshore structures could elicit attraction, avoidance, or other behavioral responses in sea turtles. In laboratory experiments, juvenile loggerhead sea turtles consistently oriented toward lightsticks of various colors and types used by pelagic longline fisheries (Wang et al. 2019), indicating that hard-shelled sea turtle species expected to occur in the vicinity of offshore wind projects (i.e., green, Kemp’s ridley, and loggerhead) could be attracted to offshore light sources. In contrast, juvenile leatherback sea turtles failed to orient toward or oriented away from lights in laboratory experiments (Gless et al. 2008), indicating that this species may not be attracted to offshore lighting. Any behavioral responses to offshore lighting are expected to be localized and temporary.

All WTGs and OSPs associated with planned offshore wind activity have yellow flashing navigational lighting and red flashing FAA hazard lights, in accordance with BOEM's (2021c) lighting and marking guidelines. Following these guidelines, direct lighting would be avoided, and indirect lighting of the water surface would be minimized to the greatest extent practicable. As described in the previous paragraph, offshore lighting may attract juvenile green, Kemp's ridley, and loggerhead sea turtles, based on laboratory experiments. The flashing lights on offshore structures associated with planned offshore wind activities are unlikely to disorient juvenile or adult sea turtles, as they do not present a continuous light source (Orr et al. 2013). There is no evidence that lighting on oil and gas platforms in the Gulf of Mexico, which may have considerably more lighting than offshore WTGs, has had any effect on sea turtles over decades of operation (BOEM 2019a). Therefore, lighting on offshore structures associated with planned offshore wind activities is not expected to have detectable effects on sea turtles and impacts would be negligible.

Cable emplacement and maintenance: Ongoing and planned offshore wind activities will involve the placement and maintenance of export and interarray cables. Cable emplacement associated with ongoing and planned offshore wind activities (not including the Proposed Action) is expected to disturb more than 181,882 acres (73,605 hectares) of seabed while associated undersea cables are installed, causing an increase in suspended sediment (Appendix D, Table D2-2). During cable installation, sediment plumes would be present for up to 6 hours at a time until the activity is completed and suspended sediments settle back to the seabed. Areas subject to cumulative increases in suspended sediment from simultaneous activities would be limited because the occurrence of concurrent cable installation operations is expected to be limited. The increases in suspended sediment associated with new cable emplacement and maintenance would be short term and localized to the cable corridor.

There are no data on the physiological effects of suspended sediment on sea turtles. However, elevated suspended sediment may cause sea turtles to alter their normal movements and behaviors, as sea turtles would be expected to avoid the area of elevated suspended sediment. Such alterations are expected to be too small to be detected (NMFS 2020a). No effects are anticipated if sea turtles swim through the area of elevated suspended sediment. Suspended sediment is most likely to affect sea turtles if the area of elevated concentrations acts as a barrier to normal behaviors. However, no adverse effects are anticipated due to sea turtles avoiding or swimming through areas of elevated suspended sediment (NMFS 2020a). In addition to direct effects on sea turtle behavior, suspended sediment can indirectly affect sea turtles through impacts on prey species, including benthic mollusks, crustaceans, sponges, and sea pens. Elevated suspended sediment concentrations are shown to have adverse effects on benthic communities when they exceed 390 mg/L (NMFS 2020a). See Section 3.5.5*, Finfish, Invertebrates, and Essential Fish Habitat*, for a discussion of cable emplacement impacts on prey species.

Dredging for sand wave clearance may be necessary in places to ensure cable burial below mobile seabed sediments, which could contribute to additional impacts on sea turtles related to impingement, entrainment, and capture associated with mechanical and hydraulic dredging techniques. Mechanical dredging is not expected to capture, injure, or kill sea turtles (NMFS 2020b). Hopper dredges may strike, impinge, or entrain sea turtles, which may result in injury or mortality (Ramirez et al. 2017 citing Dickerson et al. 1990; Ramirez et al. 2017 citing Dickerson et al. 1991; Ramirez et al. 2017 citing Reine et al. 1998; Ramirez et al. 2017 citing Richardson 1990). The sea turtle species most often affected by dredge interactions is loggerhead sea turtles, followed by green sea turtles, then Kemp's ridley sea turtles (Ramirez et al. 2017). However, the risk of interactions between hopper dredges and individual sea turtles is expected to be lower in the open ocean areas where dredging may occur compared to nearshore navigational channels where sea turtles are more concentrated in a constrained operating environment (Michel et al. 2013; USACE 2020). This may be due to the lower density of sea turtles in these areas, as well as differences in behavior and other risk factors. Given the available information, the risk of injury or mortality of individual sea turtles resulting from dredging necessary to support offshore wind project construction would be low and population-level effects are unlikely to occur.

Noise: Ongoing and planned offshore wind activities would generate anthropogenic noise from aircraft, HRG surveys, offshore wind turbines, pile driving, cable laying, and vessels. These noise sources have the potential to affect sea turtles through behavioral or physiological effects.

The installation of WTG foundations into the seabed for ongoing and planned offshore wind projects involves pile driving and other construction activities that could cause underwater noise in the geographic analysis area and result in short-term behavioral disturbance and impacts on sea turtle hearing that may recover over time (i.e., TTS) as well as long-term impacts on sea turtle hearing (i.e., PTS). The potential for underwater noise to result in adverse impacts on a sea turtle depends on the received sound level and the frequency content of the sound relative to the hearing ability of the animal. The limited data available on sea turtle hearing abilities are summarized in Table 3.5.7-3. Sea turtles appear to hear frequencies from 30 Hz to 2 kilohertz, with a range of best hearing sensitivity between 100 and 700 Hz; however, there is some sensitivity to frequencies as low as 60 Hz and possibly as low as 30 Hz (Lavender et al. 2014; Bartol et al. 1999). Therefore, there is substantial overlap in the frequencies that sea turtles can detect and the dominant frequencies produced by offshore wind activities, including pile driving, impulsive sources used for HRG surveys, and UXO.

Table 3.5.7-3. Hearing Capabilities of Sea Turtles

<table>
<tr><th rowspan="2">Species</th><th colspan="2">Hearing Capabilities</th><th rowspan="2">Source</th></tr>
<tr><th>Range (Hertz)</th><th>Highest Sensitivity (Hertz)</th></tr>
<tr><td rowspan="3">Green Sea Turtle
(Chelonia mydas)</td><td>60–1,000</td><td>300–500</td><td>Ridgway et al. 1969</td></tr>
<tr><td>100–800</td><td>600–700 (juveniles)
200–400 (subadults)</td><td>Bartol and Ketten 2006;
Ketten and Bartol 2006</td></tr>
<tr><td>50–1,600</td><td>50–400</td><td>Piniak et al. 2012a, 2016</td></tr>
<tr><td rowspan="2">Loggerhead Sea Turtle
(Caretta caretta)</td><td>250–1,000</td><td>250</td><td>Bartol et al. 1999</td></tr>
<tr><td>50–1,100</td><td>100–400</td><td>Martin et al. 2012; Lavender et al. 2014; Bartol et al. 1999</td></tr>
<tr><td>Kemp's Ridley Sea Turtle
(Lepidochelys kempii)</td><td>100–500</td><td>100–200</td><td>Bartol and Ketten 2006;
Ketten and Bartol 2006</td></tr>
<tr><td>Leatherback Sea Turtle
(Dermochelys coriacea)</td><td>50–1,600</td><td>100–400</td><td>Piniak et al. 2012b</td></tr>
</table>

Given the high energy levels of offshore wind energy survey and installation noise sources, it can be concluded that sea turtles would be affected by associated noise. However, there are no available empirical data regarding threshold levels for impacts on sea turtle hearing from sound exposure. As a result, there have been no regulatory threshold criteria established for sea turtles. There are limited data pertaining to behavioral responses of sea turtles and none specifically to sounds generated by offshore wind activities. Thresholds that have been established are presented in Table 3.5.7-4. McCauley et al. (2000) observed that one green sea turtle and one loggerhead sea turtle in an open water pen increased swimming behaviors in response to a single seismic airgun at received levels of 166 dB re 1 µPa and exhibited erratic behavior at received levels greater than 175 dB re 1 µPa. Moein et al. (1994) documented similar avoidance reactions to similar levels of seismic signals, although both studies were done in a caged environment, so the extent of avoidance could not be monitored. DeRuiter and Larbi Doukara (2012) observed that 57 percent of loggerhead sea turtles exhibited a diving response after seismic airgun array firing at received levels between 175 and 191 dB re 1 µPa. Moein et al. (1994) did observe a habituation effect to the airguns; the animals stopped responding to the signal after three presentations. Sea turtles can become habituated to repeated noise exposure over time and not suffer long-term consequences (O'Hara and Wilcox 1990). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018).

In the absence of NMFS acoustic thresholds, the U.S. Navy has adopted PTS and TTS thresholds for sea turtles as presented in Finneran et al. (2017). Table 3.5.7-4 outlines the acoustic thresholds for the onset of PTS, TTS, and behavioral disturbance for sea turtles for impulsive and non-impulsive noise sources. NMFS has considered behavioral response beginning at 175 dB re 1 µPa SPL_{RMS} (Navy 2017a). These thresholds apply to juvenile, subadult, and adult life stages.

Table 3.5.7-4. Acoustic thresholds for onset of acoustic impacts (PTS, TTS, or behavioral disturbance) for sea turtles

Injury (PTS)		TTS		Behavioral Disturbance
SPL_{peak} (dB re 1 µPa) Impulsive	SEL_{cum} (dB re 1 µPa^{2}s) Impulsive/Non-Impulsive	SPL_{peak} (dB re 1 µPa) Impulsive/Non-Impulsive	SEL_{cum} (dB re 1 µPa^{2}s) Impulsive Non-Impulsive	SPL_{RMS} (dB re 1 µPa) Impulsive/Non-Impulsive
232	204	226	189	175

dB re 1 µPa = decibels relative to 1 micropascal; dB re 1 µPa^{2}s = decibels relative to 1 micropascal squared second; SEL_{cum} = cumulative sound exposure level

In the geographic analysis area, ongoing activities that may produce noise would include site characterization surveys and scientific surveys (i.e., HRG surveys). These would be infrequent and produce high-intensity impulsive noise that has the potential to affect sea turtles, including potential auditory injuries and behavioral responses, which could include short-term displacement of feeding or migrating (NSF and USGS 2011). The potential for PTS and TTS in sea turtles is considered possible if these animals were to occur near the HRG survey noise source. Also, noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded.

Noise transmitted through water or through the seabed can result in high-intensity, low-exposure-level, and long-term but localized intermittent risk to sea turtles. Lastly, noise from infrequent trenching activities for pipeline and cable laying, as well as other cable burial, dredging, and marine minerals extraction, could cause behavioral disturbance to sea turtles, which is expected to be localized and temporary. The impacts of noise on sea turtles resulting from ongoing non-offshore wind activities are expected to be minor. Although there is some risk for permanent injury (PTS), no mortality is expected. The most significant underwater noise-producing activities are discussed further below.

The installation of WTG foundations into the seabed would likely involve impacts from pile driving, which can cause traumatic stress and behavioral disturbance to sea turtles. In the planned activities scenario (Appendix D), the construction of 2,945 WTGs and OSPs would create underwater noise and may temporarily affect sea turtles present in the area. Foraging disruptions related to project installation would be temporary and localized to within the wind energy area during construction. This displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on sea turtles. Although information is lacking, construction activities could temporarily displace animals into areas that have a lower foraging quality or result in higher risk of interactions with ships or fishing gear. Potential impacts on sea turtles from multiple construction activities in the same calendar year could affect migration, feeding, breeding, and individual fitness. Intermittent, long-term impacts may be high-intensity and result in a high-exposure level. The magnitude of these impacts would be dependent upon the locations of concurrent construction operations, as well as the number of hours per day, the number of days that pile driving would occur, and the time of year in which pile driving occurs. Individuals repeatedly exposed to pile driving over a season, year, or life stage may incur energetic costs that have the potential to lead to long-term consequences (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); 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). Sea turtles exposed to underwater root-mean-square sound pressure levels (L_{rms} or SPL) greater than 175 dB referenced to 1 µPa may experience behavioral disturbance (Finneran et al. 2017; McCauley et al. 2000). Although there is no information available about potential sea turtle injury due to impulsive pile-driving noise, injury is not expected from SEL less than 204 dB re 1 μPa^2 s.

Helicopters may be used to transport crew during construction or operation of offshore wind facilities. When aircraft travel at relatively low altitude, non-impulsive aircraft noise has the potential to elicit stress or behavioral responses (e.g., diving or swimming away or altered dive patterns) (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). Helicopters transiting to offshore wind facilities are expected to fly at sufficient altitudes to avoid behavioral effects on sea turtles, with the exception of WTG inspections, take-off, and landing. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area; these responses are not expected to be biologically significant.

Offshore wind energy projects perform geological and geophysical surveys, including HRG surveys that use a combination of sonar-based methods to map shallow geophysical features and can be classified as impulsive or non-impulsive noise sources. The equipment is towed behind a moving survey vessel and generates a short-duration pulse in the 1.1 to 200 kilohertz (kHz) range, with the interval between pulses ranging from 0.2 to 1 second, depending on the specific type of equipment used. The equipment only operates when the vessel is moving along a survey transect, meaning that the ensonified area is intermittent and constantly moving. HRG surveys that use non-impulsive sources are not expected to affect sea turtles because they operate at frequencies above the sea turtle hearing range (e.g., multibeam echosounders, side scan sonar). BOEM (2018) and NMFS (2021) evaluated potential underwater noise effects on sea turtles from HRG surveys using impulsive sources (boomers/airguns/sparkers/sub-bottom profilers) and concluded that for an individual sea turtle to experience PTS (204 dB re 1 µPa²s SEL_{cum}; 232 dB re 1 µPa²·s SPL [0–pk] impulsive sources), it would have to be within 3.3 feet (1 meter) of the loudest possible noise source. In fact, NMFS (2021) states that none of the equipment being operated for HRG surveys—with frequencies that overlap with sea turtles' hearing—has source levels loud enough to result in PTS or TTS. However, noise from impulsive sources used during HRG surveys could exceed the behavioral effects threshold (175 dB) up to 90 meters from the source, depending on the type of equipment used. Given the limited extent of potential noise effects, injury-level exposures (PTS/TTS) are unlikely to occur. As stated above and based on the loudest impulsive noise source, it is highly unlikely that noise from HRG survey sound sources would cause PTS or TTS in sea turtles (NMFS 2021). While low-level behavioral exposures could occur, these disruptions would be limited in extent and short term in duration given the movement of the survey vessel and the mobility of the animals. Therefore, underwater noise impacts from HRG surveys are expected to be minor.

Offshore wind activities may encounter UXO on the seabed in the lease areas or along export cable routes. While non-explosive methods may be employed to lift and move these objects, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to sea turtles, but the number of affected individuals would be small relative to the population sizes. The number and location of detonations that may be required for offshore wind projects are relatively unknown. Impacts associated with UXO detonations for other projects would be similar to those described for the Proposed Action in Section 3.5.7.5.

Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Modeling based on noise data collected during cable laying operation in Europe estimates that underwater noise levels would exceed 120 dB in a 98,842-acre area surrounding the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the dynamic nature of the ensonified area, a given location would not be ensonified for more than a few hours. Therefore, it is unlikely that cable-laying noise would result in adverse effects on sea turtles.

Operating WTGs generate non-impulsive underwater noise that is audible to sea turtles. Operational sound is generated by WTGs due to pressure differentials across the airfoils of moving turbine blades and from mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by the airfoils, like aircraft, is produced in the air and enters the water through the air-water interface. Mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. Both airfoil sound and mechanical vibration may result in long-term, continuous noise in the offshore environment. Measured underwater sound levels in the literature are limited to geared smaller wind turbines (less than 6.15 MW), as summarized by Tougaard et al. (2020). Tougaard et al. 2009 measured SPLs ranging between 109 and 127 dB re 1 µPa underwater 45 and 65 feet (14 and 20 meters) from the foundations at frequencies below 315 Hz up to 500 Hz. Wind turbine acoustic signals above ambient background noise were detected up to 2,066 feet (630 meters) from the source (Tougaard et al. 2009). Noise levels were shown to increase with higher wind speeds (Tougaard et al. 2009). Operational noise from larger, current-generation WTGs on the order of 10 MW would generate higher source levels than the range noted above, at around 170 dB re 1 µPa SPL_{RMS} (Stöber and Thomsen 2021). However, the shift from using gear boxes to direct-drive technology is expected to reduce the sound level by around 10 dB and, based on available data, the sound levels produced during the operation of planned offshore wind projects would be less than the injurious thresholds defined by NMFS for sea turtles. At Block Island Wind Farm, turbine noise reaches ambient noise levels within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017); so while sound may cause behavioral effects, these effects would be at relatively short distances from the foundations (Miller and Potty 2017; Tougaard et al. 2009). Additionally, studies suggest that sea turtles acclimate to repetitive underwater noise in the absence of an accompanying threat (Bartol and Bartol 2011; Hazel et al. 2007; Navy 2018). Underwater noise from offshore wind project operation is unlikely to result in significant effects on the forage base for sea turtles. These species are primarily invertivores or, in the case of green sea turtles, omnivorous vegetarians. The sound sensitivity of invertebrates like crabs, jellyfish, and mollusks is restricted to particle motion and the effect dissipates rapidly such that any effects are highly localized to the immediate proximity (i.e., less than 3.3 feet [1 meter]) of the noise source (Edmonds et al. 2016). Although loggerhead and Kemp's ridley sea turtles may periodically prey on fish, fish represent a minor component of a flexible and adaptable diet. Underwater noise could temporarily reduce the availability of fish prey species, but these effects would be limited in extent and duration. Therefore, noise impacts on sea turtles are not anticipated from operating WTGs.

Vessels generate low-frequency (10 to 100 Hz) (MMS 2007), non-impulsive noise that could affect sea turtles. Vessel noise overlaps with the hearing range of sea turtles and may elicit behavioral responses, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes (NSF and USGS 2011; Samuel et al. 2005). However, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. The increase in vessel activity associated with planned offshore wind activities could cause repeated, intermittent impacts on sea turtles resulting from short-term, localized behavioral responses, which would dissipate once the vessel leaves the area. BOEM considers these temporary behavioral effects to be unlikely given the patchy distribution of sea turtles in the geographic analysis area, and, therefore, no stock or population-level effects would be expected.

Impacts of noise on sea turtles from construction and operation of offshore wind projects have been previously analyzed and could range from negligible to moderate during construction and would be negligible during operation. Moderate impacts could result from impact pile driving during construction;

however, low numbers of sea turtles are expected to be present and population-level effects are unlikely, which reduces the potential adverse impact level to minor. WTG operation noise could result in localized behavioral effects (BOEM 2021a, 2021b) but are likely to be negligible. Based on the above discussion, BOEM anticipates that the impacts of noise on sea turtles from planned offshore wind activities would be minor and is anticipated to be localized, infrequent, and temporary.

Traffic: Planned offshore wind activities would result in increased vessel traffic due to vessels transiting to and from individual lease areas during construction, operation, and decommissioning. Vessel strikes are an increasing concern for sea turtles. The percentage of stranded loggerhead sea turtles with injuries that were apparently caused by vessel strikes increased from approximately 10 percent in the 1980s to over 20 percent in 2004, although some stranded turtles may have been struck post-mortem (NMFS and USFWS 2007b). Sea turtles, with the exception of hatchlings and pre-recruitment juveniles, spend a majority of their time submerged, during which time they may not be susceptible to vessel strikes. Sea turtles spend less than 6 percent of their time at the water's surface (Lutcavage and Lutz 1997), during which they would be most vulnerable to being struck by vessels or propellers. Information on swim depth is provided in the U.S. Navy Undersea Warfare Center's dive distribution and group size parameter reports (Watwood and Buonantony 2012; Borcuk et al. 2017); these data suggest that loggerhead and green sea turtles spend 60 to 75 percent of the time within 32 feet (10 meters) of the surface, leatherback sea turtles spend about 20 percent of the time within 32 feet (10 meters) of the water surface, and there are insufficient data to quantify Kemp's ridley sea turtle activity. Any sea turtle found in the geographic analysis area could thus occur at or near the surface, whether resting, feeding, or periodically surfacing to breathe.

Construction of each individual offshore wind project would generate approximately 15 to 35 simultaneous construction vessels at any given time (BOEM made a conservative assumption that construction vessel traffic for other offshore wind projects would be similar to the Proposed Action; refer to Section 3.6.6 for additional information regarding vessel traffic). Combined, the other offshore wind projects in the geographic analysis area would generate approximately 36 vessels per day during normal O&M beginning in 2030. This vessel traffic increase would be expected to result in a small incremental increase in overall vessel traffic in the geographic analysis area for sea turtles. The relative risk of vessel strikes from wind industry vessels would depend on the stage of development, time of year, number of vessels, and speed of vessels during each stage. Offshore wind projects may also cause shifts in vessel traffic, including temporary restrictions of fishing vessels during project construction due to the implementation of safety zones, potential increases in vessel traffic in the offshore wind lease areas after project construction due to an influx of recreational fishing vessels targeting species associated with an artificial reef effect, and likely shifts in commercial fishing vessels from the wind energy lease areas to areas not routinely fished due to recreational vessel congestion and gear conflict concerns.

Collision risk is expected to be greatest when offshore wind vessels transit between the offshore wind lease areas and ports utilized by each project, as vessel speeds would be highest and turtles are expected to be most susceptible to strike in coastal foraging areas. Vessel speed may exceed 10 knots in such waters, and those vessels traveling at speeds greater than 4 kilometers per hour (2 knots) would pose the greatest threat to sea turtles, as the turtles cannot reliably avoid vessels moving faster than 4 kilometers per hour (Hazel et al. 2007). The risk would be greatest for species with the highest densities in a given project area. The increased risk of vessel strikes has the potential to result in injury or mortality to individual sea turtles, but would not be expected to have stock or population-level impacts on sea turtles given their low densities in the geographic analysis area and patchy distribution. Additionally, BOEM expects minimization measures for vessel impacts would be required for planned offshore wind activities, further reducing the risk of injury or mortality for sea turtles, resulting in overall minor impacts.

Port utilization: Offshore wind on the Atlantic OCS may require the expansion or improvement of regional ports to support planned projects. Direct impacts related to port expansion and improvements are localized to nearshore environments but these actions could lead to an increase in vessel traffic during construction, O&M, and decommissioning. Any future port expansion and associated increase in vessel traffic would be subject to an independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on sea turtles regionwide.

Gear utilization: Offshore wind activities are expected to include monitoring surveys in the project areas. Sea turtles could be affected by these surveys through survey vessel traffic and interactions with survey gear. Survey vessels would produce underwater noise and increase the risk of vessel strikes. The effects of vessel noise and increased strike risk would be similar to those discussed under the *Noise* and *Traffic* IPFs. Additional impacts on sea turtles could result from interactions with mobile (e.g., trawl, dredge) or fixed (e.g., trap, hydrophone) survey gear. Offshore wind projects are expected to use trawl surveys, among other methods, for project monitoring. The capture and mortality of sea turtles in fisheries utilizing bottom trawls are well documented (Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992; NRC 1990). Although sea turtles are capable of extended dive durations, entanglement and forcible submersion in fishing gear leads to rapid oxygen consumption (Lutcavage and Lutz 1997). Based on available research, restricting tow times to 30 minutes or less is expected to prevent sea turtle morality in trawl nets (Epperly et al. 2002; Sasso and Epperly 2006). BOEM anticipates trawl surveys for offshore wind project monitoring would be limited to tow times of 20 minutes, indicating that this activity poses a negligible risk of mortality. Additional mitigation measures would be expected to eliminate the risk of serious injury and mortality from forced submergence for sea turtles caught in bottom-trawl survey gear. Tows for clam dredge surveys would have a very short duration of 120 seconds, and the survey vessels would be subject to mitigation measures similar to those for the trawl survey. Therefore, effects of dredge surveys on sea turtles would be negligible.

The vertical buoy and anchor lines associated with monitoring surveys using fixed gear, such as fish traps or baited remote underwater video, could pose a risk of entanglement for sea turtles. While there is a theoretical risk of sea turtle entanglement in trap and pot gear, particularly for leatherback sea turtles (NMFS 2016), the likelihood of entanglement would be unlikely given the patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the relatively limited duration of each sampling event. BOEM also anticipates mitigation measures would be in place to reduce sea turtle interactions during fisheries surveys. Sea turtle prey species (e.g., crabs, whelks, fish) may be collected as bycatch in trap gear. However, all bycatch is expected to be returned to the water and would still be available as prey for sea turtles regardless of their condition, particularly for loggerhead sea turtles, which are known to forage for live prey and scavenge dead organisms. Given the non-extractive nature of fixed gear surveys, any effects on sea turtles from the collection of potential sea turtle prey would be so small that it cannot be meaningfully measured. Therefore, indirect effects on sea turtles due to collection of potential prey items would be negligible.

Hydrophone mooring lines for passive acoustic monitoring studies pose a theoretical entanglement risk to sea turtles, similar to trap and pot surveys. However, BOEM anticipates that monitoring studies utilizing moored systems would be required to use the best available technology to reduce any potential risks of entanglement. Therefore, passive acoustic studies are not expected to pose a meaningful risk of entanglement to sea turtles. Monitoring surveys are expected to occur at short-term, regular intervals over the duration of the monitoring program. Although the potential extent and number of animals potentially exposed cannot be determined without project-specific information, impacts of gear utilization on sea turtles are expected to be negligible given the negligible risk of mortality, the negligible risk of entanglement, and the negligible effect on sea turtle prey availability.

Presence of structures: Up to 2,945 WTG and OSP foundations with associated scour protection could be built in the geographic analysis area. These structures would occupy open-water, pelagic habitat and would provide presently unavailable hard structure within the water column. The presence of structures could result in hydrodynamic changes; obstructions that cause loss of fish gear resulting in entanglement or ingestion by sea turtles; habitat conversion from open-water pelagic and benthic soft substrates to structurally complex, mid-water and benthic hard bottom; new areas of prey aggregation; avoidance or displacement; and behavioral disruption.

The addition of new hard surfaces and structures, including WTG foundations, scour protection, and hard protection on top of cables, to a mostly sandy seafloor would create a more complex habitat. The structures would create an artificial reef effect, whereby more sessile and benthic organisms would likely colonize the structures over time (e.g., sponges, algae, mussels, shellfish, sea anemones). Higher densities of filter feeders, such as mussels that colonize the structure surfaces, could consume much of the increased primary productivity but also provide a food source and habitat to crustaceans such as crabs (Dannheim et al. 2020). Growth around the artificial reefs may provide food for sea turtles. Loggerhead sea turtles are benthic foragers, feeding on vegetation, crabs, mollusks, jellyfish, fish, and other invertebrates that would grow on the artificial reef (Dodd 1988; Seney and Musick 2007). Mollusks and crabs are primary food items for juvenile loggerheads, raising the possibility of the artificial reefs being a foraging area for young sea turtles (Burke et al. 1994). Structure-oriented finfish species such as black sea bass, striped bass, and Atlantic cod would be attracted to these more complex structures. Among the fish attracted to the structure would be sea turtle predators, such as sharks, increasing the likelihood of sea turtle predation. These impacts would likely be permanent or remain as long as the structure remains.

The presence of in-water structures could alter local hydrodynamic patterns at a fine scale downstream of the structures (see Section 3.4.2, *Water Quality*, and Section 3.5.6, *Marine Mammals* for additional discussion). Water flows are reduced immediately downstream of foundations but return to ambient levels within a relatively short distance (Miles et al. 2017). The downstream area affected by reduced flows is dependent on pile diameter. For monopiles (i.e., the structures with the largest diameter), the downstream effects are expected at a distance of 100 meters to 1 kilometer of the structures (Dorrell et al. 2022). Although effects from individual structures are highly localized, the presence of all structures associated with ongoing and planned offshore wind activities in the geographic analysis area could result in regional impacts on wind wave energy, mixing regimes, and upwelling (van Berkel et al. 2020). These localized and regional alterations to hydrodynamics could have impacts on sea turtle prey species. Fine-scale effects on water flow could have localized impacts on prey distribution and abundance. Regional hydrodynamic effects could affect prey species at a broader scale. Effects on surface currents could influence patterns of larval distribution (Johnson et al. 2021) and seasonal mixing regimes could influence primary productivity, both of which could, in turn, affect the distribution of fish and invertebrates on the OCS (Chen et al. 2018; Lentz 2017). Hydrodynamic alterations due to the presence of WTGs could increase primary productivity in the vicinity of the structures (Carpenter et al. 2016; Schultze et al. 2020). However, such an increase would be highly localized, and the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019) rather than leading to increased prey abundance for sea turtles.

The presence of WTGs is expected to result in wind-wake alterations in and around offshore wind project areas. Some authors have suggested this could result in changes to ocean stratification (mixing) that can reduce nutrient supplies to the surface ocean and alter net primary productivity. Wind wake may also disturb planktonic transport, and thus, prey availability for sea turtles (van Berkel et al. 2020). Importantly, net primary productivity is driven by photosynthesis in marine phytoplankton and accounts for half of global-scale photosynthesis and supporting major ocean ecosystem services (Field et al. 1998). There are few empirical data showing the impact of WTGs on ocean stratification (Tagliabue et al. 2021), although recent models have demonstrated ocean mixing as a result of the wind-wake effect of WTGs in the North Sea (Carpenter et al. 2016; Floeter et al. 2017, Dorrell et al. 2022). However, interannual changes in net primary productivity in the North Atlantic are poorly correlated with parallel changes to stratification and emphasize the importance of other physical mechanisms, especially the Gulf Stream (Tagliabue et al. 2021). Potential impacts on net primary productivity in the north Atlantic from offshore wind projects may occur but, without additional data, impacts are considered negligible when compared with the effects of the Gulf Stream. Wake impacts would likely be permanent but variable, and because of the relatively low offshore wind blocking effect, impacts would be expected to be minor when compared to natural variability (Floeter et al. 2017). In addition, Golbazi et al. (2022) modeled surface effects of next-generation large turbines (more than 10 MW) along the Atlantic OCS and found that due to the higher hub heights of larger turbines, meteorological changes at the water surface would be nearly imperceptible. Since the leatherback sea turtle is the most pelagic of the turtles, it is expected to be the most affected by hydrodynamic effects if they occur. The leatherback sea turtle primarily feeds on jellyfish, which are planktonic and travel at the mercy of ocean currents. Alterations in the hydrodynamic environment have the potential to alter the dispersal of jellyfish. Leatherback sea turtles are known to follow jellyfish aggregations (Bailey et al. 2012). The presence of WTGs in the Offshore Project area may influence the distribution of jellyfish and, thus, affect the distribution of leatherback sea turtles.

In the Gulf of Mexico, loggerhead, leatherback, green, Kemp's ridley, and hawksbill sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Herczeg 1994; Hastings et al. 1976). Sea turtles would be expected to use habitat in between the WTGs and around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations. Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information.

While the anticipated reef effect may result in long-term beneficial impacts on sea turtles, some potential exists for increased exposure to fishing gear that could lead to entanglement, ingestion, injury, and death. The presence of structures may concentrate recreational fishing around foundations and would also increase the risk of gear loss or damage. This could cause entanglement, especially with monofilament line, and increase the potential for entanglement in both lines and nets leading to injury and mortality due to abrasions, loss of limbs, and increased drag, resulting in reduced foraging efficiency and ability to avoid predators (Barnette 2017; Berreiros and Raykov 2014; Foley et al. 2008). The reef effect may attract recreational fishing effort from inshore areas and attract sea turtles for foraging opportunities, resulting in a small increase in risk of entanglement and hooking or ingestion of marine debris where fishers and turtles are concentrated around the same foundations.

Impacts of Alternative A on ESA-Listed Species

All sea turtle species in the geographic analysis area are either threatened or endangered and protected by ESA. Impacts of Alternative A on ESA-listed sea turtles are discussed in the previously listed IPFs. Any future federal or private activities that could affect federally listed sea turtles in the geographic analysis area would need to comply with ESA Section 7 or Section 10, respectively, to ensure that the proposed activities would not jeopardize the continued existence of the species.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, sea turtles would continue to follow current regional trends and respond to current and future environmental and societal activities. BOEM expects ongoing activities would have temporary to permanent impacts on sea turtles (disturbance, displacement, injury, mortality, and reduced foraging success), primarily due to lighting associated with coastal development, noise, marine pollution, vessel strikes, entanglement or ingestion of fishing gear, and ongoing climate change. The No Action Alternative, including ongoing non-offshore wind and offshore wind activities, would result in **minor** impacts on sea turtles because impacts on sea turtles would be detectable and measurable but of low intensity, localized, and temporary or short term in duration.

Cumulative Impacts of the No Action Alternative: BOEM expects that ongoing and planned activities would result in continuing localized and temporary to permanent impacts on sea turtles. Intermittent, temporary impacts from underwater noise may be of high intensity and result in a high exposure level but impacts on sea turtles are not expected to result in population-level effects. Although there would be a loss of existing benthic habitat, WTG and OSP foundations may provide foraging and sheltering opportunities for sea turtles. The significance of this reef effect is unknown, however, and is not expected to result in biologically significant impacts on sea turtles, resulting in negligible beneficial impacts. BOEM anticipates that the No Action Alternative combined with all ongoing and planned activities (including other offshore wind activities) would result in **minor** impacts, because potential impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.

3.5.7.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on sea turtles:

- Noise associated with the construction, operation, and decommissioning of Project structures (e.g., pile driving and construction vessels), which could have behavioral and physiological effects, or cause auditory injury to sea turtles.
- Vessel traffic, which could increase collision risk to sea turtles due to vessels transiting to and from the Wind Farm Area during construction, operations, and decommissioning, and increased recreational fishing vessels.
- The presence of structures, which could cause both beneficial and adverse impacts on sea turtles through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.

Variability of the proposed Project design exists as outlined in Appendix C. The following is a summary of potential variances in impacts:

- Foundation type: The potential acoustic impacts on sea turtles differ among the foundation types that the Proposed Action would use, which is up to 5 OSPs and up to 147 WTGs with monopile, piled-jacket, suction-bucket-jacket, or GBS foundations. Construction of the jacket-type foundation would have a higher acoustic impact than construction of the monopile foundation due to the increased risk of exposure because of the longer time required to install more piles (up to four 14.7-foot [4.5-meter] pin piles per jacket).
- Monopile diameter: The potential acoustic impacts on sea turtles differ among the WTG monopile diameters that may be used. Mayflower Wind would use monopiles with a maximum diameter of 52.5 feet (16.0 meters).
- WTG number: All potential impacts would be lessened with a decrease in number of WTGs built.

- Season of construction: The active season for sea turtles in New England waters is from May through November. Construction outside of this window would have fewer impacts on sea turtles than construction during the active season.

Although some variation is expected in the design parameters, the impact assessment on sea turtles in this section analyzes the maximum-case scenario.

Mayflower Wind has committed to measures to minimize impacts on sea turtles, which are considered part of the Proposed Action and applicable action alternatives and are assessed within each IPF. These applicant-proposed AMMs include, but are not limited to, incorporating soft start methods during initial pile-driving activities to allow sea turtles to migrate away from the area of effect, employing sound-attenuation methods, ensuring that all vessels underway do not intentionally approach any sighted sea turtle, and ensuring that all vessels maintain a separation distance of 164 feet (50 meters) or greater from any sighted sea turtles (COP Volume 2, Table 16-1; Mayflower Wind 2022).

As part of its COP, Mayflower Wind has also developed a Marine Mammal and Sea Turtle Monitoring and Mitigation Plan for ESA-listed marine mammal and sea turtle species (COP Volume 2, Appendix O; Mayflower Wind 2022). Measures proposed include but are not limited to protected species observers, vessel avoidance measures such as separation distances and speed restrictions, pile driving time-of-year restrictions, visual monitoring for HRG surveys, UXO detonation monitoring, marine debris awareness training, and monitoring and reporting of sea turtle observations during activities with potential impacts. Appendix G, Table G-1 provides a full list of the committed measures in greater detail.

3.5.7.5 Impacts of Alternative B – Proposed Action on Sea Turtles

This section summarizes the potential impacts of the Proposed Action on sea turtles during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*.

The analysis of impacts under the No Action Alternative, and references therein, applies to the following discussion of the Proposed Action. The most impactful IPFs associated with the Proposed Action are discussed below and include underwater noise during pile driving, which could cause temporary impacts; increased vessel traffic, which could lead to injury or mortality from vessel strikes; the presence of structures, which would lead to permanent impacts that may be either adverse or beneficial; and cable emplacement and maintenance, which could affect sea turtles from mechanical and hydraulic dredging techniques and via water quality effects.

Accidental releases: As discussed in Section 3.5.7.3, *Impacts of Alternative A – No Action on Sea Turtles*, accidental release of trash and debris may occur from Project vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with the Project, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, localized event in the vicinity of the Project area, likely resulting in non-measurable impacts, if any. However, because sea turtle ingestion of trash can be fatal, the overall impact would be minor.

The Proposed Action would install an HVDC converter OSP, which would result in the intake and discharge of water. The risk of direct harm caused by heated effluent water or of entrainment or impingement of sea turtles during water cycling is negligible. Impacts of water intake by HVDC converter OSPs would be limited to the entrainment of sea turtle prey. However, at this scale it is not expected to make any measurable difference in sea turtle prey availability.

Non-routine events such as accidental oil or chemical spills can have adverse or lethal effects on marine life; however, AMMs, such as a spill prevention and a response plan would be developed and implemented during all phases of the Proposed Action (COP Volume 2, Table 16-1; Mayflower Wind 2022). In addition, compliance with USCG regulations would minimize the risk of accidental release of trash or debris. Accidental releases can have both physical and chemical effects on sea turtles that negatively influence the health and survival of affected individuals (Shigenaka et al. 2021). The risk of any type of accidental release would be increased, primarily during construction, but also during O&M and decommissioning of offshore wind facilities. COP Appendix AA, Section 8.3.1, Table 8-3 discusses the maximum-case scenarios of potential releases. In the event of a release, it would be an accidental, localized event in the vicinity of the Project area, likely resulting in non-measurable impacts, if any.

EMF: The Proposed Action would entail a maximum of approximately 1,676 miles (2,697 kilometers) of cables, which includes 497 miles (800 kilometers) of interarray cables and 1,179 miles (1,897 kilometers) of offshore export cables. Sea turtles possess geomagnetic sensitivity (but not electro sensitivity) and are able to use Earth's magnetic fields for directional (compass-type) and positional (map-type) information used to aide in orientation, navigation, and migration (Normandeau et al. 2011). Sea turtle species have wide ranges of geomagnetic sensitivity, with loggerhead sea turtles able to detect fields from 0.00469 to 4,000 μT and green sea turtles able to detect fields from 29.3 to 200 μT (Normandeau et al. 2011). Sea turtles would likely encounter EMF from Project-related submarine cables during foraging activities, but it is unlikely that this detection would interfere with foraging ability because other sensory cues are used as well (Constantino and Salmon 2003; Endres and Lohmann, 2012; Narazaki et al. 2013). Given the extremely small area where exposure to this IPF would occur and the proposed burial depth of the submarine cable, impacts such as changes in swimming direction and altered migration routes would not be anticipated. Based on the EMF analysis conducted by Mayflower Wind in the Project area, which found that EMF emitted by submarine cables would be well under typical detection ranges of magnetosensitive marine species, EMF impacts on sea turtles are expected to be negligible.

Lighting: Under the Proposed Action, up to 149 WTG/OSP positions in the OCS would be lit with navigational and FAA hazard lighting in accordance with FAA and USCG lighting standards and consistent with BOEM best practices. Impacts of lighting on nesting females and hatchling turtles would not occur under the Proposed Action, as sea turtle nesting beaches do not occur north of Virginia and are not included in the Project area. Orr et al. (2013) indicated that lights on WTGs that flash intermittently for navigational or safety purposes do not present a continuous light source, and therefore do not appear to have a disorienting influence for any sea turtle life history stages. Lighting would be placed on all structures and would be visible throughout a 360-degree arc from the surface of the water. Mayflower Wind would implement an ADLS to only activate WTG lighting when aircrafts enter a predefined airspace. The short-duration synchronized flashing of the ADLS would have less impact on sea turtles at night than the standard continuous, medium-intensity red-strobe light aircraft warning systems. Vessel lights during construction, O&M, and decommissioning would be minimal and temporary, limited to vessels transiting to and from construction areas. As such, BOEM expects impacts, if any, to be long term but negligible from lighting.

Cable emplacement and maintenance: The Proposed Action would entail a maximum of approximately 1,676 miles (2,697 kilometers) of cables, which includes 497 miles (800 kilometers) of interarray cables and 1,179 miles (1,897 kilometers) of offshore export cables. Mayflower Wind would bury export cables to a depth of 3.2 to 13.1 feet (1 to 4 meters) below the surface and interarray cables to a depth of 3.2 to 8.2 feet (1 to 2.5 meters) below the surface. Impacts (disturbance, displacement, injury, and mortality) of new cable emplacement and maintenance under the Proposed Action are estimated to affect up to 2,480 acres (10.6 km^2) of seafloor in the export cable route corridors and 1,408 acres (5.7 km^2) in the Lease Area. The majority of benthic sediments in the Offshore Project area are fine sediments as described in Section 3.5.2.1, and any benthic invertebrate prey species of sea turtles would recover quickly and are not expected to have population-level impacts due to the small construction footprint compared to the geographic analysis area. Over 90 percent of the Brayton Point ECC benthic samples and 90 percent of the southern Falmouth ECC benthic samples are sand or finer, with only one sample of complex habitat occurring in the Lease Area. Seafloor disturbances during installation and maintenance of interarray and offshore export cables may cause temporary behavioral changes in foraging activities of sea turtles in the Project area. Avoidance of the disturbed area due to a decline in foraging quality may occur for Kemp's ridley, leatherback, and loggerhead sea turtles because their preferred prey species include bottom-dwelling crustaceans and mollusks, which would be directly affected during cable installation. Unburied segments of the cable (with cable protection) are expected to be short and widely dispersed, where benthic habitat alteration is unexpected to impact sea turtle prey resources.

Dredging may be used for cable installation in areas for sand wave clearance to ensure cable burial below mobile seabed sediments and for HDD in-water exit pits. The area of potential dredging is currently unknown due to the dynamic nature of sand waves. During geophysical surveys along the Brayton Point ECC, the risk to the cable due to sediment mobility along the corridor was found to be low. However, seabed preparation or alternate burial methods may be required in the northern portion of the Falmouth export cable corridor in Muskeget Channel and Nantucket Sound, where surficial boulders, subsurface boulders, geological units representing hardgrounds or glacial tills, or shallowly buried channels with variable soil properties have been identified. The seabed preparation may include dredging or leveling steep or mobile seabed features to facilitate achieving the targeted depth of lowering to ensure adequate burial over the life of the Project. Within the Falmouth ECC, Mayflower

Wind anticipates a suction hopper dredger (or similar) would be used for seabed preparation activities over approximately five percent of the cable route.

While not specific to cable emplacement, dredging would also be used if Mayflower Wind installs GBS foundations. Dredging is necessary when the seabed surface layers are too soft for a GBS to rest on. In these situations, the top layers are removed prior to placement of the rock layer. Dredging can be done using trailing suction hopper dredgers, cutter suction dredgers, or mechanical dredging vessels. The maximum total dredging volume of all locations combined is 111,973,203 cubic feet (3,170,728 cubic meters). Dredging may additionally be used during decommissioning for vessels to unearth the cables prior to being reeled onto barges or other transport vessels.

Seafloor affected by dredging prior to cable installation would result in turbidity effects that have the potential to have temporary impacts on some sea turtle foraging habitat and prey species in the immediate area (e.g., benthic mollusks, crustaceans, sponges, sea pens, crabs); however, abundant similar habitat and prey would be found in adjacent areas, resulting in fewer impacts on sea turtles. As described in Section 3.5.7.3, dredging could also contribute additional impacts on sea turtles related to impingement, entrainment, and capture associated with mechanical and hydraulic dredging techniques. Given the available information, the risk of injury or mortality of individual sea turtles resulting from dredging necessary to support offshore Project construction would be low, with impacts anticipated to be minor with no population-level effects.

Water quality impacts from cable emplacement would cause elevated suspended sediments. Inshore trenching and dredging could result in more extensive suspended sediment with concentrations above 100 mg/l (0.0008 pounds per gallon [lb/gal]) occurring at a maximum distance of 36 meters (118 feet). Maximum TSS levels are expected to drop below 10 mg/l (0.00008 lb/gal) in 2 hours, while drops below 1 mg/l (0.000008 lb/gal) are expected after less than 4 hours (COP Appendix F1; Mayflower Wind 2022). Elevated turbidity levels would be temporary, lasting 1 to 6 hours in the immediate vicinity of the cable emplacement corridor. Physical or lethal effects are unlikely to occur because sea turtles are air-breathing and land-brooding and, therefore, do not share the physiological sensitivities of susceptible organisms like fish and invertebrates. Sea turtles may alter their behavior in response to elevated suspended sediment concentrations (e.g., moving away from an affected area) and may also experience behavioral stressors, like reduced ability to forage and avoid predators. However, sea turtles are migratory species that forage over wide areas and would likely be able to avoid temporarily suspended sediment impacts that are limited in severity and extent without consequence. Sea turtles would be expected to swim away from the sediment plume and return to the area once turbidity has returned to background levels.

Noise: Noise transmitted through water, through the seabed, or both can result in high-intensity, low-exposure-level, and long-term but localized intermittent risk to sea turtles. Underwater noise generated by impact installation of monopiles and pin piles, vibratory installation and removal of sheet piles for cofferdams, detonations of UXOs, HRG surveys, vessel activity, and WTG operation would increase sound levels in the marine receiving environment and may result in potential adverse effects on sea turtles in the Project area including harm (PTS) and harassment (TTS or behavioral disturbance), as described in Section 3.5.7.3.

Noise from pile driving would result in a potential risk of PTS and behavioral disturbance to sea turtles, which would occur intermittently during the installation of offshore structures. Each monopile requires 4 hours of driving to install (two piles driven per day), while each piled jacket foundation requires 2 hours of driving to install (eight piles driven per day). Foundation installation would occur over a maximum-case scenario of a total of 146 days for WTGs and 7 days for OSPs (COP Appendix U2, Table 5; Mayflower Wind 2022). Maximum active piling duration for WTG foundations would be up to 588 hours (147 monopile WTGs times 4 hours per pile). The maximum active piling duration for OSP foundations would be up to 40 hours (2 hours per foundation, up to four foundations per OSP, and up to five OSPs). Sea turtle hearing sensitivity is within the frequency range (100 to 1,000 Hz) of sound produced by low-frequency sources such as marine drilling (for a summary, see Popper et al. 2014). Any sea turtle present in the area could be exposed to the noise from more than one pile-driving event per day, repeated over a period of days.

Predicted exposure radial distances for sea turtles, assuming broadband attenuation of 0, 6, 10, and 15 dB, are shown in COP Appendix U2, Section 3.5 (Mayflower Wind 2022). The use of bubble curtains while pile driving is planned in order to reduce noise. Bubble curtains have been measured to reduce sound levels by around 10 dB, and up to 20 dB depending on water depth and curtain configuration (Koschinski and Lüdemann. 2013). Accordingly, assuming 10 dB broadband attenuation, the modeled exposure ranges ($ER_{95\%}$) for potential behavioral disturbance to sea turtles for one 11-meter-diameter monopile per day ranged from 0.95 to 1.42 kilometers during summer. The number of sea turtles predicted to receive sound levels above exposure criteria during pile driving for WTGs and OSPs was estimated using modeling. The first model assumed the use of WTG jacket foundations and a “realistic” sound field scenario. The results of the model are summarized in Table 3.5.7-5. Further models estimating sea turtle exposure under an alternative foundation and models with maximum estimates may be found in COP Appendix U2, Tables 39 through 41 (Mayflower Wind 2022). Exposure to sound that exceeds injury thresholds during impact pile driving for WTG and OSP installation (assuming 10 dB of attenuation) is negligible for all sea turtle species potentially in the Project area, as results of the modeling indicate that fewer than one individual sea turtle is predicted to be affected. Assuming 10 dB attenuation during installation of the maximum WTG and OSP monopile foundation impact pile-driving schedule (Table 3.5.7-6), the model estimates that under the “maximum” sound field scenario that less than one Kemp’s ridley and green sea turtle, 21 leatherback sea turtles, and 24 loggerhead sea turtles could be exposed to underwater noise exceeding behavioral thresholds.

Table 3.5.7-5. Realistic WTG jacket foundation schedule: The mean number of modeled sea turtles estimated to experience sound levels above exposure criteria for different sound attenuation levels for the Project. The schedule includes the installation of both WTG and OSP foundations.

Species	Injury								Behavior			
	LE				Lpk				Lp			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle	0.04	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.50	0.15	0.06	0.02
Leatherback turtle	2.85	0.64	0.03	<0.01	0.00	0.00	0.00	0.00	40.89	14.58	7.30	2.29
Loggerhead turtle	0.42	0.01	<0.01	0.00	0.00	0.00	0.00	0.00	44.49	14.83	4.67	0.82
Green turtle	0.10	0.01	<0.01	<0.01	0.00	0.00	0.00	0.00	0.53	0.18	0.09	0.04

LE = cumulative sound exposure level, Lpk = peak pressure level, Lp= sound pressure level, dB = Decibels

Table 3.5.7-6. Maximum WTG monopile foundation schedule: The mean number of modeled sea turtles estimated to experience sound levels above exposure criteria for different sound attenuation levels for the Project. The schedule includes the installation of both WTG and OSP foundations

Species	Injury								Behavior			
	LE				Lpk				Lp			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle	0.22	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.74	0.45	0.29	0.13
Leatherback turtle	14.14	2.74	0.92	0.00	0.00	0.00	0.00	0.00	59.86	35.19	21.05	10.33
Loggerhead turtle	4.20	0.81	0.16	0.00	0.00	0.00	0.00	0.00	65.84	40.39	24.14	11.34
Green turtle	0.53	0.14	0.06	<0.01	0.00	0.00	0.00	0.00	0.83	0.50	0.36	0.16

LE = cumulative sound exposure level, Lpk = peak pressure level, Lp= sound pressure level, dB = decibels

Pile-driving noise associated with the Proposed Action may result in temporary impacts, including behavioral and physiological effects on individual turtles, during pile-driving activities. Although permanent hearing impairment has the potential to occur, the likelihood of sea turtles experiencing PTS is low given their ability to avoid noise levels that would result in long-term impacts. In addition, the anatomy of the shell and skull of sea turtles may help prevent injury from percussive shocks as research indicates these body parts protect soft tissue at very high levels of pressure (Madin 2009). Given that pile-driving activities would be conducted in accordance with AMMs, such as the use of noise-attenuating systems (e.g., bubble curtains, insulated piles), soft-start procedures, and protected species observers, impacts on individual sea turtles through this IPF would be expected to be reduced. Once pile driving stops, this IPF would be removed from the environment and sea turtle behavior would return to normal. However, in the unlikely event of PTS occurring due to a failure of preventative measures, the effects would be permanent to individuals that experience it. Impacts at the population level are not anticipated, given the low density of turtles in the Project area and due to the spacing between individual work areas. Impacts related to noise from pile-driving activities during installation of the

WTGs for the Proposed Action are considered minor but long-term for individual sea turtles that are exposed pile-driving noise that leads to PTS.

Underwater noise from operational WTGs is expected to be low-energy and low-frequency, with noise emissions likely below 700 Hz and a source level of 80 to 150 dB re 1 μPa-m (COP Volume 2, Section 6.8.2.1.4, Mayflower Wind 2022). Noise emissions could range up to 177 dB re 1 μPa-m during extremely high winds (Stober and Thomsen 2021), but direct-drive gear boxes could reduce emissions by 10 dB. Sea turtles have been observed avoiding low-frequency sounds and would likely be able to detect and potentially react to the noise generated by the WTGs (Piniak et al. 2012; Bartol and Musick 2003). Noise emissions at this level might result in behavioral effects, but sea turtles have been shown to habituate to noise and can leave the area if disturbed. In addition, based on ambient noise levels in the Project area and research on noise associated with multiple WTG foundation types, sea turtles should not be able to hear sounds generated by WTGs outside of the Lease Area as noise returns to ambient levels at approximately 500 meters from the source (Thomsen et al. 2015). Impacts related to noise generated by WTGs during the operation phase of the Proposed Action are considered minor but long-term.

The frequency range for vessel noise (primarily 10 to 1,000 Hz; MMS 2007) overlaps with sea turtles' known hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol and Ketten 2006) and, therefore, the vessel noise would be audible to sea turtles in the vicinity. The increase in vessel traffic associated with the Project would occur during construction, operations, and maintenance activities with an estimated 15 to 35 vessels operating at any given time. The construction vessels used for Project construction are described in the COP Volume 1, Section 3.3.14 and Table 3-21 (Mayflower Wind 2022). Typical large construction vessels used in this type of project range from 225 to 300 feet in length and can operate at speeds up to 12 knots. Underwater noise from vessel traffic, aircraft, geophysical surveys (HRG surveys and geotechnical drilling surveys), turbine operation, and dredging are unlikely to cause injury or death to sea turtles, but the additional noise may result in behavioral changes. Although vessel noise may result in behavioral changes in how sea turtles use the Project area and nearby waters, impacts related to vessel noise are considered negligible to minor.

HRG surveys would be conducted to support final engineering design and construction. As described in Section 3.5.7.3, survey noise could affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. However, given that sea turtles would have to be in close proximity to HRG survey activity to experience injury-level exposures (PTS/TTS) and the short duration and mobile nature of survey activity, it is unlikely HRG surveys would result in injury given that sea turtles are expected to avoid survey activities. While low-level behavioral exposures could occur, these disruptions would be limited in extent and short term in duration given the movement of the survey vessel and the mobility of the animals and would have limited effects on both the individual and population. Therefore, underwater noise impacts from HRG surveys are expected to be minor.

UXO detonations could generate high pressure levels that could cause disturbance and injury to sea turtles. The Falmouth export cable corridor does not overlap any UXO areas or Formerly Used Defense Sites (FUDS) (USACE 2019; AECOM 2020). The Brayton Point export cable corridor intersects one land-based FUDS that is listed as closed out and complete but extends out into the Sakonnet River (USACE 2019). During BOEM's pre-screening process for the selection of the Massachusetts/Rhode Island Wind Energy Areas, the nearest UXO site was found 10 miles (16 kilometers) west of the Massachusetts/Rhode Island Wind Energy Area (BOEM 2013). A desktop study by Mayflower Wind of UXO in the Offshore Project area concluded that there is a varying Low to Moderate risk from encountering UXO on site. The risk is Moderate throughout all of the Lease Area, and a relatively equal ratio between Low and Moderate within the ECCs (COP Appendix E.7; Mayflower Wind 2022). Mayflower Wind has committed to measures to minimize impacts on sea turtles from UXO detonation (Appendix G), and UXO detonation is a last resort. Other methods—such as avoidance, lift and shift, deactivation, using shaped charges that reduce the net explosive yield or that allow the UXO to burn at a slower rate, and avoiding instantaneous detonation—would be considered before a detonation. UXO detonations would only occur from May through November. While this coincides with the highest densities of leatherback and loggerhead sea turtles, pre-start clearance zones, designed to protect marine mammals, would also protect sea turtles. Pre-start clearance zones, commensurate with marine mammal hearing group and UXO charge weight range from 164 to 20,341 feet (50 to 6,200 meters). Thirty minutes prior to detonation, this zone will be monitored visually with multiple vessels. These ranges cover observed PTS/TTS ranges for sea turtles:, <656 feet (<200 meters) lethal, 1,214 feet (370 meters) minor injury, and 1,969 feet (600 meters) no injury (U.S. Navy 2017a citing O'Keeffe and Young 1984). Any sightings of a sea turtle would cause the clock to restart, after the animal has moved out of the monitoring zone. Only one detonation would occur in a 24-hour period, with no nighttime detonation planned, and a 10 dB noise attenuation system would be used, similar to the system used for pile-driving activities. Impacts associated with UXO detonation for the proposed Project are expected to be minor for the following reasons: any required detonations will be timed to occur no more than once per day and the number of UXOs identified in the Offshore Project area are expected to be low.

Traffic: The Proposed Action would generate 15 to 35 construction vessels operating in the geographic analysis area for sea turtles at any given time. Increased vessel traffic associated with the Project may increase the potential for high-intensity impacts from vessel strikes during travel between multiple ports and the Lease Area. Sea turtles spend a majority (55 to 96 percent, depending on species) of time submerged (Eckert 1989; Hays et al. 2000; Lanyon et al. 1989) but can spend long periods of time at the surface during breathing and foraging activities (Hazel et al. 2007; Shimada et al. 2017). Sea turtles at the surface are most at risk for vessel strikes and are particularly sensitive to fast-moving vessels as avoidance behaviors decrease with increasing vessel speeds.

Given the mobility of sea turtles and the use of protected species observers and AMMs, such as vessel speed restrictions and the implementation of monitoring zones and clearance zones (COP Volume 2, Section 16, Table 16-1; Mayflower Wind 2022), interactions with Project vessels and sea turtles would not be expected to occur. Although vessel strike is a major source of human-caused sea turtle mortality, the above measures would reduce the probability of a Project-related strike. Although construction will occur over a period of seven years, the Project would have a period of peak vessel activity lasting approximately one year when multiple phases of construction will be happening simultaneously (during construction and installation of offshore export cables, WTGs, OSP, and interarray cables). However, avoidance measures would be designed to avoid vessel strikes on sea turtles by reducing vessel speed and maintaining a distance of 164 feet (50 meters) or greater from sighted turtles. The additional measure of training personnel to watch for and report sea turtles would further increase vigilance to avoid striking sea turtles (COP Volume 2, Section 16, Table 16-1; Mayflower Wind 2022). Lookouts can advise vessel operators to slow the vessel or maneuver safely away from sea turtles, as well as observing for indicators of sea turtle presence such as drifting algal mats. Sea turtle exposure would be expected to be minor and risk localized to surface habitats in the transit path between ports and the Lease Area.

Port utilization: Port expansion is not proposed for Mayflower so no direct impacts on sea turtles are expected. Potential impacts from increased vessel traffic are discussed under the *Traffic* IPF.

Gear utilization: The presence of gear used for fisheries and benthic monitoring surveys under the Proposed Action could affect sea turtles by entrapment or entanglement. Surveys are expected to occur at short-term, regular intervals over the lifetime of the Project. Trawl surveys for fisheries monitoring could result in small numbers of sea turtle captures, but serious injuries or mortalities would mostly be avoided because the bottom time for proposed trawls would be limited to 20 minutes and available research indicates that limiting tow times to less than 30 minutes likely eliminates the risk of death for incidentally captured sea turtles (Epperly et al. 2002; Sasso and Epperly 2006). Because trawl surveys for Project monitoring could lead to potential capture or minor injury or mortality of small numbers of loggerhead and Kemp's ridley sea turtles, impacts on sea turtles would likely be minor.

Presence of structures: Impacts on sea turtles could result from the reef effect created by the presence of up to 149 foundations and between 390 acres (157 hectares) to 1,698 acres (686 hectares) of scour/cable protection. Studies have found increased biomass for benthic fish and invertebrates around artificial structures (Pezy et al. 2018; Raoux et al. 2017; Wang et al. 2019), indicating that offshore wind facilities could generate beneficial permanent impacts on local ecosystems, which may lead to behavioral changes related to foraging activities. The WTG and OSP foundations would provide some level of reef effect, likely increasing local prey availability, and may result in minor, long-term beneficial impacts on sea turtle foraging and sheltering. However, minor, long-term adverse impacts could occur as a result of increased interaction with fishing gear and vessels as the reef effect and associated increase in fish biomass could increase recreational fishing effort in and around turbine foundations, which may increase marine debris from fouled fishing gear in the area. Sea turtle entanglement in fishing gear is not considered a new IPF but rather a change in the distribution of fishing effort from other locations. The artificial reef may attract sea turtle predators to the area, increasing sea turtle predation risk. Structures may also reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing. During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders and further altering the prey availability to sea turtles. Leatherback sea turtles are known to forage around features, such as upwellings, that lead to an aggregation of jellyfish (Bailey et al. 2012). The Nantucket Shoals, located northeast of the Project area, provides a foraging ground for leatherback sea turtles. The addition of structures in the area has the potential to cause hydrodynamic effects on ocean currents, potentially affecting the distribution of the leatherback's planktonic jellyfish prey, but there is uncertainty around potential effects as further discussed in Section 3.5.6, *Marine Mammals*.

Impacts of Alternative B on ESA-Listed Species

All sea turtle species in the geographic analysis area are either threatened or endangered and protected by ESA. Impacts of Alternative B on ESA-listed sea turtles are discussed in the previously listed IPFs. BOEM is preparing a BA for the potential effects on ESA-listed species under NMFS' jurisdiction, in which preliminary analyses indicate that the Proposed Action may affect and is likely to adversely affect ESA-listed sea turtles. The preliminary analysis in the draft BA indicates that vessel traffic and auditory effects due to the Proposed Action are likely to adversely affect ESA-listed sea turtles. Auditory and non-auditory effects from UXO detonations due to the Proposed Action could include PTS/mortality/slight lung/gastrointestinal injury and, therefore, may adversely affect ESA-listed sea turtles. Also, trawl surveys and hopped dredging could lead to the capture or minor injury of small numbers of individual sea turtles, which may adversely affect small numbers of sea turtles. BOEM will continue to consult with NMFS under the ESA and results of consultation will be included in the Final EIS.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Planned non-offshore wind activities in the geographic analysis area that contribute to impacts on sea turtles include commercial fishing; marine transportation; military use; oil and gas activities; undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; dredging and port improvement; marine minerals use, and ocean dredged material disposal.

The contribution of the Proposed Action to the impacts of accidental releases from ongoing and planned activities on sea turtles would likely be minimal. BOEM assumes all vessels would comply with USCG laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, accidental large-scale releases are unlikely and impacts from small-scale releases would be localized and short term.

Export and interarray cables from the Proposed Action and planned offshore wind development would add an estimated 11,646 miles (18,742 kilometers) of buried cable to the geographic analysis area, of which the Proposed Action represents 14 percent. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to impacts of EMF and heat from ongoing and planned activities; however, overall cumulative impacts would be negligible given the small area that would be affected by the projects compared to the remaining area of open ocean within the geographic analysis area.

The 149 structures for the Proposed Action represent only 5 percent of the 3,094 offshore wind structures that would add new sources of lighting on the OCS from existing and planned offshore wind farms. In context of reasonably foreseeable environmental trends, the Proposed Action would incrementally contribute to cumulative lighting impacts from ongoing and planned activities, which would be negligible as offshore lighting is anticipated to have minimal effect on adult sea turtles.

The 3,888 acres (1,573 hectares) of seabed disturbance from cable emplacement associated with the Proposed Action represents only 2 percent of the 185,710 acres (75,154 hectares) of seabed expected to be disturbed on the OCS due to existing and planned offshore wind farms, including the Proposed Action. While increases in foraging effort or displacement due to turbidity may occur to individual sea turtles, these temporary effects are not anticipated to lead to population-level effects on sea turtle populations. Therefore, the Proposed Action when combined with past, present, and reasonably foreseeable projects would result in minor impacts on sea turtles.

Planned offshore wind activities would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving followed by vessels. The 149 structures for the Proposed Action represent only 5 percent of the 3,094 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action, although some foundations from the Proposed Action and other wind farms may be installed without pile driving. Project vessels would represent only a small fraction of the large volume of existing traffic in the geographic analysis area. In context of reasonably foreseeable environmental trends, the Proposed Action would incrementally contribute to cumulative noise impacts on sea turtles from ongoing and planned activities, which would be minor overall.

The contribution of the Proposed Action to impacts of vessel traffic from ongoing and planned activities would be small given the large volume of existing vessel traffic in the geographic analysis area. The cumulative impact from vessel traffic is anticipated to be the same as the Proposed Action, minor, assuming other offshore wind projects adopt similar AMM measures to reduce the potential of vessel strikes.

The deployment of gear used for fisheries and benthic monitoring surveys under the Proposed Action would contribute to the cumulative impact of gear utilization in the region. However, the contribution of the Proposed Action to overall gear usage in the area is minimal, and the cumulative impacts on sea turtles would likely be minor overall.

The Proposed Action would contribute incremental impacts to sea turtles through the installation of up to 149 foundations. In combination with other offshore wind projects (estimated 3,094 offshore wind structures) would cumulatively contribute to impacts on sea turtles, primarily associated with the beneficial artificial reef effects and adverse impacts from fishing gear entanglement. Cumulative impacts on sea turtles would be minor overall.

Conclusions

Impacts of the Proposed Action: Project construction and installation, O&M, and conceptual decommissioning would result in habitat disturbance, entrainment and impingement, underwater and airborne noise, water quality degradation, vessel traffic (strikes and noise), artificial lighting, and potential discharges/spills and trash. BOEM anticipates the impacts resulting from the Proposed Action alone would range from **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts. Adverse impacts are expected to result mainly from pile-driving noise and increased vessel traffic. Beneficial impacts are expected to result from the presence of structures.

Cumulative Impacts of the Proposed Action: Cumulative impacts associated with the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would result in **minor** impacts on sea turtles. The main drivers for these impact ratings are pile-driving noise and associated potential for auditory injury, the presence of structures, ongoing climate change, and ongoing vessel traffic posing a risk of collision. The Proposed Action would contribute to the cumulative impact rating primarily through pile-driving noise, vessel traffic, and the presence of structures. BOEM made this decision because the overall effect would be detectable and measurable, but these impacts would not result in population-level effects.

3.5.7.6 Impacts of Alternatives C and F on Sea Turtles

Impacts of Alternatives C and F: Under Alternative C, the Brayton Point ECC would be routed onshore to avoid fisheries impacts in the Sakonnet River. Alternative C-1 and Alternative C-2 would reduce the offshore portion of the Brayton Point ECC by 9 miles and 12 miles (14 and 19 kilometers), respectively. The alternatives would avoid the potential impacts on sea turtles in the Sakonnet River; however, sightings of sea turtles in the Project area are uncommon and cable emplacement impacts from the other portions of the offshore cable corridors would still occur. The Kemp's Ridley sea turtle would be expected to benefit the most from the prevention of construction in the Sakonnet River. The Kemp's Ridley is associated with coastal habitats and is known to forage in bays and estuaries across Rhode Island in the summer months (Schwartz 2021). No measurable difference in the impacts on sea turtles are expected between the Proposed Action and Alternative C.

Under Alternative F, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use ±525kV HVDC cables connected to one HVDC converter OSP, instead of HVAC cables connected to one or more HVAC OSPs as proposed under the Proposed Action. During operation, there would be increased intake and discharge from the additional HVDC converter OSP, which could result in increased entrainment of sea turtle prey compared to the Proposed Action. However, impacts would remain localized near the OSP locations, and the overall impact magnitude would be the same.

Additionally, the Falmouth offshore export cable route would include up to three HVDC cables compared to up to five HVAC cables under the Proposed Action, which would reduce seafloor disturbance by approximately 700 acres (2.8 square kilometers). The lesser number of cables would also reduce potential EMF effects compared to the Proposed Action. Offshore impacts on sea turtle prey from cable emplacement and anchoring may be reduced under Alternative F due to the lesser number of cables installed. Because impacts associated with cable installation and maintenance would still occur in the same corridor, the impacts on sea turtles under Alternative F would be slightly reduced but not materially different than those described for the Proposed Action.

Cumulative Impacts of Alternatives C and F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C and Alternative F would be similar to those described under the Proposed Action.

Impacts of Alternatives C and F on ESA-Listed Species

Impacts of Alternatives C and F on ESA-listed species would be the same as the IPFs discussed in the Proposed Action.

Conclusions

Impacts of Alternatives C and F: Impacts of Alternative C and Alternative F would not differ from the impacts of the Proposed Action. Therefore, construction and installation, O&M, and decommissioning of Alternative C and Alternative F would likewise result in **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts.

Cumulative Impacts of Alternatives C and F: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative C and Alternative F would be similar to the Proposed Action and result in **minor** impacts on sea turtles in the geographic analysis area.

3.5.7.7 Impacts of Alternative D on Sea Turtles

Impacts of Alternative D: Alternative D addresses potential impacts on hydrodynamic features and foraging habitat for several species of birds and whales, which may also contribute to changes of impacts on sea turtles. The area of concern in Alternative D is the Nantucket Shoals, an area of elevated sea floor that creates an upwelling, and thus, ideal conditions for plankton growth. Leatherback sea turtles use this area for foraging due to its unique geography. Oceanographic features, such as mesoscale eddies, convergence zones, and areas of upwelling like those in the Nantucket Shoals, attract foraging leatherbacks because these features are often associated with aggregations of jelly fish (Bailey et al. 2012). The removal of up to six WTGs under Alternative D would reduce construction and installation impacts from noise, vessel traffic, and anchoring when compared to the Proposed Action. The reduction of six turbines would likely not have an appreciable impact on hydrodynamic and atmospheric wake effects of the WTGs, as further described under the analysis of Alternative D in Section 3.5.6, *Marine Mammals*. Impacts associated with sea turtle prey dispersal and availability are not expected to differ from the Proposed Action. Since the number of WTGs to be removed would be small relative to the total number of WTGs, BOEM does not expect a measurable reduction in impacts on sea turtles compared to the Proposed Action.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to those described under the Proposed Action.

Impacts of Alternative D on ESA-Listed Species

Impacts of Alternative D on ESA-listed species would be the same as the IPFs discussed for the Proposed Action.

Conclusions

Impacts of Alternative D: Impacts of Alternative D would not differ from the impacts of the Proposed Action, except a slight reduction in noise impacts and vessel traffic from construction and installation. Therefore, construction and installation, O&M, and decommissioning of Alternative D would likewise result in **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts as described in Section 3.5.7.5, *Impacts of Alternative B – Proposed Action on Sea Turtles*.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative D would be similar to the Proposed Action and result in **minor** impacts on sea turtles in the geographic analysis area.

3.5.7.8 Impacts of Alternative E on Sea Turtles

Impacts of Alternative E: Alternative E includes the use of all piled (Alternative E-1), all suction bucket (Alternative E-2), or all GBS (Alternative E-3) foundations for WTGs and OSPs. Installation activities would not differ between the Proposed Action and Alternative E-1, which assumes pile driving would be used for all foundations with corresponding noise impacts. Under Alternative E-2 and Alternative E-3, no pile driving would occur; therefore, there would be no underwater noise impacts on sea turtles due to pile driving. The avoidance of pile-driving noise impacts would reduce overall construction and installation impacts on sea turtles under Alternative E-2 and Alternative E-3 compared to the Proposed Action. Cable emplacement and the number of structures constructed under Alternative E remains the same as the Proposed Action.

Gravity-based foundations, under Alternative E-3, would result in the greatest area of habitat conversion due to foundation footprint and scour protection. Alternative E-1 would result in at least a 77 percent reduction in footprint and scour protection, and Alternative E-2 would result in at least a 58 percent reduction in footprint and scour protection, compared to Alternative E-3. Alternative E-2 and Alternative E-3 may have a greater artificial reef effect with increased surface area, which would be a potential beneficial impact on sea turtles. However, adverse impacts from these larger underwater structures may include entanglement in lost or discarded fishing gear, potential of vessel strike from increased recreational fishing vessel traffic, and incidental hooking. For example, the GBS of Alternative E-3 may have less entanglement potential as it has a smooth, sloping exterior in the water column compared to the suction bucket foundation of Alternative E-2 that has steel cross beams which may create more entanglement potential of marine debris and recreational fishing gear. Given that Alternative E includes increases in both beneficial and adverse impacts, there is not expected to be a measurable difference in impacts on sea turtles from those anticipated under the Proposed Action.

Cumulative Impacts of Alternative E: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative E would be similar to those described under the Proposed Action.

Impacts of Alternative E on ESA-Listed Species

Impacts of Alternative E on ESA-listed species would be the same as the IPFs discussed for the Proposed Action.

Conclusions

Impacts of Alternative E: Impacts of Alternative E-1 would not be measurably different from the impacts of the Proposed Action. Construction and installation, O&M, and decommissioning of Alternative E-1 would likewise result in **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts.

Impacts of Alternative E-2 and Alternative E-3 would be similar to impacts of the Proposed Action with the most notable difference the avoidance of impact pile-driving noise impacts and increase in artificial reef effects. Construction and installation, O&M, and decommissioning of Alternative E-2 and Alternative E-3 would result in **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts.

Cumulative Impacts of Alternative E: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative E would be similar to the Proposed Action and result in **minor** impacts on sea turtles in the geographic analysis area.

3.5.7.9 Proposed Mitigation Measures

BOEM has proposed several mitigation measures to minimize impacts on sea turtles in the BA, which are listed in Appendix G, Table G-2. Implementation of these measures would further reduce impacts on sea turtles but the overall impact magnitude is not expected to change.

3.5 Biological Resources

3.5.8 Wetlands

This section discusses potential impacts on wetlands from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The wetlands geographic analysis area, as shown on Figure 3.5.8-1, includes all subwatersheds that intersect the Onshore Project area, which encompasses all wetlands and surface waters that are most likely to experience impacts from the proposed Project. See Section 3.4.2, *Water Quality*, for a discussion of impacts on water quality.

3.5.8.1 Description of the Affected Environment and Future Baseline Conditions

Wetlands and vernal pools[1] in the Massachusetts part of the geographic analysis area were mapped using the Mass GIS 2005 Wetlands detailed dataset (MassGIS 2017), and the National Wetland Inventory (NWI) (USFWS 2021) was used to map wetlands in the Rhode Island part of the geographic analysis area.[2] Mayflower Wind also delineated wetlands during field surveys conducted within the onshore substation sites in Falmouth; however, the field delineation report for the onshore substation sites under consideration in Falmouth is private data and, therefore, has not been provided. Additional field delineations will be completed as part of the federal (CWA Section 404) and state permitting processes as necessary (COP Volume 2, Section 6.4.1.1; Mayflower Wind 2022). Impacts on regulated wetland resources would require coverage under federal permits issued by USACE pursuant to the CWA, state permits or authorizations pursuant to the Massachusetts Wetland Projection Act and RIDEM Coastal Resources Management Council, and local municipal wetland bylaws. CWA Section 404 requires that all appropriate and practicable steps be taken first to avoid and minimize impacts on jurisdictional wetlands; for unavoidable impacts, compensatory mitigation may be required to replace the loss of wetlands and associated functions.

The Falmouth Onshore Project area lies entirely within one watershed: Wequaquet Lake (Hydrologic Unit Code [HUC] 10900020206). Characteristic wetland types occurring in the Falmouth Onshore Project area include palustrine wetland types, such as red maple swamps, Atlantic white cedar bogs, kettlehole bogs, highbush blueberry thickets, shrub swamps, and emergent marsh (COP Appendix J, Section 4.1.4; Mayflower Wind 2022). Examples of natural wetland communities common to Upper Cape Cod are further described in Appendix B, *Supplemental Information and Additional Figures and Tables*.

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[1] Originally defined and protected under the Massachusetts Wetlands Protection Act Regulations, Certified Vernal Pools also receive protection under: Title 5 of the Massachusetts Environmental Code, Section 401 of the Clean Water Act, the Massachusetts Surface Water Quality Standards, and the Massachusetts Forest Cutting Practices Act (MassDEP 2022a).

[2] BOEM also reviewed University of Rhode Island (URI) Environmental Data Center and Rhode Island Geographic Information System (RIGIS) Wetlands datasets (RIDEM 2022) but found that the NWI wetland mapping appeared more accurate in the Project area based on desktop review of aerial imagery overlaid with the wetland datasets.

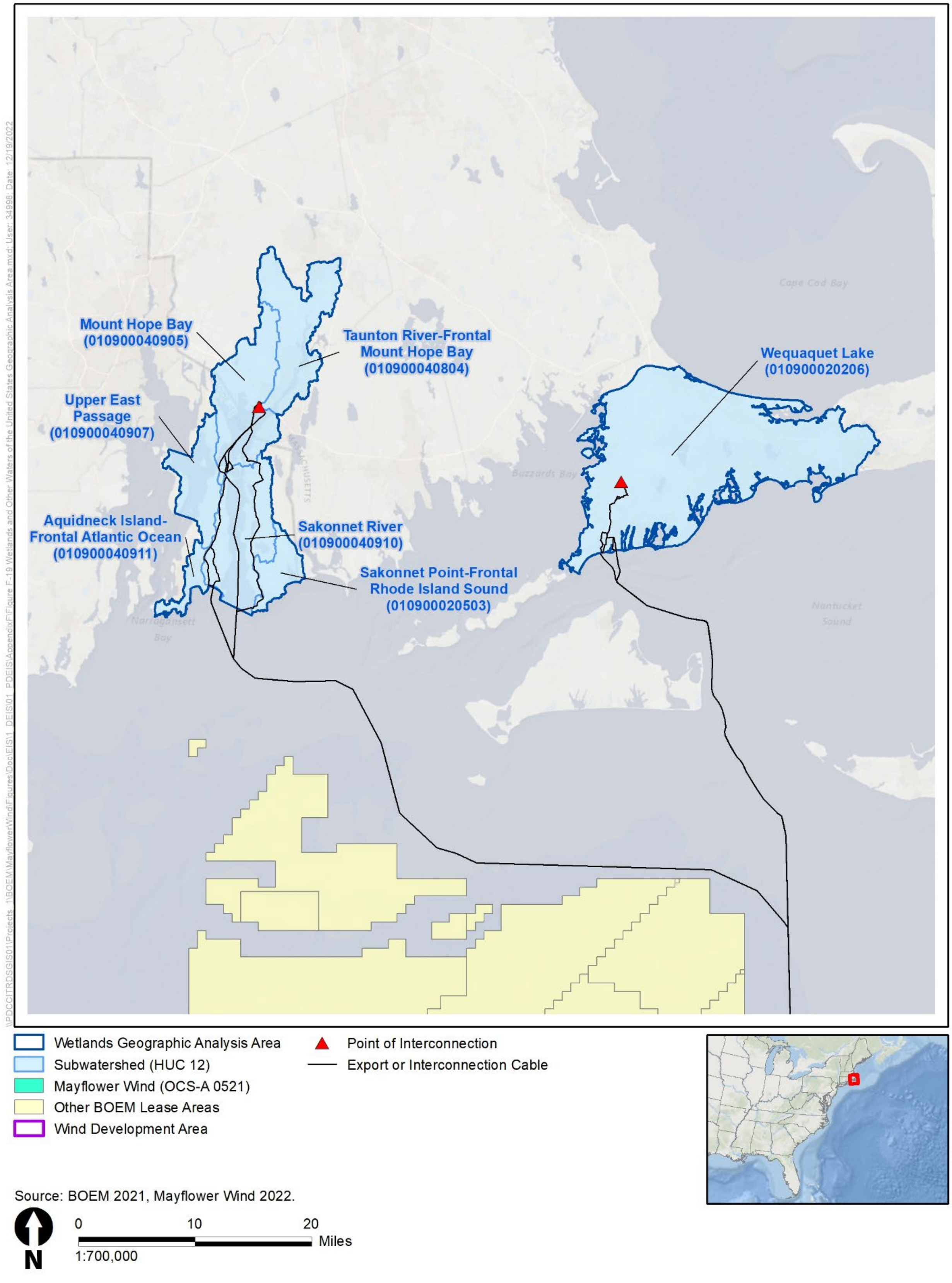


Figure 3.5.8-1. Wetlands geographic analysis area

The Brayton Point Onshore Project area lies within seven watersheds: Taunton River-Frontal Mount Hope Bay (HUC 10900040804), Mount Hope Bay (HUC 10900040905), Sakonnet River (HUC 10900040910), Sakonnet Point-Frontal Rhode Island Sound (HUC 010900020503), Upper East Passage (HUC 010900040907), Aquidneck Island-Frontal Atlantic Ocean (HUC 010900040911), and Wequaquet Lake (HUC 010900020206). According to MassGIS data (MassGIS 2017,2020), freshwater wetlands are limited in the vicinity of the Brayton Onshore Project area and consist of a few ponds, coastal wetlands, and emergent wetlands. NWI data suggest that the Brayton Point intermediate landfall routes on Aquidneck Island in Portsmouth, Rhode Island, are adjacent to and potentially within estuarine wetlands, particularly Route Option 2 (USFWS 2021).

Wetlands are important features in the landscape that provide numerous beneficial services or functions. Wetlands protect drinking water, prevent storm damage, and provide fish, shellfish, and wildlife habitats. COP Volume 2, Table 6-28 (Mayflower Wind 2022) provides a list of species associated with habitats in the Onshore Project area, including species that use wetland habitats. Wetlands also support commercial fishing, tourism, recreation, and educational opportunities. Coastal wetlands, like those found in the vicinity of the Onshore Project area, buffer uplands from storm damage by absorbing wave energy and reducing the height of storm waves. Wetland plants also bind the soil and help slow shoreline erosion (MassDEP 2022b).

As shown in Table 3.5.8-1, the geographic analysis area contains approximately 34,876 acres of wetlands according to state agency wetland data for Massachusetts and NWI wetland data for Rhode Island (MassGIS 2017, 2020; USFWS 2021). NWI wetland data for Falmouth are provided in Appendix B.

Table 3.5.8-1. Wetland communities in the geographic analysis area

Wetland Community	Acres (Massachusetts)	Acres (Rhode Island) [a]	Total	Percent of Total
Falmouth Onshore				
Barrier Beach System [b]	2,558	0	2,558	18.1%
Bog	54	0	54	0.4%
Cranberry Bog	862	0	862	6.1%
Deep Marsh	162	0	162	1.1%
Salt Marsh	6,431	0	6,431	45.6%
Shallow Marsh Meadow or Fen	624	0	624	4.4%
Shrub Swamp	1,316	0	1,316	9.3%
Tidal Flat	241	0	241	1.7%
Wooded Swamp Coniferous	258	0	258	1.8%
Wooded Swamp Deciduous	1,246	0	1,246	8.8%
Wooded Swamp Mixed Trees	347	0	347	2.5%
Falmouth Total	**14,099**	**0**	**14,099**	**100%**
Brayton Point Onshore [c]				
Barrier Beach System [b]	24	0	24	0.1%
Bog	46	0	46	0.2%
Cranberry Bog	36	0	36	0.2%
Deep Marsh	228	0	228	1.1%
Salt Marsh	246	3,179	3,425	16.5%
Shallow Marsh Meadow or Fen	527	963	1,490	7.2%
Shrub Swamp	761	0	761	3.7%
Tidal Flat	13	0	13	0.1%
Wetland	50	0	50	0.2%
Wooded Swamp	23	9,917	9,940	47.8%
Wooded Swamp Deciduous	4,359	0	4,359	21.0%
Wooded Swamp Mixed Trees	405	0	405	1.9%
Brayton Point Total	**6,718**	**14,059**	**20,777**	**100%**
Geographic Analysis Area Total	**20,817**	**14,059**	**34,876**	**-**

[a] Rhode Island data are based on NWI. NWI wetland categories include estuarine and marine wetlands, freshwater emergent wetlands, and freshwater forested/scrub wetlands, which were synced to MassGIS' salt marsh, shallow marsh or fen, and wooded swamp wetland categories, respectively.
[b] Barrier Beach System wetland types include coastal beach, coastal dune, marsh, open water, salt marsh, shrub swamp, wooded swamp coniferous, wooded swamp deciduous, and wooded swamp mixed trees.
[c] Wetland types and acreages reported for Brayton Point include the intermediate landfall on Aquidneck Island in Portsmouth, Rhode Island.
Sources: MassGIS 2017, 2020; USFWS 2021.

3.5.8.2 Impact Level Definitions for Wetlands

The definitions of impact levels for wetlands are provided in Table 3.5.8-2. USACE, MassDEP, and RIDEM define wetland impacts differently than BOEM's due to requirements under CWA Section 404, the Massachusetts Wetlands Protection Act, and the Rhode Island Freshwater Wetlands Act (as summarized below).

Table 3.5.8-2. Definitions of impact levels for wetlands

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on wetlands would be so small as to be unmeasurable, and impacts would not result in a detectable change in wetland quality and function.
Minor	Adverse	Impacts on wetlands would be minimized; and would be relatively small and localized. If impacts occur, wetland functions and values would completely recover.
Moderate	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be unavoidable. Compensatory mitigation would be required to offset impacts on wetland functions and values, and mitigation measures would have a high probability of success.
Major	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be regionally detectable. Extensive compensatory mitigation would be required to offset impacts on wetland functions and values, and mitigation measures would have a marginal or unknown probability of success.

Under CWA Section 404, USACE considers fill impacts that permanently convert a wetland to an upland as a permanent impact. Conversion of a wetland type may also be considered a permanent impact. Temporary impacts occur when fill is placed in wetlands but the wetlands are restored to preconstruction contours when construction activities are complete (e.g., stockpile, temporary access).

Under Massachusetts General Laws Chapter 131, Section 40 (Wetlands Protection Act) no one may "remove, fill, dredge, or alter" any wetland, floodplain, bank, land under a water body, land within 100 feet (31 meters) of a wetland, or land within 200 feet (61 meters) of a perennial stream or river (25 feet [8 meters]of a few urban rivers), without a permit (known as an Order of Conditions) from the local conservation commission that protects the wetland "interests" identified in the Wetlands Protection Act. The "interests" or values protected by the Wetlands Protection Act are flood control; prevention of storm damage; prevention of pollution; and protection of fisheries, shellfish, groundwater, public or private water supply, and wildlife habitat. The term "alter" is defined to include any destruction of vegetation, or change in drainage characteristics or water flow patterns, or any change in the water table or water quality. The wetland regulations prohibit most destruction of wetlands and naturally vegetated riverfront areas, and require replacement of flood storage loss when floodplains are filled (MACC 2022).

Rhode Island Code of Regulations 250-RICR-150-15-1 define "alter" and "alteration" as the "act of changing the character of a freshwater wetland as a result of activities within or outside of the wetland. Such activities include but are not limited to the following: excavating; draining; filling; placing trash, garbage, sewage, road runoff, drainage ditch effluent, earth, rock, borrow, gravel, sand, clay, peat, or other materials or effluents upon; diverting water flows into or out of; diking; damming; diverting; clearing; grading; constructing in; adding to or taking from; or other activities that individually or cumulatively change the character of any freshwater wetland“ (Rhode Island Department of State 2022).

3.5.8.3 Impacts of Alternative A – No Action on Wetlands

When analyzing the impacts of the No Action Alternative on wetlands, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for wetlands. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for wetlands described in Section 3.5.8.1, *Description of the Affected Environment and Future Baseline Conditions* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that may contribute to impacts on wetlands are generally associated with onshore development activities and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect wetlands through activities that can have permanent (e.g., fill placement) and short-term (vegetation removal) impacts on wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss. Climate change induced sea level rise in the geographic analysis area is also anticipated to continue to affect wetlands. Inundation and rising water levels would result in the conversion of vegetated areas into areas of open water, with a consequent loss of wetland functions associated with the loss of vegetated wetlands. Wetlands have very specific water elevation tolerances, and if water is not deep enough it is no longer a wetland. Slowly rising waters on a gentle, continuously rising surface can result in wetlands migrating landward. In areas where slopes are not gradual or where there are other features blocking flow (e.g., bulkhead or surrounding developed landscape), wetland migration would be slowed or impeded. Rising coastal waters would also continue to cause saltwater intrusion, which occurs when saltwater starts to move further inland and creeps into freshwater/non-tidal areas. Saltwater intrusion would continue to change wetland plant communities and habitat (i.e., freshwater species to saltwater species), and overall wetland functions.

Ongoing construction of the Vineyard Wind 1 project (OCS-A 0501) would install cable landfalls and associated onshore equipment in Barnstable, Massachusetts, in the geographic analysis area, contributing to impacts on wetlands associated with the primary IPFs of accidental releases and land disturbance. Impacts of ongoing construction of Vineyard Wind 1 would have the same type of impacts on wetlands that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect wetlands would primarily include increasing onshore construction (Appendix D). These activities may permanently (e.g., fill placement) and temporarily (e.g., vegetation removal) affect wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss.

Impacts on wetlands from other offshore wind projects may occur if onshore and nearshore activity from these projects overlaps with the geographic analysis area. In addition to ongoing construction of the Vineyard Wind 1 project, BOEM is aware of one planned project with cable landings and onshore components in the geographic analysis area: New England Wind. Similar to Vineyard Wind 1, New England Wind would also install cable landfalls in Barnstable, Massachusetts, which is within the Wequaquet Lake watershed (HUC 010900020206) of the geographic analysis area.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on wetlands during construction, O&M, and decommissioning of the projects. BOEM expects offshore wind activities to affect wetlands through the following IPFs.

Accidental releases: During onshore construction of offshore wind projects in the geographic analysis area, oil leaks and accidental spills from construction equipment are potential sources of wetland water contamination. While many wetlands act to filter out contaminants, any significant increase in contaminant loading could exceed the capacity of a wetland to perform its normal water quality functions. Although degradation of water quality in wetlands could occur during construction, decommissioning, and to a lesser extent O&M, due to the small volumes of spilled material anticipated, these impacts would all be short term, until the source of the contamination is removed. Compliance with applicable state and federal regulations related to oil spills and waste handling would minimize potential impacts from accidental releases, including the Resource Conservation and Recovery Act, Department of Transportation Hazardous Material regulations, and implementation of a Spill Prevention, Control, and Countermeasure Plan. Impacts from accidental releases on wetlands would be minor because accidental releases would be small and localized and compliance with state and federal regulations would avoid or minimize potential impacts to wetland quality or functions.

Land disturbance: Construction of onshore components in the geographic analysis area is anticipated to require clearing, excavating, trenching, fill, and grading, which could result in the loss or alteration of wetlands, causing adverse effects on wetland habitat, water quality, and flood and storage capacity functions. Fill material permanently placed in wetlands during construction would result in the permanent loss of wetlands, including any habitat, flood and storage capacity, and water quality functions that the wetlands may provide. If a wetland were partially filled and fragmented or if wetland vegetation were trimmed, cleared, or converted to a different vegetation type (e.g., forest to herbaceous), habitat would be altered and degraded (affecting wildlife use), and water quality and flood and storage capacity functions would be reduced by changing natural hydrologic flows and reducing the wetland's ability to impede and retain stormwater and floodwater.

On a watershed level, any permanent wetland loss or alteration could reduce the capacity of regional wetlands to provide wetland functions. Short-term wetland impacts may occur from construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands, as well as alter wetland functions if sediment loads are high (e.g., habitat impacts from burying vegetation). The extent of wetland impacts would depend on specific construction activities and their proximity to wetlands. These impacts would occur primarily during construction and decommissioning; impacts during O&M would only occur if new ground disturbance was required, such as to repair a buried component.

BOEM anticipates that onshore project components from other offshore wind projects would likely be sited in disturbed areas (e.g., along existing roadways), which would avoid and minimize wetland impacts. In addition, BOEM expects the offshore wind projects would be designed to avoid wetlands to the extent feasible. Offshore wind projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. This would include compliance with the Massachusetts and Rhode Island National Pollutant Discharge Elimination System permits for stormwater discharges associated with construction activities and implementation of sediment controls and a Stormwater Pollution Prevention Plan to avoid and minimize water quality impacts during onshore construction. Any in-wetland work would require a CWA Section 404 permit from USACE, Section 401 Water Quality Certification from RIDEM or MassDEP, and additional RIDEM or MassDEP wetland permits if applicable. Work within 100 feet of wetlands in Massachusetts may also require MassDEP wetland permits pursuant to Massachusetts General Laws Chapter 131, Section 40 (Wetlands Protection Act). If impacts would not be avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands. Overall, impacts from land disturbance on wetlands are anticipated to be moderate.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, wetlands would continue to follow current regional trends and respond to IPFs introduced by ongoing activities. Land disturbance from onshore construction periodically would cause short-term and permanent loss of wetlands. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands. BOEM anticipates that the No Action Alternative would result in **moderate** impacts on wetlands.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and wetlands would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to wetland impacts from the same IPFs. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands, thereby avoiding or minimizing impacts. If impacts would not be entirely avoided, compensatory mitigation would be anticipated for projects that result in permanent impacts. Therefore, BOEM anticipates the cumulative impacts of the No Action Alternative would be **moderate**. Offshore wind activities are expected to contribute to the impacts through land disturbance and accidental releases, although the majority of these IPFs would be attributable to non-offshore wind ongoing activities.

3.5.8.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in similar or lesser impacts than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on wetlands:

- The sea-to-shore transition and landfall site variants in the Onshore Project area.
- Onshore export cable route and onshore substation site variants in the Onshore Project area.

An onshore export cable route with less wetlands in or adjacent to the right-of-way would have less potential for direct and indirect impacts on wetlands.

Mayflower Wind has committed to measures to minimize impacts on wetland resources. Mayflower Wind would implement BMPs to avoid, control, and address accidental releases and place construction mats to minimize soil disturbance in any wetland areas that cannot be avoided or are required to be temporarily crossed (COP Volume 2, Section 16; Mayflower Wind 2022).

3.5.8.5 Impacts of Alternative B – Proposed Action on Wetlands

The Proposed Action could affect wetlands through the following IPFs.

Accidental releases: Onshore construction activities would require heavy equipment use and horizontal directional drilling (HDD) activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Mayflower Wind would develop and implement a Project-specific SPCC plan to minimize impacts on water quality (prepared in accordance with applicable regulations such as the Massachusetts Oil and Hazardous Material Release Prevention Act and the Rhode Island Oil Pollution Prevention and Control Act). In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action alone would result in minor and temporary impacts on wetlands as a result of releases from heavy equipment during construction and other cable installation activities.

Land disturbance: Construction impacts on wetlands and related functions would be similar to those described in Section 3.5.8.3, *Impacts of Alternative A – No Action on Wetlands*. Much of the proposed onshore Project components have been sited in areas that are previously disturbed or undergoing active management. The underground portion of the onshore export cable routes would be largely located in existing paved public roadway. The primary wetland impacts under the Proposed Action would be excavation, rutting, compaction, mixing of topsoil and subsoil, and potential alteration due ground disturbance associated with construction activities for the proposed onshore export cable routes. Based on MassGIS wetland data and the extent of the potential ground disturbance, there would be no wetland impact for the Brayton Point onshore Project components in Massachusetts and very little impact for the Falmouth onshore Project components (Table 3.5.8-3). Small areas of deep marsh (<0.01 acre) and wooded swamp deciduous wetland (0.06 acre) have the potential to be affected from cable installation at Falmouth; impacts on the wooded swamp deciduous wetland would likely be long term, because the cable corridor would need to be maintained as low vegetation during operations. One isolated open water area is located in the Lawrence Lynch onshore substation site for Falmouth; this open water area would not be considered wetland due to lack of vegetation.

Onshore export cable installation at the intermediate landfall on Aquidneck Island in Rhode Island would result in some wetland impacts. The impacts would be short term because these wetlands are not forested and restoration would be conducted in accordance with applicable federal and state wetland permit requirements. As shown in Table 3.5.8-3 and Figure 3.5.8-2, Route Option 2a would result in the greatest amount of wetland impact (2.48 acres), followed by Route Option 2b and Route Option 3 (both 0.34 acre), with Route Option 1 having the least impact (0.15 acre). In addition, 2.1 acres of wetland impact would be avoided along Route Option 2a by using HDD, and 0.1 acre of wetland would be avoided along Route Option 1 and Route Option 3 by using HDD. Approximately 0.3 acre of wetland would be avoided along Route Option 2b by using HDD. No permanent (e.g., permanent fill) or long-term wetland impacts are anticipated on affected wetlands on Aquidneck Island. Mayflower Wind anticipates that wetland impacts would be avoided to the maximum extent practicable during the detailed design, engineering, and construction of the Project (COP Volume 2, Section 4.1.5.3; Mayflower Wind 2022).

MassDEP-regulated adjacent transition areas may also be affected by clearing and soil disturbance. Water quality in wetlands could be affected by sedimentation from nearby exposed soils. Mayflower Wind would use erosion and sedimentation controls to avoid and minimize impacts during onshore construction (COP Volume 2, Table 16-1; Mayflower Wind 2022). Dewatering also may be required during onshore construction. BMPs would be used during dewatering activities, such as temporary settling basins, filter bags, or temporary holding tanks. Dewatering activities would be short term, and water drawdown would be minimal. All earth disturbances from construction activities would be conducted in compliance with the Massachusetts and Rhode Island Pollutant Discharge Elimination System requirements for stormwater discharges associated with construction activities.

Table 3.5.8-3. Wetland impacts in the Onshore Project area – Proposed Action

Onshore Project Component	Wetland Community	Impact (Acres)	% Relative to Wetlands in GAA	Duration
Falmouth Onshore				
Onshore Export Cable Routes				
Worcester Avenue Route	N/A	0	0	N/A
Shore Street Route Eastern Option	N/A	0	0	N/A
Shore Street Route Western Option	N/A	0	0	N/A
Central Park Route	N/A	0	0	N/A
Lawrence Lynch to Cape Cod Aggregates Route	N/A	0	0	N/A
Paper Road – Thomas B Landers Road Deviation	N/A	0	0	N/A
Onshore Substation Locations				
Lawrence Lynch	N/A	0	0	N/A
Cape Cod Aggregates	N/A	0	0	N/A
Underground Transmission Route and Point of Interconnection				
Underground Transmission Route from Cape Cod Aggregates to POI	Deep Marsh	<0.01	<0.1	Short term (1–3 years)
	Wooded Swamp Deciduous	0.06	<0.1	Long term (> 5 years)
Point of Interconnection (Falmouth Switching Station)	N/A	0	0	N/A
Brayton Point Onshore				
Brayton Point Landing and Onshore Components [a]	N/A	0	0	N/A
Aquidneck Island Onshore Export Cables [b]				
Landing to Options Split (common to all route options below)	N/A	0	0	N/A
Route Option 1	Estuarine and Marine Wetland	0.15	<0.1	Short term (1–3 years)
Route Option 2a	Estuarine and Marine Wetland	2.48	<0.1	Short term (1–3 years)
Route Option 2b	Estuarine and Marine Wetland	0.34	<0.1	Short term (1–3 years)
Route Option 3	Estuarine and Marine Wetland	0.34	<0.1	Short term (1–3 years)

Source: MassGIS 2018a, 2018b, 2020; USFWS 2021.
GAA = geographic analysis area; N/A = not applicable.
Note: The disturbance area used to calculate the potential wetland impact areas from export cables is based on a 40-foot-wide corridor along the cable route, except for the cable route from Cape Cod Aggregates to POI, which is a 100-foot-wide corridor.
[a] Includes the Brayton Point Onshore landfall locations, underground transmission lines, and converter station construction areas.
[b] Mayflower Wind could use one of the three route options, with the Landing to Options Split segment common to all three. In addition, any wetland area along the cable corridor after the cable enters the HDD site is not considered an impact because the cable would be installed underneath any wetlands that may be along the cable corridor.

Figure 3.5.8-2. Wetlands along the Aquidneck Island onshore export cable routes

Any work in regulated wetlands would require a CWA Section 404 permit from USACE, permits from MassDEP and/or RIDEM, and a Section 401 Water Quality Certification from MassDEP or RIDEM. Per CWA Section 404, Mayflower Wind is required to take all appropriate and practicable steps to first avoid and minimize impacts on jurisdictional wetlands, and for those impacts that are unavoidable, provide compensatory mitigation to replace the loss of wetlands and associated functions. If necessary, Mayflower Wind would identify compensatory mitigation based on the requirements of USACE and MassDEP or RIDEM. Mayflower Wind would comply with all requirements of any issued permits. Because most wetlands would be avoided, and the wetland impacts that could occur are likely to be further avoided based on the width of the corridor used for the preliminary analysis in this EIS, BOEM anticipates wetland impacts would be mostly short term, localized, and small, and would not require any permanent fill or likely would not require compensatory mitigation. Therefore, potential adverse impacts on wetlands from construction activities are anticipated to be minor.

BOEM would not expect normal O&M activities to involve further wetland alteration. The onshore cable route and associated facilities generally have no maintenance needs unless a fault or failure occurs; therefore, O&M is not expected to affect wetlands. In the event of a fault or failure, impacts would be expected to be short term and negligible. Decommissioning of the onshore Project components would have similar impacts as construction.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, and other offshore wind activities. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on wetlands through the primary IPF of land disturbance and accidental releases. Temporary disturbance and permanent loss of wetland may occur as a result of offshore wind development. Impacts would likely be short term and minor due to the low risk and localized nature of the most likely spills, the use of an Oil Spill Response Plan for projects, and regulatory requirements for the protection of wetlands. If wetland alteration or loss is anticipated, it would likely be minimal, the overall scale of impacts is expected to be small, and any activities that would result from these impacts would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding and minimizing impacts.

In the context of reasonably foreseeable environmental trends, the impacts on wetlands under the Proposed Action may add to the impacts of ongoing and planned land disturbance. Impacts due to onshore land use changes are expected to include a gradually increasing amount of wetland alteration and loss. The future extent of land disturbance from ongoing and planned non-offshore wind activities over the next 35 years is not known with as much certainty as the extent of land disturbance that would be caused by the Proposed Action, but based on regional trends is anticipated to be similar to or greater than that of the Proposed Action. If other future projects were to overlap the geographic analysis area or even be co-located (partly or completely) within the same ROW corridor that the Proposed Action would use, then the impacts of those future projects on wetlands would be of the same type as those of the Proposed Action alone; the degree of impacts may increase, although the location and timing of future activities would influence this. For example, repeated construction in a single ROW corridor would be expected to have less impact on wetlands than construction in an equivalent area of undisturbed wetland. All earth disturbances from construction activities would be conducted in compliance with the state Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Construction Activities and implementation of sediment controls and an SWPPP to avoid and minimize water quality impacts during onshore construction. Any work in wetlands would require a CWA Section 404 permit from USACE and a Section 401 Water Quality Certification; any wetlands permanently lost would require compensatory mitigation.

Conclusions

Impacts of the Proposed Action: The Proposed Action may affect wetlands through short-term disturbance from cable installation activities in or adjacent to these resources. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), and that no permanent or long-term impacts on wetlands are anticipated, construction of the Proposed Action would likely have **minor** impacts on wetlands.

Cumulative Impacts of the Proposed Action: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with the impacts on wetlands from ongoing and planned activities including offshore wind would likely be **moderate**. The Proposed Action would contribute to the cumulative impact rating primarily through short-term impacts on wetlands from onshore construction activities. Measurable impacts would be relatively small, and the resource would likely recover completely when the affecting agent (e.g., temporary construction activity) is gone and remedial or mitigating action is taken.

3.5.8.6 Impacts of Alternative C on Wetlands

Impacts of Alternative C: Under Alternative C, the export cable route to Brayton Point would be rerouted onshore to avoid sensitive fish habitat in the Sakonnet River. The onshore export cable route would be installed largely within existing road ROWs, increasing the total length of the onshore cable route by 9 miles (14 kilometers) under Alternative C-1, and by 13 miles (21 kilometers) under Alternative C-2. The types of impacts under Alternative C-1 and Alternative C-2 would be similar to those described for the Proposed Action, but slightly greater due to the larger area of land disturbance. Alternative C-1 east variant and C-1 west variant could each result in an additional 1 acre of wetland impact compared to the Proposed Action. Alternative C-2, which does not go through Aquidneck Island, would potentially result in 0.24 acre of wetland impact, which would be slightly less than the Proposed Action for Route Option 2a, Route Option 2b, and Route Option 3, but a slightly greater wetland impact than the Proposed Action for Route Option 1 (Table 3.5.8-3). These impact estimates are based on wetland mapping within the onshore export cable corridor (using a 40-foot-wide corridor) and includes some small area (<0.1 acre total) of forested/shrub wetland impacts along Alternative C-1 west variant and Alternative C-2, which would be considered a long-term impact if the wetlands needed to be cleared. This is a small difference compared to the Proposed Action, because the Proposed Action would not affect any wooded wetlands on Aquidneck Island. Wetland impacts from land disturbance and maintenance would still remain limited, impacts would primarily occur in existing ROWs, mitigation measures would be implemented, and compliance with federal and state regulations (e.g., CWA Section 404) for protection of wetlands would be required. Trenchless crossing methods (e.g., HDD) may also be used that would further avoid impacts at stream or wetland crossings.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative C: Alternative C-1 and Alternative C-2 would have the same **minor** short-term impacts on wetlands as the Proposed Action, although there could be a very small area of wooded wetland that could be permanently cleared if not avoided. The overall impacts on wetlands would not be materially different because land disturbance would remain limited, and implementation of mitigation measures and regulatory compliance would minimize impacts related to onshore ground disturbance.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative C would be the same as the Proposed Action, resulting in **moderate** impacts on wetlands.

3.5.8.7 Impacts of Alternatives D, E, and F on Wetlands

Impacts of Alternatives D, E, and F: The impacts of Alternatives D, E, and F on wetlands would be the same as the Proposed Action, because these alternatives differ only with respect to offshore components, and offshore components of the proposed Project have no potential impacts on wetlands.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives D, E, and F would be the same as described under the Proposed Action.

Conclusions

Impacts of Alternatives D, E, and F: The expected short-term **minor** impacts associated with the Proposed Action alone would not change under Alternatives D, E, and F because the alternatives only differ in offshore components, and offshore components would not contribute to impacts on wetlands.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternatives D, E, and F would be the same as the Proposed Action and result in **moderate** impacts on wetlands.

3.5.8.1 Proposed Mitigation Measures

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

3.6 Socioeconomic Conditions and Cultural Resources

3.6.1 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial fisheries and for-hire recreational fishing from the proposed Project, alternatives, and ongoing and planned activities in the commercial fisheries and for-hire recreational fishing geographic analysis area. The commercial fisheries and for-hire recreational fishing geographic analysis area, as shown in Figure 3.6.1-1, spans more than 200 million acres and includes waters within the Greater Atlantic Region, managed by the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council (MAFMC) for federal fisheries in the U.S. Exclusive Economic Zone (from 3 to 200 nautical miles [5.6 to 370.4 kilometers] from the coastline, plus the state waters within the Greater Atlantic Region—out to 3 nautical miles [5.6 kilometers]—from the coastline) from Maine to North Carolina. The boundaries for the geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and U.S. Exclusive Economic Zone waters surrounding the proposed Project.

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

3.6.1.1 Description of the Affected Environment and Future Baseline Conditions

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

Commercial Fisheries

The primary source for regional fisheries data (Mid-Atlantic and New England regions) was Vessel Trip Report (VTR) data provided by NMFS (2021a). The summary VTR data included catch estimates by fishing location combined with NMFS estimates of revenue using ex-vessel price data drawn from commercial fisheries data dealer reports. The primary source of fisheries data in the Lease Area was NMFS's Socioeconomic Impacts of Atlantic Offshore Wind Development website (NMFS 2022b,c,d,e,f) which summarizes commercial fisheries data for each proposed wind lease area along the U.S. Atlantic coast. In addition, figures developed by BOEM based on NMFS Vessel Monitoring System (VMS) data provided by NMFS (2019) are included and provide additional information about fishing activities in the Lease Area.

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

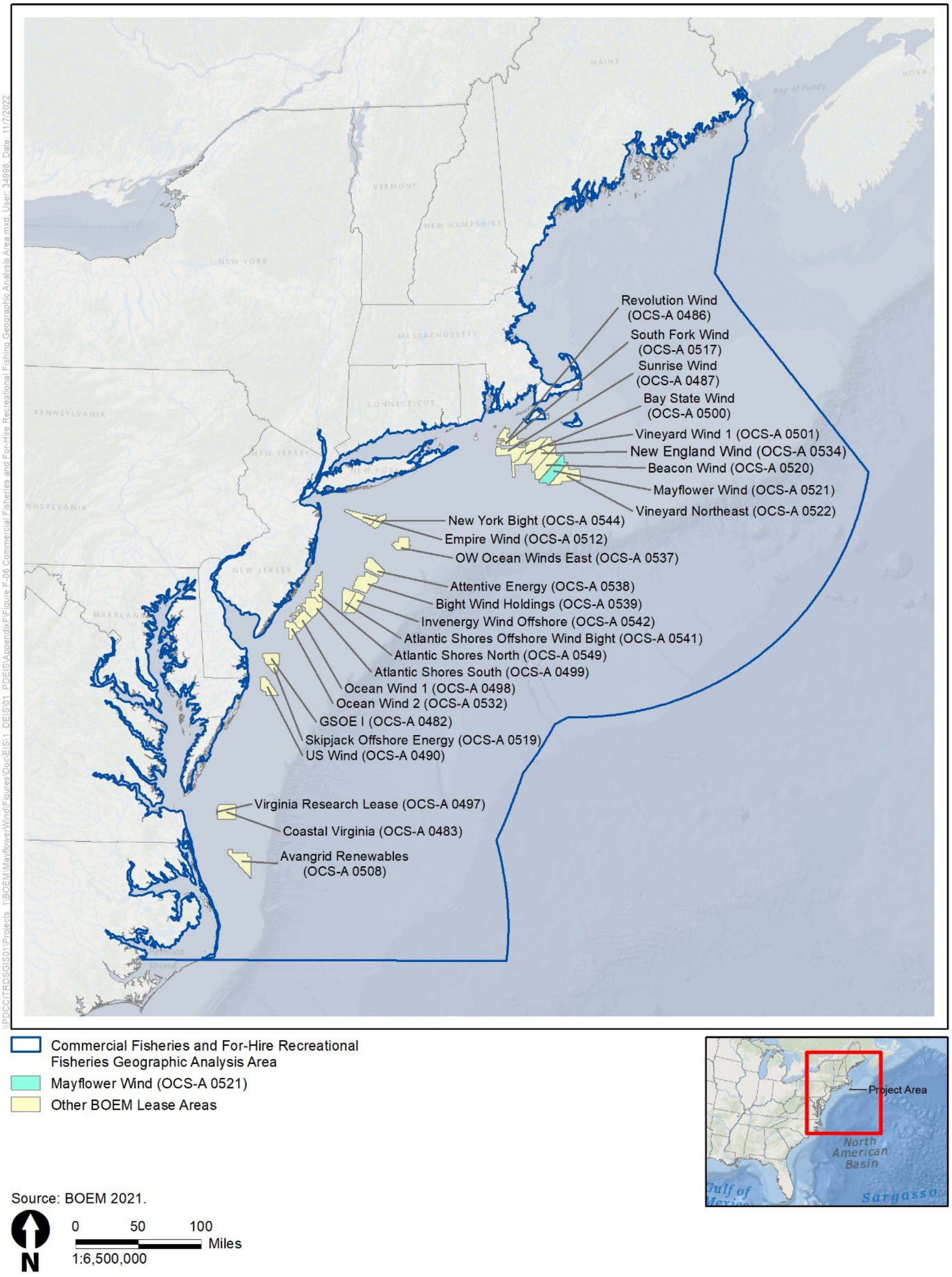


Figure 3.6.1-1. Commercial fisheries and for-hire recreational fishing geographic analysis area

Within Massachusetts and Rhode Island state waters of the Offshore Project area, commercial and recreational fisheries are further managed by state regulatory agencies under various ocean management plans developed at the state level or at the regional level (NEFMC) and by the ASMFC, a deliberative body of the Atlantic coastal states that coordinates the conservation and management of 27 nearshore, migratory fish species. Each coastal state has its own structure of agencies and plans that govern fisheries resources. In Massachusetts and Rhode Island, the Massachusetts Division of Marine Fisheries and the Rhode Island Department of Environmental Management administers all laws relating to marine fisheries and are responsible for the development and enforcement of state and federal regulations pertaining to marine fish and fisheries in their respective state waters, including the management of diadromous species (e.g., American eel, striped bass, river herring, sturgeon).

Regional Setting

Commercial fisheries operating in federal waters off the Mid-Atlantic and New England regions are known for large catches of a variety of species, including Atlantic herring (*Clupea harengus*), clams (Atlantic surfclam [*Spisula solidissima*] and ocean quahog [*Arctica islandica*]), squid (*Decapodiformes*), Atlantic sea scallops (*Placopecten magellanicus*), skates (Rajidae), summer flounder (*Paralichthys dentatus*), groundfish, monkfish (*Lophius americanus*), American lobster (*Homarus americanus*), and Jonah crab (*Cancer borealis*). These fishery resources are harvested with a broad assortment of fishing gear, specifically mobile gear (e.g., bottom trawl, dredge, midwater trawl) and fixed gear (e.g., gillnet, pot, bottom longline, seine, hand line). The fishery resources are managed under several FMPs: the Northeast Multispecies (large-mesh and small-mesh) FMP, Sea Scallop FMP, Monkfish FMP, Atlantic Herring FMP, Skate FMP, and Red Crab FMP under NEFMC (NEFMC 2021); the Summer Flounder/Scup/Black Sea Bass FMP, Spiny Dogfish FMP, Mackerel/Squid/Butterfish FMP, Bluefish FMP, Surfclam/Ocean Quahog FMP, and Golden and Blueline Tilefish FMP under MAFMC (MAFMC 2021); the Highly Migratory Species FMP under NMFS (NMFS 2021e); and the Shad and River Herring FMP, Lobster FMP, and Jonah Crab FMP under the ASMFC (ASMFC 2021). These FMP fisheries are referred to throughout this section; therefore, the author-date citations are provided only here. Commercial fisheries species managed in state waters include the American eel (*Anguilla rostrata*), Atlantic croaker (*Micropogonias undulatus*), Atlantic menhaden (*Brevoortia tyrannus*), American shad (*Alosa sapidissima*) and river herring (Alosa), red drum (*Sciaenops ocellatus*), horseshoe crab (*Limulus polyphemus*), northern shrimp (*Pandalus borealis*), striped bass (*Morone saxatillis*), bluefish (*Pomatomus saltatrix*), tautog (*Tautoga onitis)*, and weakfish (*Cynoscion regalis*) among others (ASMFC 2021). The American lobster, as well as Jonah crab, is managed under the authority of the Atlantic Coastal Fisheries Cooperative Management Act and is cooperatively managed by the states under the framework of ASMFC and NMFS in federal waters. There are also smaller fisheries that are not managed under FMPs with importance in the region.

Economic Value and Landings

The predominant commercial fish and shellfish species in the geographic analysis area based on ex-vessel revenue and landed weight are summarized by species for the years 2010 through 2019 in Table 3.6.1-1 and Table 3.6.1-2, respectively. During this period, the species with the highest average annual landed weight included Atlantic menhaden, which represented 34 percent of the average landed weight, American lobster, Atlantic herring, blue crab, sea scallop, and surf clam. The most valuable species over this period were sea scallop and American lobster, which together represented 58 percent of the average annual ex-vessel revenue. Other valuable species harvested in state and federal waters included Atlantic herring, Atlantic menhaden, Atlantic surf clam, longfin and northern shortfin squid, summer flounder, and monkfish. Commercial fisheries provide economic benefits to the coastal communities of New England and the Mid-Atlantic region by contributing to the income of vessel crews and owners and by creating demand for dockside services to process seafood products and maintain vessels. On average, commercial fishing activity in New England and the Mid-Atlantic generated approximately $1.2 billion in annual ex-vessel revenue from 2010 through 2019. Table 3.6.1-3 depicts the average annual revenue of commercial fisheries in the geographic analysis area by gear type for the 2008–2019 period. The most valuable gear type was scallop dredges, which generated $489.4 million in annual revenue, followed by bottom trawls ($187.2 million), pot-other gear ($115.1 million), and clam dredges ($61.3 million). Table 3.6.1-4 shows the average annual revenue by port of landing from 2010 through 2019 for ports in the geographic analysis area. Landings in New Bedford, Massachusetts represented approximately 33 percent of the average annual commercial fishing revenue in the geographic analysis area. The ports with the next highest revenues—Cape May, New Jersey and the Hampton Roads area, Virginia—represented 6 percent and 5 percent, respectively.

The current trends for fisheries in the New England region are driven by the reliance on fewer species. The lowest species diversity to date occurred in 2020 (NEFSC 2022a). A decline in revenue for a number of species including monkfish, lobster, and scallops and price declines for monkfish, lobster, scallops and groundfish (NEFSC 2022a) was also observed in 2020 as compared to 2015–2019. Over the past 30 years, total landings coming from the New England region have been on a downward trend. Commercial fleet diversity indicates a shift toward a reliance on American lobster in the Gulf of Maine and scallops on Georges Bank. These two species are the primary drivers behind the current profits realized by the commercial fishing industry (NEFSC 2022a). Conversely, recreational fish species diversity is increasing due to increases in southerly species and lower catch limits on traditional regional species. In the Mid-Atlantic, revenue was down across many federally managed species due to a mix of lower prices for summer flounder, scup, black sea bass, squids, and monkfish and landings from surfclam, ocean quahogs, and monkfish. The Mid-Atlantic has been subject to frequent and intense marine heatwaves over the past decade and the observed cold pool is becoming warmer, smaller, and shorter in duration, which has affected the habitat for federally managed species (NEFSC 2022b). Similar to the New England region, commercial fishing revenue is on a downward trend, and recreational fishing effort is increasing, although recreational fleet diversity is decreasing (NEFSC 2022b).

Table 3.6.1-1 Commercial fishing revenue of the top 20 most valuable species in the Geographic Analysis Area (2010–2019)

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

Source: NMFS 2021f.

[a] Species are sorted by average annual revenue in descending order

[b] Farmed

[c] Includes 250 species and taxonomic groups (e.g., drums, skates) for which there were recorded landings.

Table 3.6.1-2. Commercial fishing landings of the top 20 species by landed weight (pounds) in the Geographic Analysis Area (2010–2019)

Species	FMP Fishery	Peak Annual Landings (millions of pounds)	Average Annual Landings (millions of pounds)	Percentage of Landings in Geographic Analysis Area
Atlantic menhaden	Atlantic Menhaden	504.8	430.3	33.6%
Atlantic herring	Atlantic Herring	206.1	146.5	11.4%
American lobster	American Lobster	159.4	141.1	11.0%
Blue crab	No federal FMP	119.3	74.1	5.8%
Sea scallop	Sea Scallop	60.5	49.3	3.8%
Atlantic surf clam	Surfclam/Ocean Quahog	44.6	38.0	3.0%
Skates	Skate	40.1	33.3	2.6%
Illex squid	Mackerel/Squid/Butterfish	58.2	27.7	2.2%
Loligo squid	Mackerel/Squid/Butterfish	40.1	25.3	2.0%
Monkfish	Monkfish	23.9	20.3	1.6%
Spiny dogfish	Spiny Dogfish	24.1	16.7	1.3%
Jonah crab	Jonah Crab	20.1	15.1	1.2%
Scup	Summer Flounder/Scup/Black Sea Bass	17.8	14.7	1.1%
Silver hake	Northeast Multispecies (small-mesh)	17.8	14.4	1.1%
Ocean quahog	Surfclam/Ocean Quahog	29.6	13.8	1.1%
Atlantic mackerel	Mackerel/Squid/Butterfish	21.7	12.7	1.0%
Haddock	Northeast Multispecies (large-mesh)	21.6	12.1	0.9%
Pollock	Northeast Multispecies (large-mesh)	15.9	9.7	0.8%
Acadian redfish	Northeast Multispecies (large-mesh)	11.7	8.7	0.7%
Summer flounder	Summer Flounder/Scup/Black Sea Bass	13.0	8.3	0.6%
All FMP species		**724.7**	**645.3**	**50.3%**
All species		**1,454.1**	**1,281.8**	**--**

Source: NMFS 2021f.
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

Table 3.6.1-3 shows the average annual revenue by gear type for the 2008–2019 period. Scallop dredge gear accounted for 51 percent ($489.4 million) of the revenue generated by all gear in the Mid-Atlantic and New England regions, while bottom trawl gear and pot-other gear (including pot gear used in the Lobster FMP fishery) each generated over $115 million in average annual revenue. Dredge-clam gear accounted for approximately 6 percent ($61.3 million) of the total average annual revenue generated.

Table 3.6.1-3. Commercial fishing revenue by gear type in the Geographic Analysis Area (2010–2019)

Gear Type [a]	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)	Percentage of Revenue in Geographic Area
Dredge-scallop	$615.2	$489.4	51.3%
Trawl-bottom	$229.2	$187.2	19.6%
Pot-other	$146.2	$115.1	12.1%

Gear Type [a]	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)	Percentage of Revenue in Geographic Area
Dredge-clam	$65.8	$61.3	6.4%
Gillnet-sink	$44.6	$30.0	3.1%
Trawl-midwater	$26.6	$19.0	2.0%
Handline	$6.2	$4.8	0.5%
All other gear [b]	$62.4	$47.3	5.0%
All gear types	**$1,135.2**	**$954.1**	--

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

Commercial fishing fleets are important to coastal communities in the Mid-Atlantic and New England regions. These fleets not only generate direct employment and income for vessel owners and crew, but also contribute indirectly to the employment and revenue generated through products and services necessary to maintain and operate fishing vessels, seafood processors, wholesalers/distributors, and retailers. In 2019, total species landings in the Mid-Atlantic and New England regions were valued at $2.02 billion, including landings from non-federally permitted vessels. The Mid-Atlantic region contributed $498 million and the New England region $1.52 billion to the total landings (NMFS 2021f). The region is also home to aquaculture production and research that provides employment and business opportunities for coastal communities. The seafood industry generated $3.8 billion in personal and proprietor income in the Mid-Atlantic region and $5.6 billion in New England (NOAA 2019). Table 3.6.1-4 shows the average annual revenue by port of landing in the Mid-Atlantic and New England regions for the period from 2008 through 2019. This data includes revenue only from those vessels issued federal fishing permits by the NMFS Greater Atlantic Region, and therefore does not include all sources of commercial fishing revenue. New Bedford, Massachusetts had the highest revenue of the regional landings, accounting for approximately 40 percent of the total commercial fishing revenue in the Mid-Atlantic and New England regions. Cape May, New Jersey comparatively accounted for approximately 9 percent of the total average annual revenue.

Table 3.6.1-4. Commercial fishing landings and revenue for the Top 30 highest revenue ports in the Geographic Analysis Area (2010–2019)

Port and State [a]	Peak Annual Landings (millions of pounds)	Average Annual Landings (millions of pounds)	Peak Annual Revenue (millions dollars)	Average Annual Revenue (millions dollars)	Percentage of Revenue in Geographic Analysis Area
New Bedford, Massachusetts	143.0	123.3	$450.8	$371.4	32.1%
Cape May, New Jersey	101.6	60.2	$102.7	$74.3	6.4%
Hampton Roads Area, Virginia	18.3	15.1	$88.3	$61.9	5.4%
Stonington, Maine	25.4	19.2	$68.0	$54.7	4.7%
Gloucester, Massachusetts	88.8	67.6	$60.7	$52.2	4.5%

Port and State [a]	Peak Annual Landings (millions of pounds)	Average Annual Landings (millions of pounds)	Peak Annual Revenue (millions dollars)	Average Annual Revenue (millions dollars)	Percentage of Revenue in Geographic Analysis Area
Point Judith, Rhode Island	57.3	47.4	$65.9	$50.1	4.3%
Vinalhaven, Maine	13.4	10.1	$42.3	$34.3	3.0%
Reedville, Virginia	426.1	357.9	$36.9	$33.5	2.9%
Portland, Maine	62.4	50.3	$38.1	$30.8	2.7%
Provincetown-Chatham, Massachusetts	26.5	19.6	$34.8	$29.7	2.6%
Point Pleasant, New Jersey	43.3	26.4	$35.4	$29.0	2.5%
Barnegat Light, New Jersey	8.9	7.5	$34.1	$27.0	2.3%
Wanchese-Stumpy Point, North Carolina	25.6	18.9	$26.6	$22.6	2.0%
Beals Island, Maine	8.1	6.6	$23.5	$19.9	1.7%
Friendship, Maine	9.1	5.9	$24.6	$19.9	1.7%
Atlantic City, New Jersey	29.9	25.5	$22.1	$19.3	1.7%
Newington, New Hampshire	4.7	4.1	$26.6	$19.3	1.7%
Montauk, New York	14.8	12.2	$21.2	$17.4	1.5%
Boston, Massachusetts	20.2	15.4	$19.3	S17.0	1.5%
Fairhaven, Massachusetts	7.5	5.3	$25.2	%16.7	1.4%
All New England/Mid-Atlantic Ports [b]	1,037.7	1,025.1	$1,384.1	$1,156.5	--

Source: NMFS 2021f

[a] Gear types are sorted by revenue in descending order.

[b] Includes revenue from federally permitted vessels using longline gear, sein gear, other gillnet gear, and unspecified gear.

Commercial Fisheries in the Regional Fisheries Area

The Regional Fisheries Area (RFA) for the Offshore Project area includes Greater Atlantic Region Statistical Areas 537, 538, 539, 611 and 612. The RFA provides a condensed region, relative to the geographic analysis area, to better analyze impacts at a more relevant scale for the fisheries that operate in the Offshore Project area. For instance, much of the American lobster landings and revenue in the geographic analysis area occur in the inshore waters of the Gulf of Maine, followed by the offshore waters of Georges Bank. American lobsters landed in southern New England waters, where the RFA is located, primarily occur inshore and account for much less of the total landings and revenue compared to the Gulf of Maine. Further, the Gulf of Maine and Georges Bank stock of American lobster is at record high abundance, and the southern New England stock of American lobster is at record low abundance (NOAA 2022a).

Table 3.6.1-5 shows the average annual revenue in the RFA by FMP fishery from 2008 through 2019. On average, federally permitted commercial fishing activity in the RFA annually generated $143.9 million in revenue, with the Sea Scallop FMP fisheries accounting for 35 percent of the total; the Mackerel, Squid, and Butterfish FMP fishery accounting for 11 percent; and the Summer Flounder, Scup, Black Sea Bass FMP, "Other FMPs, non-disclosed species, and non-FMP fisheries" accounting for 23 percent of the average annual revenue for all FMP and non-FMP Fisheries. Table 3.6.1-5 also shows the percentage of each FMP fishery's total revenue in the Mid-Atlantic and New England regions that came from the RFA from 2008 through 2019. The RFA accounted for a large share of the total revenue of the Jonah crab FMP fishery (61 percent), Skate FMP fishery (48 percent), Bluefish FMP fishery (46 percent), and Monkfish FMP fishery (36 percent). Across all FMP and non-FMP fisheries, the RFA accounted for approximately 15 percent of the total revenue in the geographic analysis area.

Table 3.6.1-5. Commercial fishing revenue of federally permitted vessels in the RFA by fishery management plan (2008-2019)

FMP Fishery	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)	Average Annual Revenue as a Percentage of Total Revenue in the geographic analysis area
American lobster	$11,498.0	$7,799.0	8.4%
Atlantic herring	$6,853.8	$2,994.1	11.5%
Bluefish	$816.3	$582.6	45.7%
Highly migratory species	$315.5	$219.7	9.9%
Jonah crab	$11,244.6	$5,871.9	61.1%
Mackerel, squid, and butterfish	$29,544.7	$15,424.7	29.7%
Monkfish	$11,610.7	$7,520.2	36.5%
Northeast multispecies (large-mesh)	$4,616.6	$2,389.4	3.3%
Northeast multispecies (small-mesh)	$3,928.6	$2,823.6	25.1%
Sea scallop	$107,023.3	$49,741.2	9.6%
Skates	$5,671.1	$3,579.6	48.1%
Spiny dogfish	$546.8	$244.0	8.2%
Summer flounder, scup, black sea bass	$14,327.2	$10,999.8	27.6%
Other FMPs, non-disclosed species, and non-FMP fisheries [a]	$42,517.3	$33,757.3	35.9%
All FMP and non-FMP fisheries	$213,098.9	$143,947.2	15.1%

Source: Developed using NMFS 2021g, 2022a.

Notes: Revenue is adjusted for inflation to 2019 dollars. Peak annual revenue is calculated independently for all rows including the total row.

[a] Other FMPs, non-disclosed species, and non-FMP fisheries includes revenue from three FMP fisheries: surfclam/ocean quahog, red crab, and river herring. In addition, it includes revenue from species in FMP fisheries for which data could not be disclosed due to confidentiality restrictions, and revenue earned by federally permitted vessels operating in fisheries that are not federally managed.

Table 3.6.1-6 shows the average annual landings by individual species from 2008 through 2019. The top three species were Atlantic herring, skates, and Loligo squid accounting for 27 percent, 16 percent, and 12 percent of the total landings, respectively. Table 3.6.1-6 also shows the percentage of each species' total landings in the Mid-Atlantic and New England regions that came from the RFA from 2008 through

2019. The RFA accounted for a large share of the total landings of rock crab (71 percent), skates (65 percent), scup (65 percent), Jonah crab (54 percent), red hake (48 percent), monkfish (44 percent), Loligo squid (41 percent), butterfish (38 percent), and summer flounder (37 percent).

Table 3.6.1-6. Commercial fishing landings of federally permitted vessels in the RFA by species (2008–2019)

Species	FMP Fishery	Peak Annual Landings (pounds)	Average Annual Landings (pounds)	Average Annual Landings as a Percentage of the Total Landings in the geographic analysis area
Atlantic herring	Atlantic herring	49,580,526	23,065,828	14.8%
Skates	Skates	15,472,505	13,964,696	65.5%
Silver hake	Northeast multispecies (small-mesh)	5,527,656	3,557,841	25.3%
Scup	Summer flounder, scup, black sea bass	9,912,424	7,105,610	65.4%
Loligo squid	Mackerel, squid, and butterfish	21,451,952	10,224,109	41.5%
Atlantic mackerel	Mackerel, squid, and butterfish	16,142,814	2,803,012	14.9%
Monkfish	Monkfish	4,975,969	4,302,449	44.2%
Spiny dogfish	Spiny dogfish	2,168,519	1,061,854	7.9%
American lobster	American lobster	1,930,635	1,334,642	6.9%
Jonah crab	Jonah crab	10,396,456	6,372,109	53.7%
Red hake	Northeast multispecies (small-mesh)	1,030,911	658,114	48.5%
Summer flounder	Summer flounder, scup, black sea bass	5,161,839	3,425,527	36.9%
Butterfish	Mackerel, squid, and butterfish	2,761,688	1,230,067	37.9%
Sea scallops	Sea scallops	11,529,926	4,685,271	9.4%
Bluefish	Bluefish	1,000,463	730,175	40.0%
Yellowtail flounder	Northeast Multispecies (large-mesh)	1,032,864	409,308	18.8%
Cod	Northeast Multispecies (large-mesh)	386,358	201,932	2.7%
Black sea bass	Summer flounder, scup, black sea bass	944,309	422,898	23.4%
Winter flounder	Northeast multispecies (large-mesh)	947,933	357,060	9.8%
Rock crab	Other FMPs, non-disclosed species and non-FMP fisheries	3,042,399	667,393	70.7%

Source: Developed using data from NMFS (2021, 2022a).
Notes: The table shows landings of the top 20 species landed (by pounds) in the RFA

Table 3.6.1-7 shows the average annual revenue in the RFA by gear type during the period from 2008 through 2019. Scallop dredge gear accounted for 34 percent of the revenue generated by all gear types, bottom trawl gear accounted for 30 percent, and clam dredge gear accounted for 14 percent. Table 3.6.1-7 also shows the percentage of each gear type's total revenue in the Mid-Atlantic and New England regions that came from the RFA from 2008 through 2019. The RFA accounted for a large share of the total revenue for clam dredge (34 percent), sink gillnet (32 percent), handline (29 percent), and bottom trawl (23 percent).

Table 3.6.1-7. Commercial fishing revenue of federally permitted vessels in the RFA by gear type (2008–2019)

Gear Type	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)	Average Annual Revenue as a Percentage of Total Revenue in the Mid-Atlantic and New England Regions
Dredge-clam [a]	$25,562.9	$20,831.9	34.0%
Dredge-scallop	$105,678.5	$48,458.7	9.9%
Gillnet-sink	$13,149.3	$9,615.9	32.0%
Handline	$1,673.2	$1,369.0	28.8%
Pot-other	$19,272.8	$16,089.3	14.0%
Trawl-bottom	$60,400.9	$43,039.0	23.0%
Trawl-midwater	$5,373.1	$2,348.8	12.4%
All other gear [b]	$4,601.1	$2,665.0	5.6%
All gear types	$213,098.9	$144,417.7	15.1%

Source: Developed using data from NMFS (2021, 2022a).

Notes: Revenue is adjusted for inflation to 2019 dollars. Peak annual revenue is calculated independently for all rows including the total row.

[a] Fewer than 12 years but more than 5 years of data were used to calculate the estimates.

[b] Includes revenue from federally permitted vessels using longline gear, seine gear, other gillnet gear, and unspecified gear, as well as listed gear for years when they were not disclosed.

Table 3.6.1-8 shows the ports at which fish and shellfish caught in the RFA from 2008 through 2019 were landed. New Bedford and Point Judith together accounted for 53 percent of the revenue generated by commercial fishing activity in the RFA. Table 3.6.1-8 also shows the percentage of each port's total revenue in the Mid-Atlantic and New England regions that came from the RFA from 2008 through 2019. The RFA accounted for a large share of the total revenue for Little Compton (97 percent), Westport (90 percent), Chilmark/Menemsha (89 percent), Montauk (64 percent), Point Judith (60 percent), and Tiverton (57 percent).

Table 3.6.1-8. Commercial fishing revenue of federally permitted vessels in the RFA by port (2008–2019)

Port and State	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)	Average Annual Revenue as a Percentage of Total Revenue in the Mid-Atlantic and New England Regions
Port Judith, RI	$37,052.6	$27,546.5	59.8%
New Bedford, MA	$90,794.6	$48,503.9	12.8%
Little Compton, RI	$2,936.8	$1,940.2	97.4%
Westport, MA	$1,562.6	$1,169.0	89.6%
Newport, RI	$5,302.2	$2,880.8	32.4%
Chilmark/Menemsha, MA	$573.4	$419.6	89.1%
Fairhaven, MA	$4,142.1	$1,439.0	12.8%
Montauk, NY	$16,563.0	$11,859.8	64.1%
Fall River, MA [a]	$649.8	$445.9	39.3%
Tiverton, RI [a]	$880.0	$651.1	56.7%
Other Ports, MA	$8,655.1	$4,875.2	4.7%
Point Pleasant, NJ	$15,019.8	$8,593.3	27.7%
Newport News, VA	$3,587.3	$1,698.9	5.5%
Beaufort, NC [a]	$2,031.2	$862.9	32.5%
Hampton, VA [a]	$3,478.3	$1,562.6	10.9%
Other New England/Mid-Atlantic ports [b]	$48,508.3	$29,943.3	10.0%
All New England/Mid-Atlantic Ports	$213,098.9	$144,391.8	15.1%

Source: Developed using data from NMFS (2021, 2022a).
Notes: Revenue is adjusted for inflation to 2019 dollars. Peak annual revenue is calculated independently for all rows, including the total row.
[a] Fewer than 12 years but more than 5 years of data were used to calculated the estimates.
[b] Includes ports with not applicable (NA) in the table and other unlisted ports that had landings from federally permitted vessels fishing in the RFA from 2008 through 2019.

In 2010, during the first stage of the public process for BOEM's call for information and nominations to establish the Rhode Island and Massachusetts Wind Energy Area, all of Cox Ledge was included in the area considered for leasing (i.e., call area). However, BOEM held a lengthy stakeholder and scientific review process that identified "high-value" fishing grounds and excluded those areas from the Rhode Island and Massachusetts Wind Energy Area (BOEM 2012; Schumann et al. 2016). From 2008 through 2019, the excluded area accounted for approximately 22 percent of the revenue generated by all fisheries in the call area. It accounted for 32 percent of the Sea Scallop FMP fishery revenue and 25 percent of the Monkfish FMP fishery revenue in the call area (NMFS 2021a). For the Sea Scallop and Monkfish FMP fisheries combined, the revenue per square mile in the excluded area was approximately 50 percent higher than that in the Rhode Island and Massachusetts Wind Energy Area in 2007 to 2018 (BOEM 2021c).

Commercial Fisheries in the Offshore Project Area

The commercial fisheries active in the Offshore Project area, inclusive of the Brayton Point and Falmouth ECCs and Lease Area encompass a wide range of FMP fisheries, gears, and landing ports, although VTR data indicate that most FMP fisheries in the Lease Area do not have a high level of fishing effort compared to surrounding areas (COP Volume 2, Section 11, Figures 11-7 to 11-13, Tables 11-10 to 11-12; Mayflower Wind 2022). Table 3.6.1-9 and Table 3.6.1-10 provide data on revenue and landings for 2008 through 2021 for commercial fisheries in the Lease Area for vessels that were issued federal fishing permits by the NMFS Greater Atlantic Region. The top FMPs by revenue in the Lease Area were the ASMFC FMP (driven by Jonah crab) (Table 3.6.1-9); Summer Flounder, Scup, Black Sea Bass; Mackerel, Squid, and Butterfish; Small-Mesh Multispecies; and Monkfish. The top FMP fisheries accounted for approximately 77 percent of total revenue generated commercially in the Lease Area from 2008 through 2021 and approximately 68 percent of all landings from affected FMPs. The Atlantic Herring FMP fishery landed over one million pounds in 2010, making it the second largest FMP fishery in pounds landed over the 14-year period; however, in other years, no pounds were landed. The Skate FMP fishery was the 6th highest in pounds landed, but the 8th highest by revenue over the 14-year period.

Table 3.6.1-9. Commercial fishing revenue of federally permitted vessels in the Lease Area by FMP (2008–2021) [a]

FMP Fishery	Average Annual Revenue (Lease Area)	Total Revenue (Lease Area)	Average Annual Expected Vessels in the Lease Area [f]	Average Annual Expected Vessel Trips in the Lease Area [f]
Top Five FMPs				
ASMFC FMP [b]	$117,500	$1,645,000	9	11
Summer flounder, scup, black sea bass	$100,929	$1,413,000	16	18
Mackerel, squid, and butterfish	$88,286	$1,236,000	14	15
Small-Mesh multispecies	$44,643	$625,000	11	12
Monkfish	$41,357	$579,000	19	25
Total Top Five FMPs	**$392,714**	**$$5,498,000**	**139**	**81**
Other Affected FMPs				
Golden and blueline tilefish	$36,643	$513,000	2	2
Sea scallop	$27,500	$385,000	1	1
Skates	$22,500	$315,000	13	19
No Federal FMP [c]	$8,000	$112,000	6	6
Atlantic herring	$8,000	$112,000	1	1
Northeast multispecies	$4,071	$57,000	2	2
Surfclam, ocean quahog	$4,000	$56,000	1	1
All others [d]	$3,500	$49,000	NA	NA
Spiny Dogfish	$1,714	$24,000	4	5

FMP Fishery	Average Annual Revenue (Lease Area)	Total Revenue (Lease Area)	Average Annual Expected Vessels in the Lease Area [f]	Average Annual Expected Vessel Trips in the Lease Area [f]
Bluefish	$1,000	$14,000	10	10
Highly migratory species	$357	$5,000	2	2
SERO FMP [e]	**<$35**	**<$500**	1	1
Other Affected FMPS	**$117,321**	**$1,642,000**	**43**	**50**
All FMP Fisheries	**$510,035**	**$7,140,000**	**182**	**131**

Source: NMFS 2022f

[a] Data are for vessels issued federal fishing permits by NMFS Greater Atlantic Region. Numbers are in 2021 dollars and Total Revenue is rounded to nearest $1,000. NA indicates data not available to perform calculations. Federal lobster vessels, with only lobster permits, do not have a VTR requirement. Many Atlantic HMS-permitted vessels also do not have a VTR requirement. Trips with no VTR are not reflected in this summary. Further there exists other fisheries in state waters that may not be reflected in data from federal sources (e.g. whelk, bluefish, and menhaden).

[b] ASMFC FMP includes American lobster, cobia, Atlantic croaker, black drum, red drum, menhaden, NK sea bass, NK seatrout, spot, striped bass, tautog, Jonah crab, and pandalid shrimp.

[c] No federal FMP contains a variety of species that are managed under an FMP but are not federally regulated, such as spotted seatrout (*Cynoscion nebulosus*), whelk (*Buccinidae*) and weakfish (*Cynoscion regali*).

[d] All others refers to FMP Fisheries with fewer than three permits or dealers affected to protect data confidentiality.

[e] SERO FMP includes the following species: Amber jack, brown shrimp, dolphinfish, greater amberjack, grouper, grunts, hogfish, king mackerel, long tail grouper, NK porgy, penaeid shrimp, red grouper, red hind, red porgy, red snapper, rock hind, sand tilefish, scamp grouper, snapper, snow grouper, spadefish, Spanish mackerel, speckled hind, spiny American lobster, triggerfish, vermillion snapper, wahoo, wreckfish, yellowedge grouper.

[f] Vessel and trip numbers are weighted by the probability of overlap with the Lease Area to generate a more precise expected count of trips and vessels in the Lease Areas.

Table 3.6.1-10. Commercial fishing landings (pounds) of federally permitted vessels in the Lease Area by FMP (2008–2021) [a]

FMP Fishery	Average Annual Landings (Pounds)	Total Landings (Pounds)
Top Five FMP Fisheries		
ASMFC FMP [b]	98,214	1,375,000
Summer Flounder, Scup, Black Sea Bass	74,786	1,047,000
Mackerel, Squid, and Butterfish	70,929	993,000
Small-Mesh Multispecies	64,786	907,000
Monkfish	24,714	346,000
Total Top Five FMPs	**333,429**	**4,668,000**
Other Affected FMPs		
Atlantic Herring	79,357	1,111,000
Skates	38,714	542,000
No Federal FMP [c]	9,143	128,000
Tilefish	8,500	119,000
Spiny Dogfish	6,500	91,000
All Others [d]	4,929	69,000

FMP Fishery	Average Annual Landings (Pounds)	Total Landings (Pounds)
Surfclam, Ocean Quahog	3,571	50,000
Sea Scallop	2,714	38,000
Northeast Multispecies	2,214	31,000
Bluefish	1,143	16,000
Highly Migratory Species	429	6,000
SERO FMP [e]	<35	<500
Other Affected FMPs	**157,249**	**2,201,000**
All FMP Fisheries	**490,678**	**6,869,000**

Source: NMFS 2022f

[a] Data are for vessels issued federal fishing permits by NMFS Greater Atlantic Region. Pounds are reported in landed (dressed) pounds. Federal lobster vessels, with only lobster permits, do not have a VTR requirement. Many Atlantic HMS permitted vessels also do not have a VTR requirement. Trips with no VTR are not reflected in this summary. Further, there exists other fisheries in state waters that may not be reflected in data from federal sources (e.g., whelk, bluefish, and menhaden).

[b] ASMFC FMP includes American lobster, cobia, Atlantic croaker, black drum, red drum, menhaden, NK sea bass, NK seatrout, spot, striped bass, tautog, Jonah crab, and pandalid shrimp.

[c] No federal FMP contains a variety of species that are managed under an FMP but are not federally regulated, such as spotted seatrout (*Cynoscion nebulosus*), whelk (*Buccinidae*) and weakfish (*Cynoscion regali*).

[d] All others refers to FMP Fisheries with fewer than three permits or dealers affected to protect data confidentiality.

[e] SERO FMP includes the following species: Amber jack, brown shrimp, dolphinfish, greater amberjack, grouper, grunts, hogfish, king mackerel, long tail grouper, NK porgy, penaeid shrimp, red grouper, red hind, red porgy, red snapper, rock hind, sand tilefish, scamp grouper, snapper, snow grouper, spadefish, Spanish mackerel, speckled hind, spiny American lobster, triggerfish, vermillion snapper, wahoo, wreckfish, yellowedge grouper.

Table 3.6.1-11 shows the top ten most affected species in the Lease Area (2008–2021), whereas Table 3.6.1-12 shows the average revenue, landings, and effort (Days-At-Sea [DAS]) as percentages of the total revenue, landings, and effort across the entire geographic analysis area for the top ten species deriving the most revenue from the Lease Area by year (2008–2021). The primary difference between the tables is the disproportionate impact that landings of high value species such as lobster and sea scallops can have on the 14-year total. Both American lobster and Atlantic sea scallop had substantially fewer pounds landed than skate, but the 14-year revenue was higher for American lobster and Atlantic sea scallop than skate. Further, while skate was included in Table 3.6.1-11, due to relatively high landings, skate was not included in Table 3.6.1-12, as it was not one of the top ten species deriving the most revenue from the Lease Area, similar to American lobster and Atlantic sea scallop. The species consistent across the two tables are Jonah crab, silver hake, longfin squid, scup, monkfish, summer flounder, and golden tilefish. For the 14 years analyzed, butterfish, Jonah crab, and monkfish were amongst the top ten species that derived the most revenue annually, in all years analyzed. Golden tilefish, silver hake, red hake, and longfin squid were amongst the top ten species that derived the most revenue in 13 of the 14 years analyzed. All other species in Table 3.6.1-12, besides scup, derived the most revenue from the Lease Area, in less than 10 of the years analyzed. As depicted in these tables, Jonah crab is the most affected species and FMP by revenue and by landings for the Lease Area. The average revenue, landings, and effort associated with the capture of Jonah crabs in the Lease Area, however, contributed 0.8 percent of revenue, 0.8 percent of landings, and 0.4 of percent of DAS for Jonah crab annually over the 14 years analyzed (Table 3.6.1-12); peaking in 2016 at 1.4 percent of revenue and 1.3 percent of landings for the entire geographic analysis area. While spot ranked higher on average revenue and landings than red hake, butterfish, longfin squid, and monkfish, it only occurred in 4 of the 14 years analyzed and is driven by relatively high revenue, 1.5 percent and 2.5 percent and landings 1.7 percent and 3.3 percent in 2008 and 2010, respectively.

Table 3.6.1-11. Commercial fishing revenue and landings (pounds) of federally permitted vessels in the Lease Area by most affected species (2008–2021) [a]

Species	Fourteen Year Revenue [b]	14-Year Landings (pounds) [c]
Jonah crab	$1,185,000	1,290,000
Longfin squid	$1,123,000	808,000
Summer flounder	$733,000	241,000
Scup	$633,000	792,000
Silver hake	$586,000	809,000
Monkfish	$579,000	346,000
Golden tilefish	$513,000	119,000
American lobster	$459,000	85,000
Sea scallop	$385,000	38,000
Skates	$315,000	542,000
Total	**$6,510,000**	**5,069,000**

Source: NMFS 2022f

[a] Data are for vessels issued federal fishing permits by NMFS Greater Atlantic Region. Pounds are reported in landed (dressed) pounds. Federal lobster vessels, with only lobster permits, do not have a VTR requirement. Many Atlantic HMS permitted vessels also do not have a VTR requirement. Trips with no VTR are not reflected in this summary. Further, there exists other fisheries in state waters that may not be reflected in data from federal sources (e.g., whelk, bluefish, and menhaden).

[b] Values are reported in real 2021 dollars as calculated using the GDP Implicit Price Deflator.

[c] Pounds are reported in landed (dressed) pounds.

Table 3.6.1-12. Average commercial fishing revenue, landings, and DAS of the Lease Area as percentages of total revenue, landings, and DAS for the entire geographic analysis area for the top ten species deriving the most revenue from the Lease Area by year [a] (2008–2021)

Species	Average Annual Revenue as a Percentage of Total Revenue in the Geographic Analysis Area	Average Annual Landings as a Percentage of the Total Landings in the Geographic Analysis Area	Average Annual DAS as a Percentage of the DAS In The Geographic Analysis Area	Number of Years as One of the Top Ten Species by Revenue
Jonah crab	0.8	0.8	0.3	14
Golden tilefish	0.6	0.6	0.2	13
Scup	0.5	0.5	0.3	10
Silver hake	0.4	0.4	0.3	13
Spot	0.3	0.4	0.4	4
Red hake	0.3	0.4	0.3	13
Butterfish	0.2	0.3	0.3	14

Species	Average Annual Revenue as a Percentage of Total Revenue in the Geographic Analysis Area	Average Annual Landings as a Percentage of the Total Landings in the Geographic Analysis Area	Average Annual DAS as a Percentage of the DAS In The Geographic Analysis Area	Number of Years as One of the Top Ten Species by Revenue
Longfin squid	0.2	0.2	0.2	13
Offshore hake	0.2	0.2	0.1	5
Monkfish	0.2	0.3	0.1	14
Summer flounder	0.2	0.2	0.2	9
Atlantic bluefish	0.1	0.1	0.2	5
Spotted seatrout	0.0	0.0	0.0	1
Yellowtail flounder	0.0	0.0	0.0	3
Atlantic herring	0.0	0.1	0.0	1
Spiny dogfish	0.0	0.0	0.1	3
All Others [b]	0.0	0.0	0.0	2
Black sea bass	0.0	0.0	0.0	1
Weakfish	0.0	0.0	0.0	1
Atlantic mackerel	0.0	0.0	0.0	1

Source: NMFS 2022f

[a] More than ten species shown as the top ten most affected species changed annually, in years where a species was not amongst the top ten, percent was considered 0 for that year for the calculation of the average.

[b] All others refers to FMP Fisheries with fewer than three permits or dealers affected to protect data confidentiality.

Table 3.6.1-13 and Table 3.6.1-14 show the revenue and landings of federally permitted vessels in the Lease Area by gear type. Considering Table 3.6.1-10, Table 3.6.1-11, and Table 3.6.1-12 with Table 3.6.1-13 and Table 3.6.1-14, the majority of lobster pot gear in the Lease Area captured Jonah crabs. Longfin squid, summer flounder, scup, and silver hake are commonly caught with bottom-trawl gear accounting for the most affected gear type across the 14 years analyzed. Together, trawl-bottom and pot-lobster accounted for approximately 72 percent of the total revenue generated by commercial fishing activity in the Lease Area. While longfin squid may rank as the second highest species in the Lease Area by revenue and landings (Table 3.6.1-11), in the years analyzed it accounted for less than 0.5 percent, respectively, of the revenue, landings, and effort for the entire geographic analysis area with percentages of revenue, landings, and effort of silver hake and scup being more relevant to the geographic analysis area with revenues exceeding 1 percent in some of the years analyzed. Most of the top ten most affected species by year did not exceed 2 percent of the total revenue of the geographic analysis area. Spot exceeded 2 percent in 2010 and golden tile fish in 2019. In most years, spot generated no value relative to the geographic analysis area, and golden tilefish varies from 0 to over 2 percent of total revenue of the geographic analysis area.

Table 3.6.1-13. Commercial fishing revenue of federally permitted vessels in the Lease Area by gear type (2008–2021)

Gear Type	Average Annual Revenue	Total Revenue
Trawl-bottom	$247,500	$3,465,000
Pot-lobster	$120,643	$1,689,000
Gillnet-sink	$59,571	$834,000
Longline-bottom	$30,786	$431,000
Dredge-scallop	$26,786	$375,000
All others	$10,786	$151,000
Trawl-midwater	$6,786	$95,000
Dredge-clam	$3,786	$53,000
Pot-other	$3,357	$47,000
Total	**$510,000**	**$7,140,000**

Source: NMFS 2022f
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Revenue is in 2021 dollars.

Table 3.6.1-14. Commercial fishing landings (pounds) of federally permitted vessels in the Lease Area by gear type (2008–2021)

Gear Type	Average Annual Landings	Total Annual Landings
Trawl-bottom	227,286	3,182,000
Pot-lobster	103,071	1,443,000
Trawl-midwater	72,786	1,019,000
Gillnet-sink	60,214	843,000
All others	10,286	144,000
Longline-bottom	8,143	114,000
Dredge-clam	3,357	47,000
Pot-other	2,857	40,000
Dredge-scallop	2,714	38,000
Total	**490,714**	**6,870,000**

Source: NMFS 2022f
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

Table 3.6.1-15 shows the average number and expected number of vessel trips and average number and expected number of vessels fishing in the Lease Area by port from 2008 through 2021. The Lease Area is predominantly used by vessels whose homeports are in New England. Table 3.6.1-16 provides a ranking of the top ten ports by revenue of fishing vessels in the Lease Area from 2008 through 2021, as well as the level of commercial fishing engagement and reliance of the community in which the port is located. These rankings portray the level of dependence of the community on commercial fishing and are compiled by NMFS (NOAA Fisheries Office of Science and Technology 2021). Thirty-two percent of the average expected number of trips of fishing vessels that operate in the Lease Area originate from Point Judith, Rhode Island, and New Bedford, Massachusetts. Both receive the highest value of landings of any ports, from the Lease Area, with respective totals of $2 million and $1.7 million from 2008 through 2021. These ports contribute 59 percent of the total revenue derived from the Lease Area and account for 74 percent and 63 percent of their respective states revenue derived from the Lease Area (Table 3.6.1-17). As shown in Table 3.6.1-16, the commercial fishing engagement and reliance differ across communities that engage in commercial fishing in the Lease Area. For example, while New Bedford ranks high in commercial fishing engagement and medium in reliance, Chatham, Massachusetts, which ranks fifth in revenue and landings from the Lease Area, ranks high in fishing engagement and high in fishing reliance, given its relative isolation, size, and relative lack of other industries to engage the coastal community. Information regarding the ranking determinations for each community is provided in the community profiles available from NMFS (NMFS 2021b). These profiles present the most recent data available for these key indicators of New England and Mid-Atlantic fishing communities related to dependence on fisheries and other economic and demographic characteristics. Selected socioeconomic characteristics of communities with fishing ports that could be affected by the Project are also presented in Sections 3.6.3 and 3.6.4.

Table 3.6.1-15. Average number of total and expected commercial fishing trips and vessels in the Lease Area by port (2008–2021)

Port and State	Average Number of Vessels [a]	Average Number of Trips [a]	Average Expected Number of Vessels [b]	Average Expected Number of Trips [b]
Point Judith, RI	63	560	11	13
New Bedford, MA	72	367	7	8
Chatham, MA	9	53	4	6
Montauk, NY	15	81	3	3
Fairhaven, MA	5	50	3	4
Westport, MA	6	67	2	2
Newport, RI	6	61	2	2
Little Compton, RI	5	51	2	2
Barnstable, MA	4	16	2	2
Harwichport, MA	3	62	2	2
Shinnecock, NY	4	5	1	1
Beaufort, NC	23	37	1	1
Chilmark, MA	5	16	1	1
New London, CT	4	25	1	1
Point Pleasant, NJ	5	12	1	1
Barnegat, NJ	3	4	1	1
Boston, MA	7	28	1	1
Cape May, NJ	5	5	1	1
Chincoteague, VA	7	9	1	1
Davisville, RI	3	13	1	1
Fall River, MA	3	31	1	1
Gloucester, MA	5	8	1	1

Port and State	Average Number of Vessels [a]	Average Number of Trips [a]	Average Expected Number of Vessels [b]	Average Expected Number of Trips [b]
Hampton Bay, NY	3	12	1	1
Hampton, VA	14	24	1	1
Hyannis, MA	9	80	1	1
Menemsha, MA	3	5	1	1
Newport News, VA	11	18	1	1
North Kingstown, RI	3	18	1	1
Stonington, CT	6	23	1	1
Tiverton, RI	3	30	1	1
Wanchese, NC	4	5	1	1
Woods hole, MA	3	4	1	1
Total	**321**	**1779**	**58**	**66**

Source: NMFS 2022f
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.
[a] Number of Trips and Number of Vessels represent, "An upper bound on the counts as it does not take into account the probability of these trips actually overlapping the area of interest and identifies all the individuals who could be displaced by wind energy development."
[b] Expected Trips and Expected Vessels represent, "A count of trips and vessels weighted by probability of overlap with the area of interest, to generate a more precise expected count of trips and vessels fishing within the area."

Table 3.6.1-16. Commercial fishing revenue of federally permitted vessels in the Lease Area by the ten most affected ports (2008–2021) and commercial fishing engagement and reliance (2018)

Port and State	Fourteen Year Revenue	Fourteen Year Landings	Commercial Fishing Engagement Categorical Ranking [a]	Commercial Fishing Reliance Categorical Ranking [b]
Point Judith, RI	$2,004,000	1,892,000	High	Medium
New Bedford, MA	$1,693,000	2,132,000	High	Medium
Montauk, NY	$925,000	562,000	High	Medium
Newport, RI	$473,000	434,000	NA	NA
Chatham, MA	$351,000	339,000	High	High
Fairhaven, MA	$291,000	291,000	High	Low
Beaufort, NC	$187,000	65,000	High	Low
Little Compton, RI	$109,000	111,000	High	Medium
Westport, MA	$104,000	76,000	Medium-High	Low
Newport News, VA	$99,000	41,000	Medium	Medium
Total	**$6,236,000**	**$5,943,000**		

Source: NMFS 2022f; NOAA Fisheries Office of Science and Technology 2021.
[a] Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement. Rankings are for 2018, the latest year data are available.
[b] Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates more reliance. Rankings are for 2018, the latest year data are available.
Notes: Data is for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Revenue is in 2021 dollars with total revenue rounded to nearest thousand.

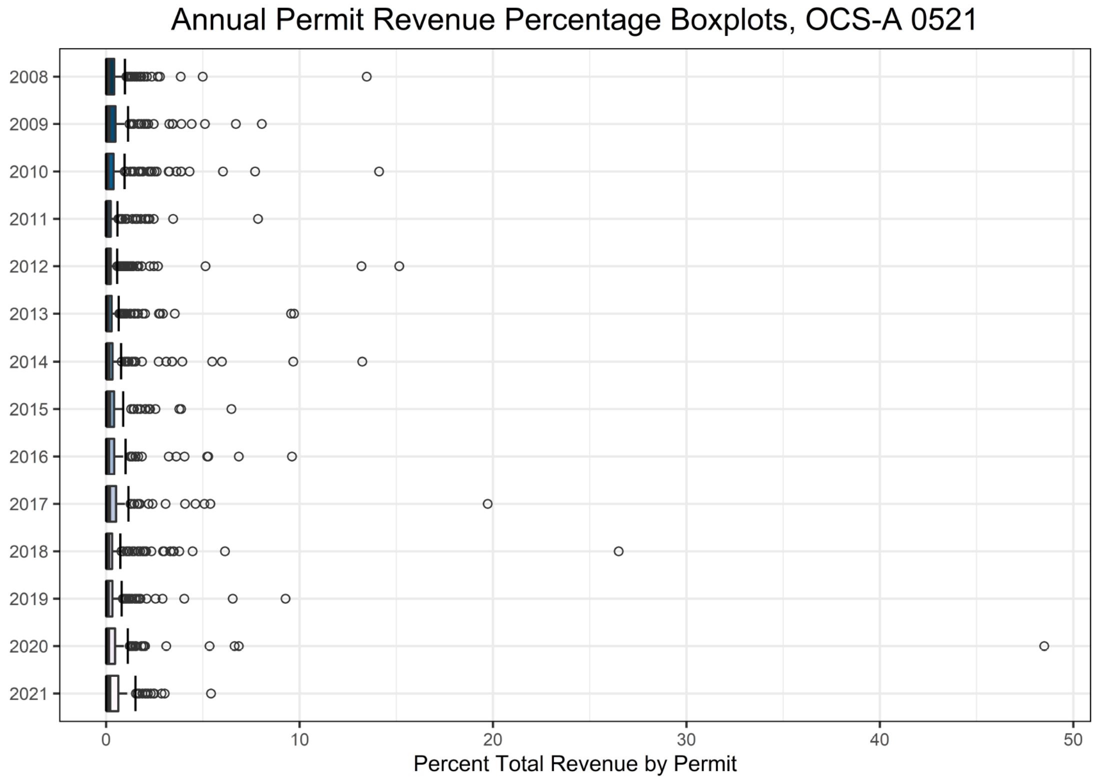
Table 3.6.1-17. Total revenue and total landed pounds by state in the Lease Area (2008–2021)

State	14-Year Revenue	14-Year Landings
Rhode Island	$2,704,000	2,633,000
Massachusetts	$2,682,000	3,297,000
New York	$976,000	585,000
North Carolina	$268,000	93,000
Virginia	$218,000	90,000
New Jersey	$125,000	43,000
Connecticut	$122,000	109,000
Maryland	$31,000	11,000
All Others	$5,000	3,000
Maine	$1,000	2,000

Source: NMFS 2022f
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

To analyze differences in the economic importance of fishing grounds in the Lease Area across the commercial fishing fleet, NMFS analyzed the percentage of each permit's total commercial fishing revenue attributed to catch in the Lease Area during 2008 through 2021 (NMFS 2022f).The vessel-level annual revenue percentages were divided into quartiles, which were created by ordering the data from lowest to highest percentage value and then dividing the data into four groups of equal size. The first quartile represents the lowest 25 percent of ranked percentages, while the fourth quartile represents the highest 25 percent.

The distributions of the vessel-level annual revenue percentages for the Lease Area that NMFS presented are provided in Figure 3.6.1-2.The boxplot begins at the first quartile, or the value beneath which 25 percent of all vessel-level revenue percentages fall. A thick line in the box identifies the median, the observation that 50 percent of vessel-level revenue percentages are above or beneath. The box ends at the third quartile, or the vessel-level revenue percentage beneath which 75 percent of observations fall. Nonparametric estimates of the minimum and maximum values are also indicated by the "whiskers" (dashed line terminating in a vertical line) that jut out from each side of the box. Any points outside of these whiskers are vessel-level revenue percentages that are considered outliers. In the context of this analysis, an outlier is a vessel that derived an exceptionally high proportion of its annual revenue from the Lease Area in comparison to other vessels that fished in the area.



Source: NMFS 2022f

Figure 3.6.1-2. Annual permit revenue percentage boxplots for the Lease Area

Table 3.6.1-18 presents the minimum, first quartile, median, third quartile, and maximum revenue values for each portion of the Lease Area as delineated by NMFS from 2008 through 2021. Table 3.6.1-19 shows the number of revenue outliers by year from 2008 through 2021. A total of 75 percent of the permit revenue from the Mayflower Lease Area derived less than 0.37 percent of their total annual revenue from the Lease Area (Table 3.6.1-18). The highest percentage of total annual revenue attributed to catch is 48 percent (Table 3.6.1-18). Although outliers derived a high proportion of their annual revenue from the Lease Area in comparison to other vessels that fished in the area, Figure 3.6.1-2 and Table 3.6.1-19 show that, in any given year, the revenue percentage for the majority of vessels was less than 0.37 percent and the majority of outliers derived less than 5 percent of their total revenue from the Lease Area. In 7 of the 14 years, there was one permit holder (two in 2012) who derived greater than 10 percent of their revenue from the Lease Area. The interannual variation of the extreme outliers varies greatly, with reliance fluctuating from approximately 13 percent to 15 percent, up to 48 percent in 2020, and down to approximately 5 percent in 2021. As such, no permit holder consistently relies on the Lease Area for a significant portion of their total revenue; given the number of outliers in the data, the median is a better representation of the data versus the mean (the mean would be unduly inflated in a year like 2020), thus, the majority of permit holders derive less than 0.1 percent of their total revenue from the Lease Area. Table 3.6.1-20 and Table 3.6.1-21 show the potential total number of trips and vessels that may have overlapped the Lease Area, thus, identifying all the individuals who could be displaced by wind energy development and the number of trips and vessels weighted by the probability of overlap with the Lease Area, to generate a more precise expected count of trips and vessels in the Lease Area. Of the total number of trips and vessels that occurred in and around the Lease Area, a small proportion of them are calculated to actively fish the Lease Area in any given year.

Table 3.6.1-18. Analysis of 14-year permit revenue percentage boxplots for the Lease Area

Minimum	1st Quartile	Median	3rd Quartile	Maximum
0%	0.01%	0.09%	0.37%	48%

Source: NMFS 2022f
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

Table 3.6.1-19. Total number of federally permitted vessel revenue outliers from the Lease Area (2008–2021)

Year	Number of Revenue Outliers
2008	28
2009	23
2010	25
2011	26
2012	29
2013	26
2014	21
2015	14
2016	17
2017	17
2018	28
2019	25
2020	18
2021	15

Source: Developed using data from NMFS 2022f
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

Table 3.6.1-20. Total number of vessels and trips and total expected number of vessels and trips by year in the Lease Area (2008–2021)

Year	Number of Trips [a]	Number of Vessels [a]	Expected Trips [b]	Expected Vessels [b]
2008	1,700	218	46	37
2009	1,555	193	43	35
2010	1,303	197	53	37
2011	1,220	196	32	28
2012	1,603	225	43	31
2013	1,726	228	40	32
2014	1,891	212	38	28

Year	Number of Trips [a]	Number of Vessels [a]	Expected Trips [b]	Expected Vessels [b]
2015	1,836	194	40	30
2016	1,958	226	49	34
2017	1,724	182	60	44
2018	1,335	217	42	33
2019	1,423	255	39	35
2020	1,161	203	37	32
2021	1,233	191	34	28

[a] Number of Trips and Number of Vessels represent, "An upper bound on the counts as it does not take into account the probability of these trips actually overlapping the area of interest and identifies all the individuals who could be displaced by wind energy development."

[b] Expected Trips and Expected Vessels represent, "A count of trips and vessels weighted by probability of overlap with the area of interest, to generate a more precise expected count of trips and vessels fishing within the area."

Table 3.6.1-21 Average number of vessels and trips and average expected number of vessels and trips by FMP in the Lease Area (2008-2021)

FMP	Average Number of Vessels [a]	Average Number of Trips [a]	Average Expected Number of Vessels [b]	Average Expected Number of Trips [b]
Monkfish	128	668	19	25
Skates	93	448	13	19
Summer Flounder, Scup, Black Sea Bass	114	701	16	18
Mackerel, Squid, and Butterfish	91	613	14	15
Small-Mesh Multispecies	71	430	11	12
ASMFC FMP	76	536	9	11
Bluefish	71	367	10	10
No Federal FMP	82	336	6	6
Spiny Dogfish	18	52	4	5
Northeast Multispecies	52	124	2	2
Tilefish	49	130	2	2
Highly Migratory Species	16	45	2	2
Atlantic Herring	7	11	1	1
Sea Scallop	26	36	1	1
SERO FMP	9	14	1	1
Surfclam, Ocean Quahog	9	48	1	1
Total	911	4559	111	131

Source: NMFS 2022f

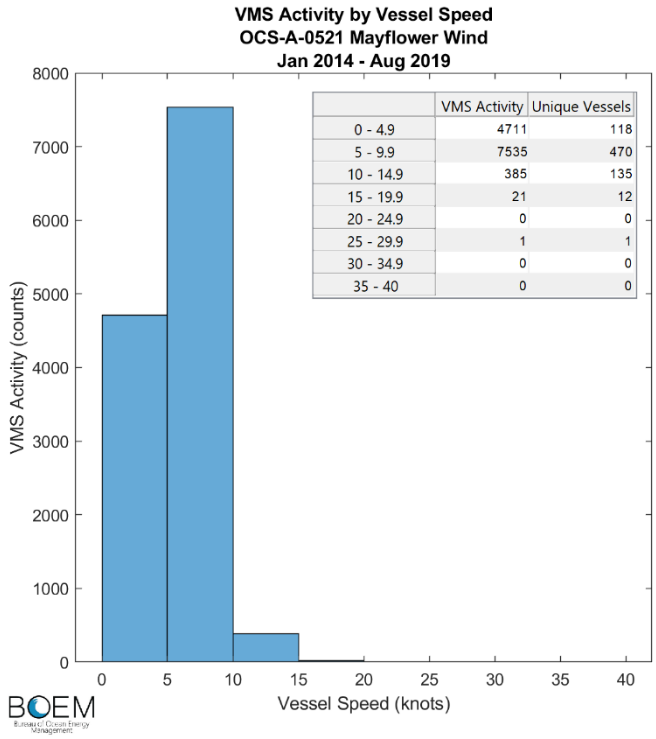
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

[a] Number of Trips and Number of Vessels represent, "An upper bound on the counts as it does not take into account the probability of these trips actually overlapping the area of interest and identifies all the individuals who could be displaced by wind energy development."

[b] Expected Trips and Expected Vessels represent, "A count of trips and vessels weighted by probability of overlap with the area of interest, to generate a more precise expected count of trips and vessels fishing within the area."

Commercial fishing regulations include requirements for VMS. A VMS is a satellite surveillance system that monitors the location and movement of commercial fishing vessels; therefore, it is a good data source for understanding the spatial distribution of fishing vessels engaged in FMP fisheries in the Northeast region. However, VMS coverage is not universal for all fisheries, with some fisheries (summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish) not covered at all by VMS. In 2018, there were 912 VMS-enabled vessels operating in the Northeast across all fisheries. These 912 vessels represented a substantial portion (71–87 percent) of summer flounder, scup, black sea bass, and skate landings, and greater than 90 percent of landings for scallops, squid, monkfish, herring, mackerel, large mesh multispecies, whiting, surfclams, and ocean quahogs. VMS vessels represented less than 20 percent of highly migratory species and 10 percent of lobster/Jonah crab landings. Of these vessels, approximately 67 percent fished or transited in all reasonably foreseeable project areas (NMFS 2021a).

Using VMS data conveyed in individual position reports (pings) from January 2014 to August 2019, BOEM compiled information about fishing activities in the Lease Area. From the VMS data, it is interpreted that vessels with speeds less than 5 knots (2.6 m/s) are actively engaged in fishing, although vessels may also be using slower speeds to transit or be engaged in other activities, such as processing at sea. Vessels traveling faster than 5 knots (2.6 m/s) are generally interpreted to be transiting. Figure 3.6.1-3 indicates that only about 16 percent of the 736 unique vessels identified operating in the Lease Area during the above-referenced period were actively fishing. BOEM also developed polar histograms using the VMS data that show the directionality of VMS-enabled vessels operating in the Project area and the targeted FMP fishery (Figure 3.6.1-4 through Figure 3.6.1-8). The larger bars in the polar histograms represent a greater number of position reports showing fishing vessels moving in a certain direction in the Project area. The polar histograms differ with respect to their scales.

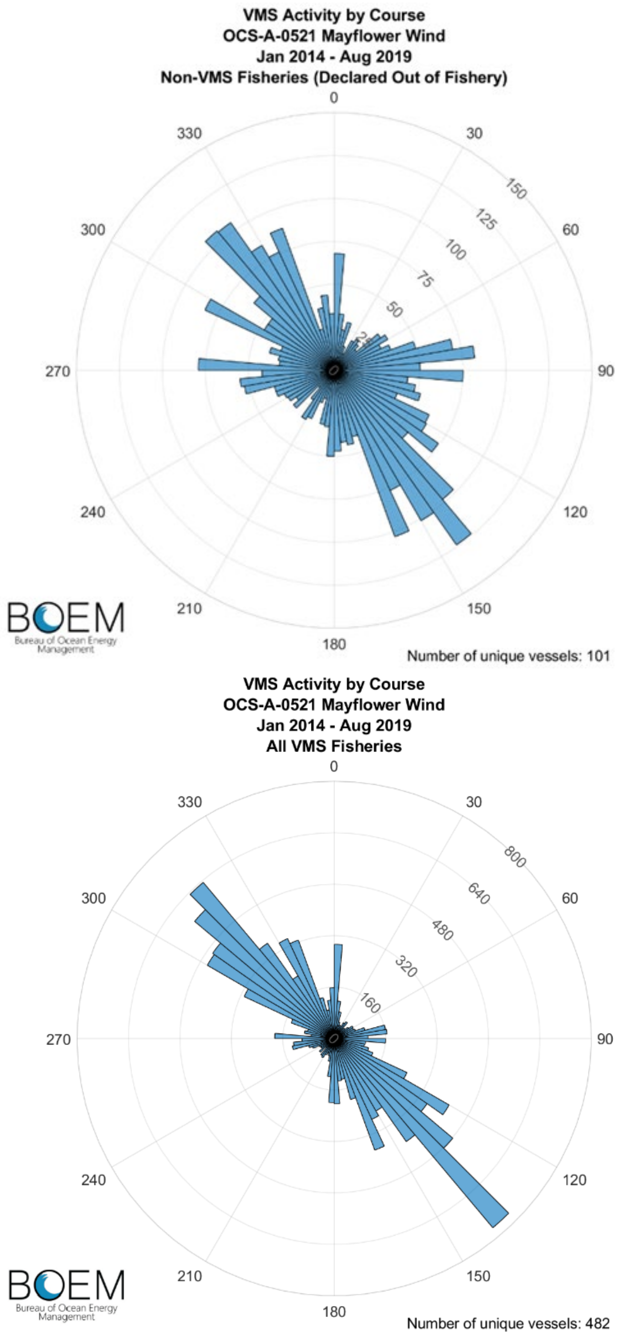


Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.6.1-3. VMS activity and unique vessels operating in the Lease Area, January 2014–August 2019

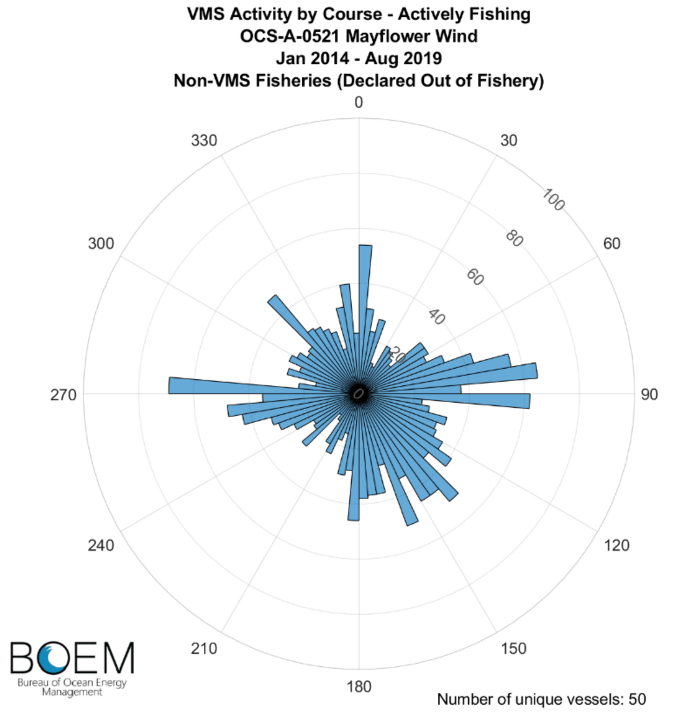
Figure 3.6.1-4 shows that for all activities (transiting and fishing combined), most of the 482 unique vessels participating in a VMS fishery generally operated in a northwest–southeast pattern with a secondary pattern of north–south. Most of the 201 unique vessels participating in a non-VMS fishery[1] followed the northwest–southeast orientation with a secondary pattern of east–west. Figure 3.6.1-5 shows multiple orientations for VMS fishery vessels fishing in the Lease Area; vessels followed a north-south, east-west, and northwest-southeast pattern. A more pronounced east-west fishing orientation was observed for non-VMS fishery vessels actively fishing in the Lease Area, but generally followed the VMS fishery vessels patterns. Figure 3.6.1-6 shows that VMS and non-VMS fishery vessels transiting the Lease Area followed primarily a northwest–southeast pattern. For individual FMP fisheries, Figure 3.6.1-7 shows that the orientation of vessels transiting the Lease Area generally followed a northwest-southeast pattern except for those in the Monkfish FMP fishery, which followed a north-south pattern primarily and northwest-southeast pattern secondarily. Figure 3.6.1-8 shows that the orientation of vessels actively fishing in the Lease Area varied by FMP fishery.

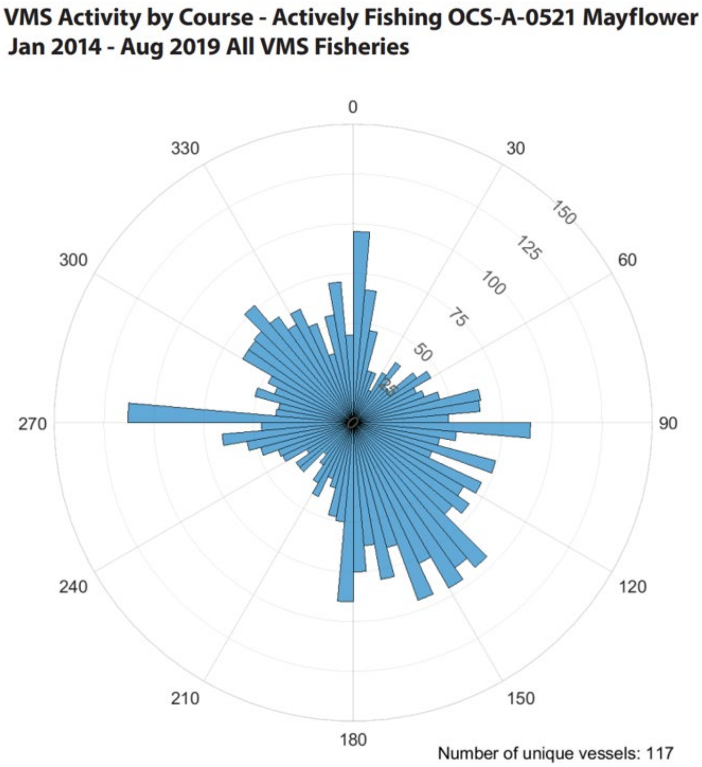
[1] These are fishing vessels that are transmitting VMS data after having declared themselves as participating in a non-VMS fishery (e.g., lobster, river herring).



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

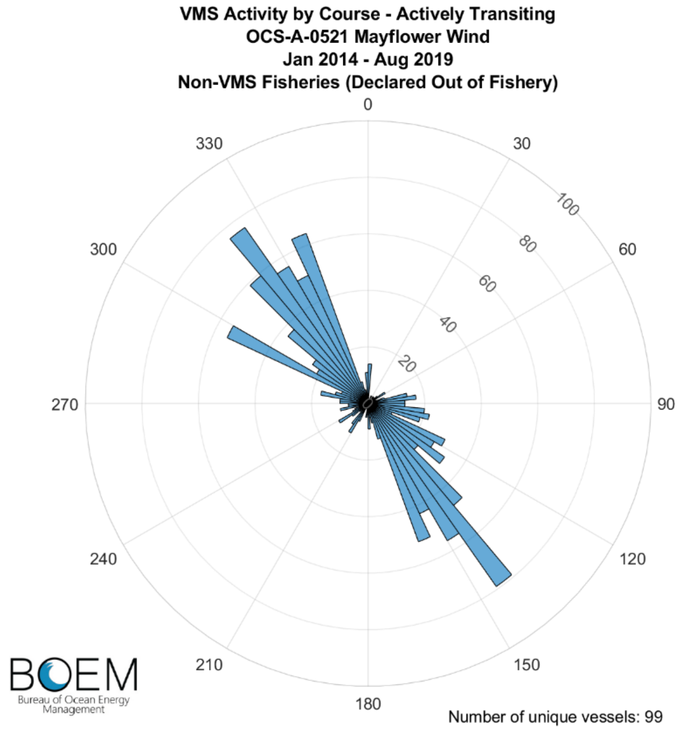
Figure 3.6.1-4. VMS bearings for all activity by VMS and Non-VMS fishery vessels in the Lease Area, January 2014–August 2019

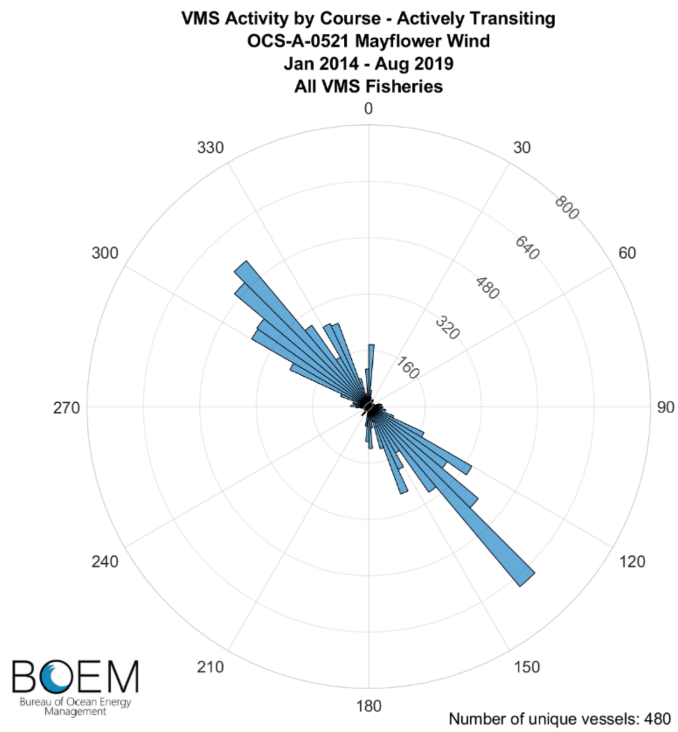




Source: Developed by BOEM using VMS data provided by NMFS (2019).

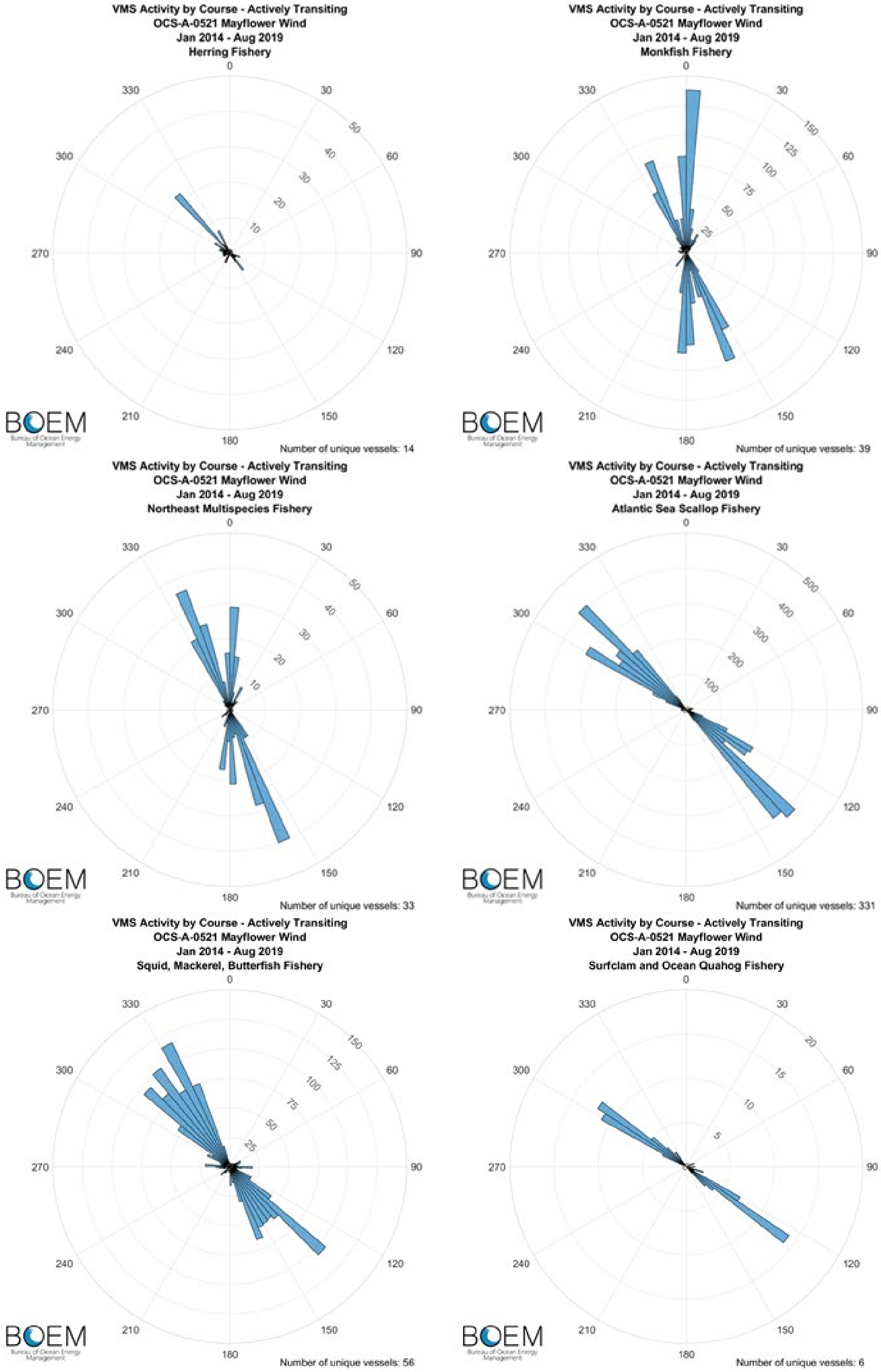
Figure 3.6.1-5. VMS bearings for fishing activity by VMS and Non-VMS fishery vessels in the Lease Area, January 2014–August 2019





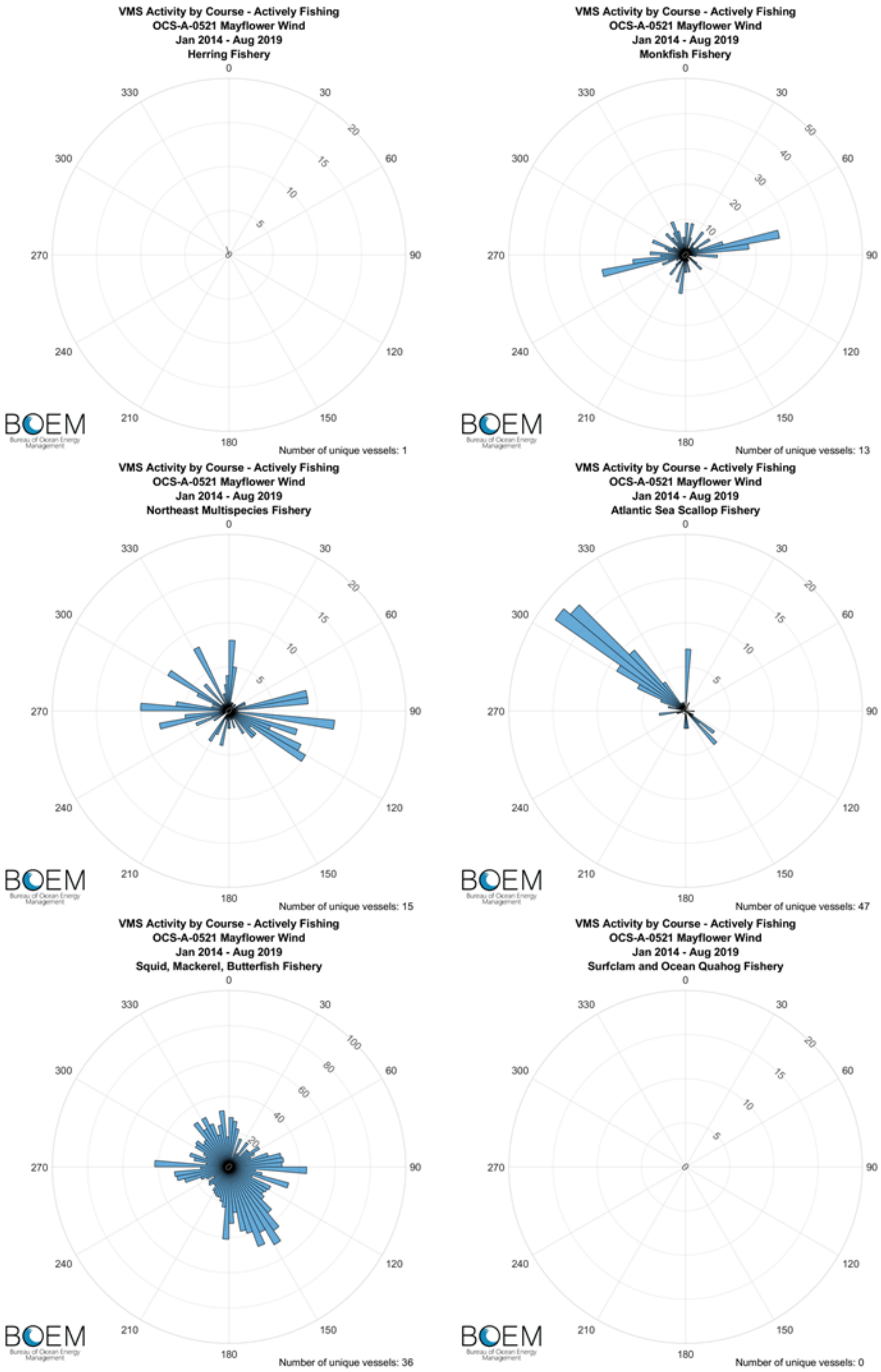
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.6.1-6. VMS bearings for transiting VMS and non-VMS fishery vessels in the Lease Area, January 2014–August 2019



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

Figure 3.6.1-7. VMS bearings for transiting VMS and non-VMS fishery vessels in the Lease Area, January 2014–August 2019



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

Figure 3.6.1-8. VMS bearings for actively fishing VMS and non-VMS fishery vessels in the Lease Area, January 2014–August 2019

Fishing activity occurs more frequently in the ECCs than in the Lease Area. VMS data for monkfish, large- and small-mesh multispecies, pelagics, scallop, squid, and surfclam/ocean quahog all had VMS activity in the medium to very high range from 2011 to 2016 (COP Appendix V, Section 2.4, Figures 2-17 and 2-18; Mayflower Wind 2022). Bottom trawling for squid is the primary fishery that operates in and near the Lease Area. VMS data from 2015 to 2016 show low to medium-high levels of squid fishing in the northwest corner of the Lease Area, and very high fishing effort north of the Lease Area in both ECCs (COP Appendix V, Section 2.4, Figure 2-18; Mayflower Wind 2022). Other fisheries with low to medium-low fishing effort in the Lease Area include monkfish, occurring throughout the Lease Area, large- and small-mesh fisheries in the southeast corner, and pelagics co-occurring in the northeast corner with squid.

Further, VTR data shows high fishing activity in both ECCs for bottom trawl, gillnet, and pots and traps (COP Appendix V, Section 2.4, Figure 2-20; Mayflower Wind 2022). Generally, fishing activity increases closer to shore, along the ECCs and in Vineyard Sound and outside of Narragansett and Buzzards Bay.

NMFS calculated the estimates of vessel revenue and landings (2008–2021) from the Brayton Point and Falmouth ECCs, similar to the Lease Area, using a buffered distance of 1 nautical mile on either side of the proposed cable corridor. The maximum Falmouth ECC cable corridor width is 3,280 feet (1,000 meters) and the maximum Brayton Point ECC cable corridor width is 2,300 feet (700 meters). Mayflower Wind intends to maintain these corridors to allow for maneuverability during installation and maintenance. The cable corridors may be locally narrower or wider to accommodate sensitive locations and to provide sufficient area at landfall locations, at crossing locations, or for anchoring. The estimated seabed disturbance, however, around each installed cable, for both ECCs, is estimated at 19.7 feet (6 meters) per cable. Thus, the landings and revenue data calculated by NMFS are likely overestimates of the affected species, given the localized and temporary impacts of cable installation.

The most affected FMPs for the Falmouth ECC are mackerel, squid, butterfish. summer flounder, scup, black sea bass. small-mesh multispecies, species with no federal FMP, and surfclam and ocean quahog. The most affected species from these FMPs is longfin squid. Other affected species include silver hake, scup, summer flounder, channeled whelk, black sea bass, conchs, American lobster, and sea scallops. Consequently, the most affected gear types fishing in the buffered zone are bottom and midwater trawls (NMFS 2022b).

The most affected FMPs for the Brayton Point ECC are mackerel, squid, butterfish, summer flounder, scup, black sea bass, species managed by ASMFC FMPs, surf clam and ocean quahog, and species not managed under a federal FMP. Similar to the Falmouth ECC, the most affected species by revenue is longfin squid; however, exceptionally high landings of Atlantic herring in 2013 put Atlantic herring as the most affected species by landings. Skate was the second-most affected species by landings and eighth-most affected by revenue. Other affected species include American lobster, summer flounder, sea scallop, scup, channeled whelk, and black sea bass. The most affected gear types are bottom and midwater trawl; however, all gear types, derived more revenue from the Brayton Point ECC relative to the Falmouth ECC (NMFS 2022c).

For-Hire Recreational Fishing in the Lease Area

As with the commercial fishing industry, the for-hire recreational fishing fleets contribute to the economy through direct employment, income, and gross revenues of the for-hire businesses, as well as through spending on products and services to maintain and operate their vessels, triggering further indirect multiplier effects that are dependent upon the initial demands of the for-hire fleet (Steinback and Brinson 2013). For-hire recreational fishing boats are operated by licensed captains for businesses that sell recreational fishing trips to anglers. These boats include both party (head) boats, defined as boats on which fishing space and privileges are provided for a fee, and charter boats, defined as boats operating under charter for a price, time, etc., whose participants are part of a preformed group of anglers (NMFS 2021c). Massachusetts recreational fleet consists of approximately 430 charter and head boats, and Rhode Island's fleet consists of 96 charter and head boats which are docked near all major inlets and bays (COP Appendix V, Section 3; Mayflower Wind 2022).

Mayflower Wind has compiled information from recreational fishing trips to identify the areas considered prime fishing areas (COP Volume 2, Section 11.1.3.2, Figure 11-22 and Tables 11-16 through 11-18; Mayflower Wind 2022). These specific areas are described as those that consistently produce good catches of commonly caught recreational fish species in Massachusetts and Rhode Island, most likely because the physical characteristics of those locations provide optimum fish habitat. Historically productive fishing grounds, for example, often occur around rock piles, shallow ridges, artificial and natural reefs, deep sloughs, and bay inlets.

NMFS works with state and local partners to monitor the recreational fishery catch and effort through the Marine Recreational Information Program (COP Volume 2, Section 11.1.1.3; Mayflower Wind 2022). Currently, there are an insufficient number of trips available for NMFS to generate a description of selected fishery landings and estimates of recreational party and charter vessel revenue from within the Project area (NMFS 2021d). In 2016, over 150,000 for-hire trips occurred in southern New England, and approximately 4 million shore and private angler fishing trips were reported. This generates thousands of jobs, and both direct and indirect sales from for-hire and private recreational fishing generated over $1.8 billion in southern New England in 2016 (COP Appendix V, Section 3, Table 3-1 and COP Volume 2, Section 11.1.3.1; Mayflower Wind 2022). A wide variety of species/groups were reported, with the highest numbers and diversity of species in offshore areas. Striped bass (*Morone saxatilis*) is the primary species targeted and caught by recreational anglers, with over 2 million pounds reported in 2019. Of the ten most commonly caught species in Massachusetts and Rhode Island (COP Volume 2, Section 11.1.3.2, Tables 11-16 and 11-17; Mayflower Wind 2022) four (Atlantic mackerel, scup, black sea bass, and bluefish) were reported caught in the Project area, with most catch associated with the ECCs. In general, the species most likely to be targeted in the Lease Area are highly migratory species.

There are several popular fishing spots that overlap either the Brayton Point ECC or the Falmouth ECC (COP Appendix V and Section 11.1.3.2; Mayflower Wind 2022). Recreational harvest of shellfish and finfish is likely in the Sakonnet River and in and around the landfall locations for both ECCs where fishers target American lobster, bay scallops, quahogs, whelk, and various crab species.

A total of 0.6 percent of for-hire vessels that fished in the Lease Area derived less than 2 percent of their total annual expenditures from the area (COP Appendix V, Section 3.23, Table 3-13; Mayflower Wind 2022). Of the states with residents likely to fish in the Lease Area, Massachusetts is the most exposed with 4.4 percent of total expenditures exposed to offshore wind activities (COP Appendix V, Section 3.23, Table 3-12; Mayflower Wind 2022).

Similar to the calculations for commercial fisheries landing and revenue data, NMFS calculated the estimates of vessel revenue and landings (2008–2021) from the Brayton Point and Falmouth ECCs, using a buffered distance of 1 nautical mile on either side of the proposed cable corridor.

The most affected FMPs for the Falmouth ECC are summer flounder, scup, black sea bass, FMPs with less than three permit holders (i.e. data are confidential), ASMFC interstate, and bluefish. The most affected species are species with less than three permit holders, for which information is confidential. Other affected species include scup, black sea bass, bluefish striped bass, and summer flounder (NMFS 2022d).

The most affected FMPs for the Brayton Point ECC are summer flounder, scup, black sea bass, other federal FMPs, ASMFC interstate, confidential FMPs, no federal FMP, bluefish FMP, and Northeast Multispecies FMP. The most affected species are summer flounder, black sea bass, scup, species with less than three permit holders, skates, tautog, bluefish, cod, sea robins and spiny dogfish (NMFS 2022e).

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

Definitions of impact levels are provided in Table 3.6.1-22.

Table 3.6.1-22 Definitions of impact levels for commercial fisheries and for-hire recreational fishing

Impact Level	Type of Impact	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Impacts on the affected activity or community would not disrupt the normal or routine functions of the affected activity or community. Once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects.
	Beneficial	Small or measurable effects that would result in an economic improvement.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Project. Once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects if proper remedial action is taken.
	Beneficial	Notable and measurable effects that would result in an economic improvement.
Major	Adverse	The affected activity or community would experience substantial disruptions. Once the affecting agent is eliminated, the affected activity or community could retain measurable effects indefinitely, even if remedial action is taken.
	Beneficial	Large local or notable regional effects that would result in an economic improvement.

3.6.1.3 Impacts of Alternative A – No Action on Commercial Fisheries and For-Hire Recreational Fishing

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for commercial fisheries and for-hire recreational fishing. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing described in Section 3.6.1.1, *Description of the Affected Environment and Future Baseline Conditions* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on commercial fisheries and for-hire recreational fishing resources are generally associated with activities that limit the aerial extent of where fishing can occur such as tidal energy projects, military use, dredge material disposal, and sand borrowing operations; increased vessel congestion that can pose a risk for collisions or allisions; dredging and port improvements, marine transportation, and oil and gas activities; or activities that pose a risk for gear entanglement such as undersea transmission lines, gas pipelines, and other submarine cables. Existing undersea transmission lines, gas pipelines and other submarine cables are generally indicated on nautical charts and may also cause commercial fishers to avoid the areas to prevent the risk of gear entanglement. Some of these activities may also result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality resulting in a less productive fishery or causing some vessel operators to seek alternate fishing grounds, target a different species, and/or switch gear types.

Commercial and for-hire recreational fisheries would continue to be affected by ongoing fisheries use and management. "Regulated fishing effort" refers to fishery management measures necessary to maintain maximum sustainable yield under the MSA, including catch quotas, effort allocations, special management areas, and closed areas. Activities of NMFS and fishery management councils could affect commercial and for-hire recreational fisheries through stock assessments, setting quotas and implementing FMPs to ensure the continued existence of species at levels that will allow commercial and for-hire recreational fisheries to occur. Ongoing commercial and recreational regulations for finfish and shellfish will affect commercial fisheries and for-hire recreational fishing by modifying the nature, distribution, and intensity of fishing-related impacts. Fishery management measures affect fishing operations differently for each fishery.

Commercial and for-hire recreational fisheries will also be affected by climate change primarily through ocean acidification, ocean warming, sea level rise, and increases in both the frequency and magnitude of storms, which could lead to altered habitats, altered fish migration patterns, increases in disease frequency, and safety issues for conducting fishing operations. Over the next 35 years, GHG emissions are expected to continue and will gradually warm ocean waters affecting the distribution and abundance of finfish and invertebrates and their food sources. Ocean acidification driven by climate change is contributing to reduced growth and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can also result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016). Risks to fisheries associated with these events include the ability to safely conduct fishing operations (e.g., because of storms) and climate-related habitat or distribution shifts in targeted species. Fish and shellfish species are expected to exhibit variation in their responses to climate change, with some species benefiting from climate change and others being adversely affected (Hare et al. 2016). To the extent that impacts of climate change on targeted species result in a decrease in catch or increase in fishing costs, the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected. Ongoing activities of NMFS and fishery management councils affect commercial and for-hire recreational fisheries through stock assessments, setting quotas, and implementing FMPs to ensure the continued existence of species at levels that will allow commercial and for-hire recreational fisheries to occur. The economies of communities reliant on marine species that are vulnerable to the effects of climate change would also be affected. Where commercial and for-hire recreational fisheries are located could be affected if the distribution of important fish stocks changes, and coastal communities with fishing related infrastructure near the shore could be adversely affected by sea level rise (Colburn et al. 2016; Rogers et al. 2019).

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on commercial fisheries and for-hire recreational.

- Continued O&M of the Block Island project (five WTGs) installed in state waters.
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect commercial fisheries and for-hire recreational fishing through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic. Ongoing offshore wind activities would have the same type of impacts that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

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

Planned offshore wind activities include offshore wind energy development activities on the Atlantic OCS other than the Proposed Action determined by BOEM to be reasonably foreseeable (see Attachment 2 in Appendix D for a complete description of planned offshore wind activities). BOEM expects ongoing and planned offshore wind activities to affect commercial and for-hire recreational fisheries through the following primary IPFs.

Anchoring: Excluding the Proposed Action, BOEM estimates that approximately 2,630 acres (10.6 square kilometers) of seabed would be disturbed by anchoring associated with other offshore wind activities (Appendix D, Table D2-2). Anchoring vessels used in the construction of offshore wind energy projects would pose a navigational hazard to fishing vessels. All impacts would be localized (within a few hundred meters of an anchored vessel) and temporary (hours to days in duration). Although anchoring impacts would occur primarily during Project construction, some impacts could also occur during O&M and conceptual decommissioning. Therefore, the adverse effects of offshore wind energy–related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long term and minor, though periodic in nature.

Cable emplacement and maintenance: Displacement of fishing vessels and disruption of fishing activities would occur from the installation of 9,970 miles (16,045 kilometers) of cables (Appendix D, Tables D2-1 and D2-2), though this disruption would not occur all at the same time. Installation of offshore cables for each offshore wind energy facility would require temporary rerouting of all vessels, including commercial and for-hire recreational fishing vessels, away from areas of active construction.

Construction activities related to offshore wind energy development that disturb the seabed, together with activities that reduce water quality, increase underwater noise, or introduce artificial lighting, could result in a behavioral response from some target species. In turn, these responses could decrease catchability for a fishery, due to factors such as fish not biting at hooks or changes in swim height. For any given offshore wind energy project, the impacts of behavioral responses on target species catch in commercial and for-hire recreational fisheries are expected to be confined to a small area, and to end shortly after construction activities end. Benthic species such as sea scallops and ocean quahogs would also be expected to repopulate cable areas once the offshore cables are installed and buried. Cable inspection and repair activities would result in types of impacts similar to those resulting from construction activities, such as temporary displacement or other behavioral responses of target species. The impacts are expected to be minor and temporary in nature, only occurring during cable placement or maintenance activities. Impacts related to gear entanglement from interactions with cables is discussed under the *Presence of structures* IPF. Details regarding potential lighting and noise impacts on finfish and invertebrates are provided in Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*.

Noise: Noise impacts caused by offshore construction, including pile driving, trenching for cable placement, O&M activities, G&G investigations, and vessels, could cause indirect impacts on commercial and for-hire recreational fisheries through their direct impacts on species targeted by commercial and for-hire recreational fisheries. Noise impacts would also occur during decommissioning activities. Most impacts would be short term and behavioral in nature, with most finfish species avoiding the noise-affected areas, while invertebrates may exhibit stress and behavioral changes such as discontinuation of feeding activities. With impulse impacts, such as those from pile driving, physiological sound thresholds may be exceeded for some species, resulting in injury or mortality, especially for affected species in the immediate vicinity (less than tens of meters); however, most pile-driving activities use ramp-up measures to allow mobile species to leave the area prior to experiencing full-impact pile driving. Once the noise-generating activities cease, most species would be expected to recolonize the affected area. Therefore, impacts on the commercial and for-hire recreational fisheries from noise-generating activities would be long-term in nature. See Section 3.5.5 for a full description of noise impacts on fish and invertebrates.

Port utilization: Construction and decommissioning of offshore wind energy projects would require port facilities for staging and installation/decommissioning vessels, including crew transfer, dredging, cable lay, pile driving, survey vessels, and, potentially, feeder lift barges and heavy lift barges. All these activities would add vessel traffic to port facilities and would require berthing. The additional vessel volume in construction ports could cause vessel traffic congestion, difficulties with navigating, and an increased risk for collisions, together with reduced access to high-demand port services (e.g., fueling and provisioning) by existing port users, including commercial fishing vessels. The impacts would be spread across the entire geographic analysis area throughout the duration of the construction period for offshore wind projects from 2023 to 2030, as well as beyond 2030 when the Project goes through decommissioning. These potential adverse impacts could cause some commercial and for-hire recreational vessel operators to change routes or use an alternative port, though impacts would be major and long-term, lasting the duration of the construction and decommissioning of the Project.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through allisions, entanglement or gear loss/damage, fish aggregation, and habitat conversion. They can also create navigation hazards (including transmission cable infrastructure) and space use conflicts, which in turn can lead to vessel collisions. These impacts may arise from buoys, meteorological towers, foundations, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Appendix D, offshore wind energy projects would include 2,884 WTGs (Appendix D, Table D2-2), up to 2,953 acres (11.95 square kilometers) (Appendix D, Table D2-2) of seabed disturbance due to foundation and scour protection, and 2,388 acres (9.7 square kilometers) of new hard protection atop cables (Appendix D, Table D2-2). BOEM anticipates that structures would be added intermittently over an assumed 10-year period and that they would remain until conceptual decommissioning of each facility is complete.

The presence of the WTG foundations and associated scour protection would convert existing sand or sand with mobile gravel habitat to hard bottom, which, in turn, would reduce the habitat for target species that prefer soft-bottom habitat (e.g., surfclams, sea scallops, squid, summer flounder) and increase the habitat for target species that prefer hard-bottom habitat (e.g., lobster, striped bass, black sea bass, cod). Where WTG foundations and associated scour protection produce an artificial reef effect and attract finfish and invertebrates, the aggregation of species could increase the catchability of target species (Kirkpatrick et al. 2017). Although species that rely on soft-bottom habitat would experience a reduction in favorable conditions, the impacts from structures are not expected to result in population-level impacts (Section 3.5.5). Decommissioning of each wind farm would then have the opposite impact, wherein the species dependent on hard-bottom or reef habitat would experience a reduction in favorable conditions, although some hard-bottom protection measures would remain, while removal of WTGs and their foundations would favor the increase of targeted species that prefer soft-bottom habitat.

USCG has stated that it does not plan to create exclusionary zones around offshore wind facilities during their operation (BOEM 2018). However, because of the height of wind turbines above the ocean surface, they would be visually detectable at a considerable distance during the day and easily detected by vessels equipped with radar regardless of the time of day. To further ensure navigational safety, all structures would have appropriate markings and lighting in accordance with USCG, BOEM, and IALA guidelines, and NOAA would chart wind turbine locations and could include a physical or virtual AIS at each turbine. Some fishing vessels operating in or near offshore wind facilities may experience radar clutter and shadowing. As described in Section 3.6.6, *Navigation and Vessel Traffic*, most instances of interference can be mitigated through the proper use of radar gain control. Impacts on navigation can also be mitigated with AIS and electronic chart systems, which many fishing vessels use, as well as use of additional watchstanders (National Academies of Sciences, Engineering, and Medicine 2022).

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

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

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

Some fishers that are displaced from traditional fishing grounds may find suitable alternative fishing grounds and continue to earn revenue, while others may switch the species they target or the gear they use, and others may leave the fishery altogether (O'Farrell et al. 2019). These behaviors are like those of fishers experiencing reduced access to fisheries resulting from fishing regulations and shifting species composition resulting from climate change (Papaioannou et al. 2021). Each of these scenarios requires adaptive behavior and risk tolerance, traits that are not universally shared by all fishers. For example, O'Farrell et al (2019) observed that some fishers have low vessel mobility and less explorative behavior, are risk averse, and take shorter trips, whereas other fishers have high mobility and a greater explorative behavior, are tolerant of risk, and conduct longer trips. Similarly, Papaioannou et al. (2021) observed that smaller trawlers had a higher affinity for their fishing grounds and were less likely to switch fishing grounds than larger trawlers. Fishers willing to seek alternate fishing grounds may experience increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less-productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. Fishers that switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishers to land their catch in different ports (Papaioannou et al. 2021), which could result in increased operational costs depending on where the port is located.

Fishing vessel operators unwilling or unable to travel through areas where offshore wind facilities are located or to deploy fishing gear in those areas may be able to find suitable alternative fishing locations and continue to earn revenue, while others may switch the species they target and/or the gear they use. Seeking alternate fishing grounds could result in increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less-productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. However, if, at times, a fishery resource is only available in the offshore wind lease area, some fishers, primarily those using mobile gear, may lose the revenue from that resource for the time that the resource is inaccessible. Those vessel operators switching species targeted and/or gear typed used may also lose revenue from targeting a less valuable species and increased costs from switching gear type. These impacts could remain until decommissioning of each facility is complete, although the magnitude of the impacts would diminish over time if fishing practices adapt to the presence of structures.

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

Table 3.6.1-23 shows the annual commercial fishing revenue exposed to offshore wind energy development in the Mid-Atlantic and New England regions by FMP fishery from 2020 through 2030. This table only shows federally permitted fishery revenue for wind energy areas and does not reflect total commercial fishing revenue that may be exposed to offshore wind energy development activities in the Greater Atlantic Region. It does not include state fisheries data or data for fishery operations along cable corridors. Thus, the regional cumulative revenue exposure is likely underestimated accordingly. The amount of revenue at risk increases as proposed offshore wind energy projects are constructed and come online according to the timeline set forth in Appendix D and would continue beyond 2030 during the continued operational phases of the offshore wind energy projects. The largest impacts in terms of exposed revenue are expected to be in the Sea Scallop, Surfclam/Ocean Quahog, and Mackerel/Squid/Butterfish FMP fisheries. The total average annual exposed revenue over the 2020–2030 period represents approximately 1 percent of the total average annual revenue of the FMP fisheries in the Mid-Atlantic and New England regions during the 2008–2019 period (Table 3.6.1-1) The maximum exposed revenue—which is projected to occur in year 2030 when construction on the last of the planned activities could begin—represents approximately 3.5 percent of the total regional revenue, though this estimate is based on only 11 years' worth of data and projects will be in operation beyond 2030.

The cumulative use of ocean space by offshore wind farms would likely result in increased travel time to landing ports, which may cause some fishers to use different landing ports, thereby resulting in economic loss to ports and communities, especially in small ports. Many fishing vessels use landing ports that differ from their primary port (i.e., the port where the vessel is docked or moored), and these vessels are likely to be particularly vulnerable to reductions in unobstructed ocean space. Silva et al. (2021) conducted an intercept survey from Maine to North Carolina and observed that 20 percent of the fishing industry participants reported different primary and landing ports from the intercept port. Among those reporting differences, the primary and landing ports were generally in different states. The ports where differences were most reported included Newport News, Virginia; Cape May and Point Pleasant, New Jersey; New Bedford, Massachusetts; and Point Judith, Rhode Island. Surfclam vessels often travel between Atlantic City, New Jersey and New Bedford, Massachusetts.

Table 3.6.1-23. Annual commercial fishing revenue exposed to offshore wind energy development in the Mid-Atlantic and New England regions under the No Action Alternative by FMP

FMP Fishery	Total Annual Revenue Exposed ($1,000s)										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030[*]
Mackerel, Squid, and Butterfish	$0.0	$0.11	$0.11	$388.43	$631.44	$783.06	$1,149.19	$1,302.48	$1,436.34	$1,570.20	$1,570.20
Summer Flounder, Scup, Black Sea Bass	$0.0	$0.15	$0.15	$306.08	$475.93	$620.53	$891.85	$1,077.71	$1,242.68	$1,407.64	$1,407.64
Northeast Multispecies (small-mesh)	$0.0	$0.00	$0.00	$143.55	$185.46	$247.59	$338.53	$366.91	$383.77	$400.63	$400.63
Skates	$0.0	–	–	$260.53	$299.66	$354.32	$449.42	$500.66	$532.89	$565.12	$565.12
American Lobster	$0.1	$0.00	$0.00	$331.97	$377.56	$438.47	$594.88	$694.50	$749.18	$803.85	$803.85
Monkfish	$0.0	$0.00	$0.00	$439.94	$513.12	$606.41	$770.83	$874.58	$957.12	$1,039.67	$1,039.67
Sea Scallop	$0.0	$0.00	$0.00	$465.66	$2,709.86	$2,963.76	$7,906.97	$12,774.22	$17,614.45	$22,454.69	$22,454.69
Jonah Crab	$0.0	$0.00	$0.00	$56.46	$94.03	$211.03	$297.65	$322.01	$342.51	$363.02	$363.02
Other FMPs, non-disclosed species and non-FMP fisheries	$0.0	$0.42	$0.42	$783.50	$946.63	$1,136.07	$1,736.29	$2,149.91	$2,531.75	$2,913.59	$2,913.59
Golden and Blueline Tilefish	$0.0	–	–	$4.14	$9.64	$34.33	$54.91	$60.01	$64.99	$69.97	$69.97
Northeast Multispecies (large-mesh)	$0.0	–	–	$182.64	$197.21	$211.99	$261.18	$283.55	$297.85	$312.14	$312.14
Bluefish	$0.0	$0.00	$0.00	$5.92	$8.61	$12.11	$15.63	$17.61	$19.15	$20.68	$20.68
Spiny Dogfish	$0.2	–	–	$21.46	$28.71	$33.12	$39.05	$43.16	$45.27	$47.37	$47.37
Surfclam, Ocean Quahog	--	–	–	$132.53	$169.30	$792.71	$1,191.92	$1,591.13	$1,990.34	$2,389.56	$2,389.56
Atlantic Herring	$0.3	–	–	$65.78	$97.88	$109.43	$161.80	$203.24	$235.62	$268.00	$268.00
Highly Migratory Species	$0.0	$0.00	$0.00	$0.15	$0.29	$0.79	$1.02	$1.25	$1.47	$1.69	$1.69
All FMP and non-FMP Fisheries	$0.7	$0.69	$0.69	$3,588.73	$6,745.33	$8,555.71	$15,861.12	$22,262.94	$28,445.38	$34,627.81	$34,627.81

Source: Developed using data from NMFS 2021a, and excludes the Proposed Action.

[a] This column represents the total average revenue exposed in 2030 in order to give a value reference to for the percentage of revenue exposed in 2030.

[*] Includes revenues from all species not assigned to an FMP including American lobster and Jonah crab fisheries.

Notes: Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery-dependent landings' data. To produce the data set, 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 does not allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates only pertain to individual offshore wind lease areas. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. Slight differences in totals are due to rounding.

"-" indicates the value Is zero;"$0" indicates the value is positive but less than $100.

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

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

Once offshore wind projects are completed, some commercial fishers may avoid the offshore wind lease areas if large numbers of recreational fishers are drawn to the areas by the prospect of higher catches. WTG foundations and associated scour protection may produce an artificial reef effect, potentially increasing fish and invertebrate abundance within a facility's footprint (Section 3.5.5). According to ten

Brink and Dalton (2018), the influx of recreational fishers into the Block Island Wind Farm caused some commercial fishers to cease fishing in the area because of vessel congestion and gear conflict concerns. If these concerns cause commercial fishers to shift their fishing effort to areas not routinely fished, conflict with existing users could increase as other areas are encroached. In general, the potential for conflict among commercial fishers due to fishing displacement may be higher for fishers engaged in fisheries that have regulations that constrain where fishers can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may also increase if mobile species targeted by commercial fishers, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to offshore wind energy facilities by the artificial reef effect, and fishers targeting these species concentrate their fishing effort in offshore wind lease areas as a result. Overall, the adverse impacts from vessel traffic would be long term and moderate.

Regulated fishing effort: Offshore wind development could influence fishery management by affecting fisheries' independent surveys used to inform management measures and by changing patterns of fishing activity. In the short term, widespread adverse impacts are likely to occur from fishery related management measures, but, in the long term, beneficial impacts are anticipated as fisheries achieve maximum sustainable yield from management measures. Fisheries managers, however, may need to revise the sampling design of fisheries surveys to include sampling in the wind farm areas to account for uncertainty in stock assessments that may accompany offshore wind development. Increased uncertainty in stock assessments could lead to more conservative quotas and resulting revenue losses in the fishing industry. Changes in fishing behavior from offshore wind development may necessitate new management measures. BOEM expects that changes in regulated fishing effort in response to future offshore wind activities will cause long-term, widespread, moderate beneficial impacts on commercial and for-hire recreational fisheries as management adapts to changing fishing patterns, data availability, and management options.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, ongoing activities would have continuing temporary to long-term impacts on commercial fisheries and for-hire recreational fishing, primarily through port use, vessel activity, other offshore development, climate change, and fisheries management. BOEM anticipates that the impacts of ongoing activities would be long term and **moderate** to **major**. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change associated with ongoing activities.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and planned non-offshore wind activities, including port expansions, new cable emplacement and maintenance, and future marine transportation and fisheries use, would contribute to impacts on commercial fisheries and for-hire recreational fishing. Planned offshore wind activities would affect commercial fisheries and for-hire recreational fishing through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic.

BOEM anticipates that cumulative impacts of the No Action Alternative would have long-term, **moderate** to **major** adverse impacts on commercial fisheries and **minor** to **moderate** adverse impacts on for-hire recreational fishing. These impacts would occur primarily due to the increased presence of offshore structures (cable protection measures and foundations) that could reduce fishing access and increase the risk of fishing gear damage or loss, regulated fishing effort, and climate change. The extent of adverse impacts would vary by fishery and fishing operation due to differences in target species, gear type, and predominant location of fishing activity. The impacts could also include long-term, **moderate** beneficial impacts for some for-hire recreational fishing operations due to the artificial reef effect. With mitigation measures implemented across all offshore wind projects, including WTG spacing and orientation measures to better accommodate commercial fishing vessels transiting the Lease Areas and typical commercial fishing path orientations, offshore cable burial to minimum depths deeper than trawl gear would penetrate, and financial compensation programs for fishing interests that have lost or entangled gear, the moderate to major impact rating for some commercial fisheries could decrease to moderate.

3.6.1.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on commercial and for-hire recreational fisheries:

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

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

- Number, size, location, and amount of scour protection for WTGs, as the level of hazard related to WTGs is proportional to the number of WTGs installed.
- Season of construction: Certain fisheries have peak times during the year. For-hire recreational fisheries are most active when the weather is more favorable, while commercial fishing is active year-round, with many species harvested throughout the year. However, construction activities can

affect access to fishing areas and availability of fish in the area, thereby reducing catch and fishing revenue.

Mayflower Wind has committed to measures to minimize impacts on commercial fisheries and for-hire recreational fishing such as developing and implementing a Fisheries Communication Plan (Mayflower Wind 2022). Mayflower Wind's Fishery Liaison Officer sits on boards and working groups with fisher and holds port hours in Point Judith, Rhode Island, New Bedford, Massachusetts, or virtually. Additionally, Mayflower Wind works with several fishery representatives such as the Massachusetts Lobstermen's Association, New Bedford Port Authority, and the Commercial Fisheries Center of Rhode Island. Lastly, Mayflower Wind and will work with fishers through a gear loss claim application form to determine if reimbursement is warranted.

3.6.1.5 Impacts of Alternative B – Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

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

Anchoring: Anchoring involves both anchoring of a vessel involved in the Project and the attachment of a structure to the sea bottom by use of an anchor or mooring. Anchoring vessels and other structures used in construction of the Project would pose a navigational hazard to fishing vessels. All impacts would be localized (within a few hundred meters of anchored vessels) and temporary (hours to days in duration). The Proposed Action would contribute up to 441.8 acres (1.8 square miles) of combined anchoring impacts on commercial fisheries and for-hire recreational fishing from planned activities in the Project area (COP Volume 1, Table 3-38; Mayflower Wind 2022). Although anchoring impacts would primarily occur during Project construction, some impacts could also occur during O&M and conceptual decommissioning. Therefore, the adverse effects of offshore wind energy-related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long term, though periodic in nature, and moderate.

Cable emplacement and maintenance: The Proposed Action would entail a maximum of approximately 1,676 miles (2,697 kilometers) of new cable installation, which includes 497 miles (800 kilometers) of interarray cables and 1,179 miles (1,897 kilometers) of offshore export cables. Mayflower Wind proposes to bury all cables to a target depth of 3.2 to 13.1 feet (1 to 4 meters) (Mayflower Wind 2022); this is well below the typical depth to which bottom trawls penetrate the ocean floor. In a study of seabed depletion and recovery from bottom trawl disturbance, Hiddink et al. (2017) found that hydraulic dredges penetrated the ocean floor the deepest at 6.3 inches (16.1 centimeters). While it is possible that cables could become uncovered during extreme storm events or other natural processes, burial to the target depth would minimize the risk of exposure and potential damage to fishing gear.

Pre-installation activities and cable laying disturbs the seabed and can reduce water quality through resuspension of sediment, increase underwater noise, or introduce artificial lighting; and can result in a behavioral response from mobile finfish species and injury or death of less-mobile species or benthic infauna such as scallops, surfclams, and ocean quahogs; as well as alter the seabed profile (Section 3.5.5). These responses could decrease catchability for a fishery, such as by changing the species composition where seabed profiles are changed or due to behavioral disturbances. Impacts (disturbance, displacement, injury, and mortality) of new cable emplacement and maintenance under the Proposed Action alone are estimated to affect up to 2,480 acres (10.6 square kilometers) of seafloor in the export cable route corridors and 1,408 acres (5.7 square kilometers) in the Lease Area (COP Volume 1, Tables 3-29 and 3-30; Mayflower Wind 2022). Behavioral responses of target species in commercial and for-hire recreational fisheries are expected to be confined to a small area at any one time, and to end shortly after construction activities end. Benthic species such as sea scallops and ocean quahogs would also be expected to readily repopulate cable areas once the offshore cables are installed and buried. Cable inspection and repair activities would result in types of impacts similar to those of construction activities, with temporary disturbance, displacement, injury, or mortality of target species. However, the areas of impact would be expected to be minor and the duration of impacts to be temporary.

Cable-laying activities, including preparatory boulder and sand wave clearance activities, would directly disrupt commercial and for-hire recreational fishing activities in areas of active construction, although disruption in any given area would be temporary. Existing aquaculture leases would be avoided to the extent practicable. Boulder clearance would be performed using a combination of grapnel plow, orange peel grabber, or a boulder clearance plow, while sand wave clearance may be undertaken by traditional dredging methods such as a trailing suction hopper or water injection dredge, or by a constant flow excavator, with the ultimate method chosen based on the results from the site investigation, surveys, and cable design (COP Volume 1, Table 3-16; Mayflower Wind 2022).

Boulder clearance, sand wave clearance, and cable laying disturbs the seabed and can reduce water quality through resuspension of sediment, increase underwater noise, or introduce artificial lighting and can result in a behavioral response from mobile finfish species and injury or death of less-mobile species or benthic infauna such as scallops, surfclams, and ocean quahogs, as well as alter the seabed profile. In turn, these responses could decrease catchability for a fishery, such as by changing the species composition where seabed profiles are changed or due to disturbances causing fish to not bite at hooks or changing swim height. The maximum impact for boulder field clearance and sand wave clearance would be 116.5 acres (0.47 square kilometer). Additionally, grapnel runs along 100 percent of the Brayton point cable route (124 miles [200 kilometers]) and the interarray cable layout (up to 497.1 miles [800 kilometers]) would be conducted (COP Volume 1, Section 3.4.1.1.1, Table 3-29 and Table 3-30; Mayflower Wind 2022). Approximately 555 acres (2.2 square kilometers) of seabed would be affected by Brayton Point grapnel runs assuming two 19.7 feet (6 meters) wide corridors for each cable bundle. Approximately 1,184 acres (4.79 square kilometers) of seabed would be affected along the interarray cables assuming a 19.7-foot- (6 meter)-wide corridor for each cable (COP Volume 1, Section 3.4.1.1.1, Table 3-29 and Table 3-30; Mayflower Wind 2022). New cable emplacement and maintenance are estimated to affect up to 2,334 acres (9.44 square kilometers) of seafloor within the export cable route. The relocation of boulders also could increase the risk of gear snags, as uncharted or unknown obstructions could result in damage to equipment, lost revenue, and potential safety impacts. Behavioral responses of target species in commercial and for-hire recreational fisheries are expected to be confined to a small area at any one time, and to end shortly after construction activities end. Cable inspection and repair activities would result in types of impacts similar to those of construction activities, with temporary disturbance, displacement, injury, or mortality of target species. Impacts would be moderate and short term.

Noise: Noise impacts associated with offshore construction activities for up to 149 WTGs/OSPs, including pile driving, trenching for cable placement, O&M activities, G&G investigations, and vessels, could cause indirect impacts on commercial and for-hire recreational fisheries in the Wind Farm Area through their direct impacts on species targeted by the commercial and for-hire fisheries. See Section 3.5.5 for a full description of noise impacts on fish and invertebrates. Most noise impacts on species would be short term and behavioral in nature, with most finfish species avoiding the noise-affected areas, while invertebrates may exhibit stress and behavioral changes such as discontinuation of feeding activities. The greatest impact would be from pile driving and the impulse noise impacts it would create, as pile driving is the only human-made, non-blasting sound source that has killed or caused hearing loss in fish in the natural environment (Kirkpatrick et al. 2017). Impulse noise from pile driving may exceed physiological sound thresholds for some species, resulting in injury or mortality, especially for affected species in the immediate vicinity (less than 164 feet [50 meters]), although many studies found no statistically significant change in direct mortality, even at distances of less than 33 feet (10 meters) (Kirkpatrick et al. 2017). To reduce potential impacts from pile driving, Mayflower Wind has committed to using ramp-up procedures to allow mobile species to leave the area prior to experiencing the full noise impact of pile driving (COP Volume 2, Table 16-1; Mayflower Wind 2022).

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

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

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

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

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

Port utilization: Construction of the proposed Project would require a range of both construction and support vessels, including vessels for transferring crew, transporting heavy cargo, and conducting heavy lifts, as well as multipurpose vessels and barges. All of these vessels would add traffic to port facilities and would require berthing. For the proposed Project, Mayflower Wind will use one or more of several Marshalling Ports. These ports are located in Sheet Harbor, Canada; New London, Connecticut; New Bedford, Massachusetts; Salem Massachusetts; Providence, Rhode Island; and Virginia. These ports are locations where Project components may be delivered from the manufacturer, may be partially assembled, or may be pre-commissioned and subsequently transferred to the installation site (COP Volume 1, Section 3.3.14.1, Figures 3-39 and 3-40; Mayflower Wind 2022). Based on information provided by Mayflower Wind, construction activities (including offshore installation of WTGs, substations, array cables, interconnection cable, and export cable) would require a daily average of 15–35 vessels depending on construction activities, with an expected peak of 50 vessels in the Lease Area at one time (COP Volume 1, Section 3.3.14.1, Table 3-21; Mayflower Wind 2022). In total, the Proposed Action would generate approximately 6,600 vessel trips during the construction and installation phase. Typical large construction vessels used in this type of project range from 325 to 350 feet (99 to 107 meters) in length, from 60 to 100 feet (18 to 30 meters) in beam, and draft from 16 to 20 feet (5 to 6 meters) (Denes et al. 2021).

The ports that would be used by Mayflower Wind are also used by commercial fishing vessels and for-hire recreational fishing vessels. For example, New Bedford ranked in the top ten for commercial fishing revenue attributed to catch from the Lease Area in the years 2008–2019. It ranked number one in average yearly landings (871,931 pounds [395,501 kilograms]) and number two in total revenue ($448,858) (COP Volume 2, Section 11.1.1.1.1, Table 11-6; Mayflower Wind 2022). The additional vessel volume in the ports associated with Project operations could cause vessel traffic congestion, difficulties with navigating, an increased risk for collisions, and reduced access to high-demand port services (e.g., fueling and provisioning) by existing port users, including commercial and for-hire recreational fishing vessels. However, Mayflower Wind proposes to employ a Fisheries Liaison Officer to communicate Project-related vessel movements with non-Project-related vessels and implement communication protocols to minimize adverse impacts on other users (COP Volume 2, Table 16-1; Mayflower Wind 2022). As a result, the adverse impact on commercial fisheries and for-hire recreational fishing would be long-term and moderate to major during construction. These same impacts would occur during decommissioning of the Project, although no data are available for the number of vessels that would be required. During O&M the number of vessels needed to service offshore wind farms would drastically reduce from the construction and installation phase. Mayflower Wind estimates 1-3 vessel trips between the Lease Area and ports per day will occur during O&M. Additionally, vessels would be dispersed throughout the region, lessening the number of vessels at any one port.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through navigation hazards (including transmission cable infrastructure) and allisions (collisions with stationary objects), entanglement or gear loss/damage, fish aggregation, habitat conversion, and space use conflicts, including potential vessel collisions (Section 3.6.6).

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

Under the Proposed Action, Mayflower Wind proposes to install up to 147 WTGs extending up to 1,066.3 feet (325 meters) above MLLW with spacing of 1-by-1 nautical miles (1.9 by 1.9 kilometers) between WTGs (Mayflower Wind 2022). The Project design orients the WTG arrays uniformly in both north-south and east-west orientations, commensurate with the rest of the Massachusetts/Rhode Island wind energy lease areas, to create straight-route orientations to maximize safe navigation amongst all lease areas (COP Volume 1, Section 2.1.2.1, Figure 2-1; Mayflower Wind 2022).

The presence of WTG arrays may restrict fishing vessel maneuverability (including risk of allisions) in the Wind Farm Area. Fishermen have expressed specific concerns about fishing vessels operating trawl gear that may not be able to safely deploy and operate in an offshore wind lease area given the size of the gear, the spacing between the WTGs, and the space required to safely navigate, especially with other vessels present and during poor weather conditions. Trawl and dredge vessel operators have commented that spacing less than 1 nautical mile (1.9 kilometers) between WTGs may not be enough to operate safely due to maneuverability of fishing gear and gear not directly following in line with vessel orientation. Clam industry representatives (Atlantic surfclam and ocean quahog fisheries) state that their operations require a minimum distance of 2 nautical miles (3.7 kilometers) between WTGs, in alignment with the bottom contours, for safe operations (BOEM 2021a; RODA 2021). Additionally, certain fixed and mobile gear fishing patterns established amongst fishers in southern New England waters may be altered. Navigating through the Wind Farm Area would not be as problematic for for-hire recreational fishing vessels, which tend to be smaller than commercial vessels and do not use large external fishing gear (other than hook and line) that makes maneuverability difficult. However, trolling for highly migratory species (e.g., bluefin tuna) may involve deploying many feet of lines and hooks behind the vessel and then following large pelagic fish once they are hooked, which poses additional navigational and maneuverability challenges around WTGs (BOEM 2021a).

Mayflower Wind's Navigation Safety Risk Assessment (NSRA) (Mayflower Wind 2022) concluded that the risk (i.e. allision, collision, grounding) of vessels in the area will increase by 0.4 vessel accidents per year; 70 percent of this increase (0.248 vessel accidents/year) is attributed to fishing vessels. The majority of the risk increase is due to the risk of a vessel striking a project structure (i.e., allision). Additionally, commercial fishing vessels routinely transit through the Lease Area, primarily through the northern portion as a transit route to fishing grounds farther offshore. The study does recognize that, depending on the exact type and length of gear being used, the distances between the WTGs may limit safe fishing patterns in the Project area. While Mayflower Wind's NSRA shows that it is technically feasible to navigate and maneuver fishing vessels and mobile gear through the Lease Area, BOEM is cognizant that maneuverability in the Wind Farm Area may vary depending on many factors, including vessel size, fishing gear or method used, and environmental conditions such as wind, sea state, current, and visibility. In addition, BOEM recognizes that even when it is feasible to fish in the Lease Area, some fishers might still not consider it safe to do so. Furthermore, operating in the Lease Area with other vessels and gear types present may restrict vessel maneuverability.

Because of the height of WTGs above the ocean surface, they would be visually detectable at a considerable distance during the day and easily detected by vessels equipped with radar regardless of the time of day. To further ensure navigational safety, all WTGs and OSPs would be lit and marked in accordance with USCG, BOEM, and IALA guidelines, and WTG locations would be charted by NOAA and could include protocols for sound signals, radar beacons, and AIS, which would be finalized with consideration for other such private aids to navigation in the area (i.e., foghorns) in coordination with USCG. Some fishing vessels operating in or near the Wind Farm Area may experience radar clutter and shadowing. Most instances of interference could be mitigated through the proper use of radar gain control (Mayflower Wind 2022). Impacts on navigation can also be mitigated with AIS and electronic chart systems, which many fishing vessels use, as well as use of additional watchstanders (National Academies of Sciences, Engineering, and Medicine 2022).

Notwithstanding these safety measures, some fishers have commented that, because of safety considerations, they would not enter an offshore wind array during inclement weather, especially during low-visibility events (Kirkpatrick et al. 2017). During interviews with commercial fishers, ten Brink and Dalton (2018) found that fishers had concerns that low visibility, wind, or crew exhaustion could lead to vessels hitting WTGs. Moreover, mechanical problems, such as loss of steerage, could result in an allision with a WTG as the vessel drifts during repair (Mayflower Wind 2022). Aside from these potential navigational issues, some commercial fishers may avoid the Lease Area if large numbers of recreational fishers are drawn to the area by the prospect of higher catches. According to ten Brink and Dalton (2018), the influx of recreational fishers into the Block Island Wind Farm in Rhode Island caused some commercial fishers to cease fishing in the area because of vessel congestion and gear conflict concerns. In addition, if these concerns cause commercial fishers to shift their fishing effort to areas not routinely fished, conflict with existing users could increase as other areas are encroached. In general, the potential for conflict among commercial fishers due to fishing displacement may be higher for fishers engaged in fisheries that have regulations that constrain where fishers can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may also increase if mobile species targeted by commercial fishers, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to the Wind Farm Area, and fishers targeting these species concentrate their fishing effort in the Lease Area as a result. As described in Section 3.6.1.3, the presence of gear entanglement hazards and navigational hazards associated with structures in the Lease Area may cause some fishers to seek alternative fishing grounds, switch the species they target or the gear they use, or leave the fishery altogether. Each of these scenarios requires adaptive behavior and risk tolerance, traits that are not universally shared by all fishers (O'Farrell et al 2019). Fishers that are willing to seek alternate fishing grounds may experience increased operating costs or lower revenue. Fishers that switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishers to land their catch in different ports (Papaioannou et al. 2021), which could increase operational costs depending on where the port is located.

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

Some fishing vessel operators unwilling or unable to travel through or deploy fishing gear in the Lease Area may be able to find suitable alternative fishing locations and continue to earn revenue, although it is difficult to predict the ability of fishing operations displaced by the Project to locate alternative fishing grounds that would allow them to maintain revenue targets while continuing to minimize costs, and some vessel operators may choose not to seek alternate fishing grounds. If a vessel operator chooses to seek alternate fishing locations, the available data suggest the presence of alternative productive fishing grounds in proximity to the Lease Area, especially for the two highest revenue-producing FMP species in the Lease Area: longfin squid and Jonah crab (COP Appendix V, Section 2.4.1, Table 2-79; Mayflower Wind 2022). The figures in the COP (COP Appendix V, Figures 2-17 through 2-20; Mayflower Wind 2022) indicate that the fishing level efforts in large expanses of ocean within 30 nautical miles (55.6 kilometers) of the Lease Area are comparable to or higher than those in the Lease Area. While comparable fishing grounds may exist in proximity to the Lease Area, shifting locations could result in increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less-productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. However, if, at times, a fishery resource is only available in the Lease Area, some fishers, primarily those using mobile gear, may lose the revenue from that resource for the time the resource is inaccessible. Not all fishers would seek alternative fishing grounds, though some may switch the species they target. Those vessel operators switching species targeted may also lose revenue from targeting a less valuable species and increased costs from switching gear type. All of these impacts could remain until decommissioning of the Project is complete, although the magnitude of the impacts would diminish over time if fishing practices adapt to the presence of structures.

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

The average amount of commercial fishing revenue that would be exposed annually, over the life of the Project is estimated to be $2,267,287 in the Offshore Project area (COP Volume 2, Section 11.1.1.4.1, Tables 11-10 through 11-12; Mayflower Wind 2022). The commercial species proportionally most affected in the Offshore Project area, in the context of the region, is longfin squid with approximately 0.6 to 3.29 percent of all landings coming from the Offshore Project area. Landings from the export cable corridors largely drive this trend although catch was highly variable in the period considered (2008–2018). The species with the highest average annual revenue in the Lease Area from 2008 to 2021 is Jonah crab with an average annual value of $76,028; in terms of pounds landed, the Lease Area contributes less than 1 percent of total Jonah crab landings for Massachusetts, Rhode Island, Connecticut, New York, and New Jersey. While New Bedford, Massachusetts, and Point Judith, Rhode Island, are the most valuable ports that operate in the Project area (COP Appendix V, Section 2.3, Table 2-68; Mayflower Wind 2022), smaller Rhode Island ports such as Tiverton and Little Compton are most exposed to the Proposed Action with 7.7 and 3.4 percent of their total revenue, respectively, at risk in the Project area (COP Appendix V, Section 2.3, Table 2-64; Mayflower Wind 2022).

As described above, the amount of fishing activity that could be affected in the Lease Area is a small fraction of the amount of fishing activity in the New England and Mid-Atlantic regions as a whole. However, for fishing vessels that choose to avoid the Wind Farm Area, that have historically derived a large percentage of their total revenue from the area, and are unable to find suitable alternative fishing locations, the adverse impacts would be long term and major. While a small number of commercial fishing vessels fish heavily in the Lease Area, the highest percentage of total annual revenue attributed to catch within the Lease Area was 23 percent in 2018. However, three-quarters of the vessels fishing in the area derived less than 0.16 percent of their total revenue from the area in 2008 through 2019 (Section 3.6.1.1). In short, some vessels depended heavily on the Lease Area, but most vessels derived a small percentage of their total annual revenue from the area. In both cases, the impacts could be long term if the respective vessels choose to avoid the Lease Area, but the level of impact for vessels deriving only a small percentage of their revenue from the area would be substantially less than for vessels that derive a large portion of their revenue from the Lease Area. Considering the low revenue risk across ports, together with the small number of vessels and fishing activity that would be affected by the Project, the impacts on other fishing industry sectors, including seafood processors and distributors and shoreside support services, would be long term and minor to major, depending on the fishery in question.

Annual exposure of revenue for for-hire recreational fishing specific to the Lease Area is not available from NMFS (2021g). However, BOEM conducted an economic analysis of recreational for-hire boats, as well as for-hire and private-boat angler trips that might be affected by the overall Massachusetts Wind Energy Area, of which the Lease Area is a part (Kirkpatrick et al. 2017). Recreational fishing was considered "exposed" to potential impact if at least part of the trip occurred within 1 nautical mile (1.9 kilometers) of a wind lease area during the study period (2007–2012). Recreational fisheries in Massachusetts, New York, and Rhode Island all fished in the WEA. Massachusetts was the most exposed at 4.4 percent, with a negligible amount from New York and Rhode Island for which approximately 0.5 percent of the revenue was exposed (Kirkpatrick et al. 2017). On average, approximately 3,872 for-hire boat trips and 54,118 for-hire angler trips were made from a home port in Massachusetts annually during this period. Of these annual estimates, approximately 0.6 percent of boat trips and 0.1 percent of for-hire angler trips were estimated to be exposed to the Massachusetts Wind Energy Area (Kirkpatrick et al. 2017). The majority of for-hire recreational fishing in the Wind Energy Area originates from Narragansett, Rhode Island, and Montauk, New York, but only accounted for 0.1 and ~0 percent of angler trips at each port, respectively (Kirkpatrick et al. 2017).

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

In areas where seabed conditions might not allow for cable burial, other methods of cable protection would be employed, such as rock placement, concrete mattress placement, front mattress placement, rock bags, or seabed spacers. It is anticipated that up to 10 percent of the offshore cable may require additional cable protection where burial depth may be less than 3 feet (1 meter). In addition to cable armoring, the Project would install up to approximately 1,751 acres (6.86 square kilometers) of scour protection for the 149 installed foundations. The scour protection would extend out 62 yards (57 meters) from the foundations and have a layered thickness of 8.2 feet (2.5 meters) and, similar to cable armoring, would pose a risk to entanglement and gear loss for commercial fishers, as well as gear loss for for-hire recreational fishers because hook and line fishing could be more challenging, as the fish (especially large migratory fishes) could use foundations and the scour protection to break free.

Cable, WTG, and OSP locations would be indicated on nautical charts, helping to reduce the potential for fishing gear interactions. Additionally, while Mayflower Wind does not currently plan to establish formal exclusion/safety zones around construction vessels during the laying of cables, USCG may implement safety zones, as described in Mayflower Wind's Fisheries and Communication and Outreach Plan (COP Appendix X; Mayflower Wind 2022). Mayflower Wind plans to employ a Fisheries Liaison to coordinate outreach to the fishing industry and disseminate information regarding Project activities such as Project vessel movements and construction schedule to minimize potential adverse interactions between commercial and for-hire recreational fisheries and Project operations. Additionally, Mayflower Wind has developed a financial compensation policy to be used when interactions between the fishing industries and Project activities or infrastructure cause gear loss or damage (COP Volume 2, Table 16-1; Mayflower Wind 2022). The use of this policy for qualifying gear interactions that may occur during operations and maintenance, is considered part of the Proposed Action and would help reduce potentially moderate adverse impacts for commercial fisheries to minor impacts.

Impacts due to entanglement and gear damage/loss would persist for the duration of Project operations. During decommissioning of the Project, all foundations for WTGs and OSP would be removed below the mudline, and BOEM would most likely require that the scour protection be removed in accordance with 30 CFR 585.902(a), eliminating the opportunities for entanglement and gear damage/loss. However, if left in place, the scour protection would continue to pose an indefinite threat for entanglement and gear damage/loss. Offshore cables may be either left in place or removed depending on the regulatory requirements at the time of decommissioning, although it is assumed that all interarray cables would be removed. Any scour protection or materials (e.g., concrete mattresses) that were used to protect exposed cables permitted to be left in-situ would continue to affect bottom trawl fisheries as well as for-hire recreational fishing due to possible entanglement and gear loss.

In addition to posing hazards to fishing gear, the presence of the WTG foundations and associated scour protection, as well as cable protection, would convert existing sand or sand with mobile gravel habitat to hard bottom, which, in turn, would reduce the habitat for target species that prefer soft-bottom habitat (e.g., surfclams, sea scallops, summer flounder) and increase the habitat for target species that prefer hard-bottom habitat (e.g., lobster, striped bass, black sea bass, Atlantic cod). Where WTG foundations, scour, and cable protection produce an artificial reef effect and attract finfish and invertebrates, the aggregation of species could increase the catchability of target species (Kirkpatrick et al. 2017). Although species that rely on soft-bottom habitat would experience a reduction in favorable conditions, the impacts from structures are not expected to result in population-level impacts (Section 3.5.5) and changes to species biomass are not expected to be significant enough to affect total quotas.

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

The Proposed Action is expected to add up to 149 foundations and 369 acres (1.5 square kilometers) of hard protection atop cables and 1,719 acres (6.95 square kilometers) of foundation scour protection. Foundations and scour/cable protection would remain for the life of the Project. This could tend to slow migration. However, water temperature is expected to be a bigger driver of habitat occupation and species movement (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact is anticipated to be negligible and would only last for the duration of the Project, as the foundations and scour/cable protection would be removed during decommissioning.

Traffic: The installation of offshore components for the Project and the presence of construction vessels (15 to 35 construction vessels operating at any given time) and O&M vessels (up to 1-3 vessel trips per day) could temporarily restrict fishing vessel movement and thus transit and harvesting activities in the Project area and along the cable routing areas. It could also lead to traffic congestion and an increased risk for collisions. Further, Mayflower Wind would implement construction safety zones and coordinate with fishers on courses of action for areas temporarily closed due to construction activities (COP Volume 2, Table 16-1; Mayflower Wind 2022). Mayflower Wind would employ a Fisheries Liaison to keep the fishing industry aware of Project vessel movements, construction timeline, and other information to help minimize conflicts and potential vessel collisions. Regardless of safety zones, fishing vessels would likely steer clear of construction vessels to avoid potential collisions and damage to their fishing gear. In doing so, fishing vessels could either forfeit fishing revenue or relocate to other fishing locations and continue to earn revenue. However, vessels that choose to relocate could incur increased operating costs such as increased fuel costs due to longer transit times to and from more distant fishing grounds and additional crew compensation due to more days at sea, among other factors. They could also experience lower revenue due to fishing potentially less-productive fishing grounds, potentially having to switch to less-valuable species, and potentially encountering more competition for a given resource.

After construction is complete, WTG foundations and associated scour protection may produce an artificial reef effect, potentially increasing fish and invertebrate abundance within a facility's footprint (Section 3.5.5), as well as recreational fishing use. Some commercial fishers may avoid the Lease Area if large numbers of recreational fishers are drawn to the area by the prospect of higher catches (ten Brink and Dalton 2018). If these congestion concerns cause commercial fishers to shift their fishing effort to areas outside of the Lease Area to areas not routinely fished, conflict with existing users could increase as other areas are encroached upon. In general, the potential for conflict among commercial fishers due to fishing displacement may be higher for fishers engaged in fisheries that have regulations that constrain where fishers can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may also increase if mobile species targeted by commercial fishers, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to offshore wind energy facilities by the artificial reef effect, and fishers targeting these species concentrate their fishing effort in the Project area as a result. Overall, the adverse effects of vessel traffic on commercial and for-hire fishing vessels are expected to be moderate and long term. Similar impacts would also occur during decommissioning of the Project. Once fully decommissioned, navigational and fishing hazards (e.g., WTG foundations and interarray cables) would be removed, minimizing space use conflicts and vessel traffic impacts previously caused by the wind farm.

Cumulative Impact of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities that have the greatest impacts on commercial fishing and for-hire recreational fishing are regulated fishing effort and climate change.

Anchoring from the Proposed Action and other offshore wind activities would result in localized, short-term, moderate cumulative impacts on commercial fisheries and for-hire recreational fishing, primarily as a result of navigational hazards that are introduced when multiple offshore wind projects overlap in the same area as fishing or transiting fishing vessels. The incremental contributions of the Proposed Action to the combined anchoring effects of ongoing and planned activities would be appreciable given the size of the area that would be affected by the Proposed Action. The 442 acres (178 hectares) of seafloor disturbed by anchoring under the Proposed Action would represent 14 percent of the estimated 3,072 acres (1,243 hectares) of seafloor that would be disturbed from anchoring on the OCS due to existing and planned offshore wind farms, including the Proposed Action.

The 3,888 acres (1,573 hectares) of seabed disturbance from cable emplacement associated with the proposed Project represents only 2 percent of the 185,710 acres (75,154 hectares) of seabed expected to be disturbed on the OCS due to existing and planned offshore wind farms, including the Proposed Action. In context of reasonably foreseeable environmental trends, the Proposed Action would incrementally contribute to minor cumulative impacts from new cable emplacement and maintenance, primarily due to fishing vessel displacement during installation.

Planned offshore wind activities would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving followed by vessels. The 149 structures for the Proposed Action represent only 5 percent of the 3,094 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action, although some foundations from the Proposed Action and other wind farms may be installed without pile driving. Project vessels would represent only a small fraction of the large volume of existing traffic in the geographic analysis area. The contribution of the Proposed Action to the combined noise impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind, would depend on the timing and overlap of disturbance areas and could rise to a minor to moderate level.

Other offshore wind projects would result in similar impacts as the Proposed Action from port utilization, although vessel traffic that would contribute to congestion at ports would be spread out across ports along the Atlantic OCS. The Proposed Action would incrementally contribute to the combined impacts associated with port utilization from ongoing and planned activities, which would likely be negligible to minor.

BOEM expects that the presence of structures associated with the Proposed Action would contribute a noticeable increment to the combined presence of structure impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind. The 149 structures for the Proposed Action represent 5 percent of the 3,094 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms. The increased number of structures would increase the risk of highly localized and periodic impacts on commercial fisheries that could be major, and impacts on for-hire recreational fishing that could be minor for those trolling for highly migratory species or minor to moderately beneficial due to increased fishing opportunities for other for-hire recreational fisheries.

The Proposed Action in combination with ongoing and planned activities would result in increased vessel traffic during construction, as well as during O&M activities, resulting in moderate cumulative impacts on commercial fishing and for-hire recreational fishing. Impacts would be most pronounced during periods of overlapping construction (Table D2-1, Appendix D) that result in increased vessel congestion and the potential for fishing displacement, vessel collisions, and gear conflict.

Conclusions

Impacts of the Proposed Action: Project construction and installation, O&M, and conceptual decommissioning could affect port and fishing access, as well as transit and harvesting activities, fishing gear interactions, and target species catch. BOEM anticipates that the adverse impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing would vary by fishery and fishing operation due to differences in target species abundance in the Project area, gear type, and predominant location of fishing activity. It is conceivable that some of the small number of fishing operations that derive a large percentage of their total revenue from areas where Project facilities would be located would choose to avoid these areas once the facilities become operational. In the event that these specific fishing operations are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is estimated that the majority of vessels that fish in the Lease Area, are not overly reliant on the Lease Area, with the majority of fishers deriving less than 5 percent of their revenue from the Lease Area. In addition, the impacts of the Proposed Action could include long-term, minor beneficial impacts for some for-hire recreational fishing operations due to the artificial reef effect. Therefore, BOEM expects that the impacts resulting from the Proposed Action would range from **minor** to **major**, depending on the fishery and fishing operation. If BOEM's recommendations related to project siting, design, navigation, access, safety measures, and financial compensation are implemented across all offshore wind energy projects as identified in *Guidelines for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf* (BOEM 2022), adverse impacts on commercial fisheries could be reduced.

Cumulative Impacts of the Proposed Action: The incremental impacts contributed by the Proposed Action to the cumulative impacts on commercial fisheries and for-hire recreational fishing would be appreciable. BOEM anticipates that the cumulative impacts on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be **major** because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with implementation of applicant-committed measures. This impact rating is primarily driven by the presence of offshore structures, climate change, and regulated fishing effort. The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind industry. However, given the array of measures available to mitigate impacts of offshore wind projects on commercial fisheries and for-hire recreational fishing, this impact rating is driven mostly by reduced stock levels from ongoing fishing mortality because of regulated fishing effort, changes in the abundance and distribution of fish and invertebrates associated with ongoing climate change, and permanent impacts from the presence of structures associated with planned offshore wind projects.

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

Impacts of Alternative C: Under Alternative C, the Brayton Point offshore export cable would be routed onshore to avoid fisheries impacts in the Sakonnet River. Alternative C-1 and Alternative C-2 would reduce the offshore cable route by 9 and 12 miles (14.5 and 19.3 kilometers), respectively, reducing the disturbances associated with vessel anchoring, increased vessel traffic, cable emplacement and maintenance, and noise associated with underwater construction and maintenance when compared to the Proposed Action. Alternative C-1 could help avoid adverse impacts on juvenile cod HAPC, which could have indirect positive impacts on the commercial and for-hire fisheries by improving juvenile recruitment into the fishery and helping the stock rebuild. Both alternatives, particularly Alternative C-2, however, would pass through areas known to have floating fish traps, a fishery unique to Rhode Island (COP Volume 2, Figure 11-21; Mayflower Wind 2022), which may temporarily affect access to the traps during cable-laying activities. Additionally, the southern New England skate bait fishery has a trawl exemption that extends from southern Massachusetts, Rhode Island, and Connecticut down to the southern shore of Long Island with most of the catch occurring around Block Island and some catch south of the Sakonnet River (NOAA 2022b). In particular, Little Compton, Rhode Island is reliant on skate bait (Ferrio pers comm. 2022). Impacts on the skate bait fishery can cause bait prices to increase, as other species are targeted for bait, and can create bait supply issues in the fisheries (lobster, crab) that rely on bait. During construction, vessels landing skate bait in Little Compton, Rhode Island may be displaced by cable-laying activities for Alternative C-2; however, this impact is expected to be temporary and impacts overall would be similar to the Proposed Action.

The primary benefits to commercial and recreational fishing would be a reduction of 52 acres (21 hectares) and 70 acres (28 hectares) of ECC seabed disturbance and permanent cable protection in the Sakonnet River for Alternative C-1 and Alternative C-2, respectively. By relocating the offshore export cable onshore, Alternative C-1 and Alternative C-2 would avoid impacts on recreational harvest of shellfish and finfish that occurs in the Sakonnet River, compared to the Proposed Action. Further, for bottom-tending mobile gear operating during construction activities, the potential for vessel collisions would be reduced.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be slightly reduced but similar to those under the Proposed Action.

Conclusions

Impacts of Alternative C: The anticipated impacts associated with Alternative C-1 and Alternative C-2 would not be substantially different from those of the Proposed Action. While these alternatives could slightly change the impacts on commercial fisheries and for-hire recreational fishing, ultimately the same or highly similar construction, O&M, and decommissioning impacts would still occur. The only difference would be for recreational and commercial fishers that exclusively use the Sakonnet River, in particular aquaculture lease holders and floating fish trap fishers. These individuals would experience negligible to major impacts from offshore wind development. Generally, aquaculture lease holders would benefit from a cable reroute to land; however, floating fish traps may be affected by either Alternative C-1 or Alternative C-2, as the reroute puts the cable in areas known to have fish traps. However, the areas of impact would be expected to be minor and the duration of impacts to be temporary because they would be localized and short-term (due to fishing vessel displacement/floating trap displacement).

Additionally, the reduction in the Brayton Point export cable corridor equates to a 2 to 3 percent reduction of the total miles of installed offshore cable. For most fishers, the exposed revenue that could be affected would not differ greatly from that under the Proposed Action. When considering all of the IPFs, the impact on commercial fisheries and for-hire recreational fishing would still be **minor** to **major**.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, BOEM anticipates that cumulative impacts on commercial fisheries and for-hire recreational fishing associated with Alternative C-1 and Alternative C-2 would be **major**, the same level as under the Proposed Action, because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely.

3.6.1.7 Impacts of Alternative D on Commercial Fisheries and For-Hire Recreational Fishing

Impacts of Alternative D: Alternative D would eliminate up to six WTGs in the northeastern portion of the Lease Area to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals. By reducing the overall footprint of the Project, Alternative D would provide more area in the northeastern portion of the Lease Area for commercial fishing vessels to operate and fish without potential impacts from structures, slightly reducing the potential for gear entanglement and loss, as well as allisions. According to VMS and vessel trip reporting data from the Northeast Ocean Data Portal, fisheries benefiting the most from removal of the WTGs under Alternative D would be the squid and pelagic fisheries and fisheries engaged in bottom trawling (COP Appendix V, Figure 2-18 and Figure 2-19; Mayflower Wind 2022). Given the small size of the added structure-free area, any additional revenue realized by the commercial fishery would likely be minimal and dependent on the targeted species that may be in that particular area and whether commercial fishers are willing to fish that part of the Lease Area.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to or slightly less than those described under the Proposed Action.

Conclusions

Impacts of Alternative D: The anticipated **minor** to **major** impacts associated with Alternative D would not be substantially different than those of the Proposed Action. While Alternative D would slightly reduce the impacts on commercial fisheries and for-hire recreational fishing by installing up to six fewer WTGs, ultimately the same or highly similar construction, O&M, and decommissioning impacts would still occur. Any additional revenue realized by commercial fisheries would be minimal, and for-hire recreational fishing may see a slight decrease due to fewer structures providing reef habitat for targeted species. When considering all of the IPFs, the impact on commercial fisheries and for-hire recreational fishing would still be minor to major.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts on commercial fisheries and for-hire recreational fishing associated with Alternative D would be **major**, the same level as under the Proposed Action, because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely.

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

Impacts of Alternative E: Alternative E includes the use of all piled (Alternative E-1), all suction bucket (Alternative E-2), or all GBS (Alternative E-3) foundations for WTGs and OSPs. For 147 WTGs including scour protection, the maximum permanent footprint would be smallest under Alternative E-1 with a total footprint of 370 acres (150 hectares) (monopile) or 384 acres (155 hectares) (pin-pile), Alternative E-2 with a footprint of 720 acres (292 hectares), and Alternative E-3 with a footprint of 1,698 acres (687 hectares) (COP Volume 1, Table 37; Mayflower Wind 2022). For five OSPs including scour protection, the maximum permanent footprint would be smallest for Alternative E-2 at 25 acres (10 hectares), Alternative E-1 at 49 acres (20 hectares), and Alternative E-3 at 58 acres (23 hectares).

Alternative E-1 would likely not provide any additional impacts on commercial and recreational fishing than the Proposed Action. Compared to Alternative E-1, Alternatives E-2 and E-3 would expand space taken up in the water column and/or benthos from WTGs, OSPs, and scour protection that would need to be avoided by bottom-tending mobile gear, increasing the potential for gear entanglement and loss and displacement of bottom-tending mobile gear fishing vessels from the Lease Area. Conversely, the larger foundations would increase artificial reef effects that may benefit recreational fisheries and pot/trap commercial fisheries. Further, Alternative E-2 and Alternative E-3 may reduce the potential for displacement, injury, and mortality of commercial/recreational fish species, from construction noise, as impulsive pile-driving would not be used.

Cumulative Impacts of Alternative E: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternative E would be similar to those described under the Proposed Action for

Alternative E-1 and would be greater than those described under the Proposed Action for Alternatives E-2 and E-3.

Conclusions

Impacts of Alternative E: The anticipated **minor** to **major** impacts associated with Alternative E would not be substantially different than those of the Proposed Action. While this alternative could slightly change the impacts on commercial fisheries and for-hire recreational fishing, ultimately the same or highly similar construction, O&M, and decommissioning impacts would still occur, with the potential exception of non-impulsive construction noise associated with Alternatives E-2 and E-3. Impacts on commercial and recreational fishers would be long-term, for the duration of O&M. Revenue realized by commercial fisheries across the alternatives would be similar, and for-hire recreational fishing may see a slight increase due to differences in structures providing reef habitat for targeted species. When considering all of the IPFs, the impact on commercial fisheries and for-hire recreational fishing would still be minor to major.

Cumulative Impacts of Alternative E: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative E on commercial fisheries and for-hire recreational fishing would be **major**, the same level as under the Proposed Action, because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely.

3.6.1.9 Impacts of Alternative F on Commercial Fisheries and For-Hire Recreational Fishing

Impacts of Alternative F: Under Alternative F, the Falmouth offshore export cable route would include up to three cables compared to up to five cables under the Proposed Action, which would reduce seafloor disturbance by approximately 700 acres (283 hectares). Impacts from cable emplacement and anchoring may be reduced due to the lesser number of cables installed. To the extent that the installation of fewer cables would reduce construction activity, BOEM anticipates that behavioral responses, such as avoidance of the area, from target species may also be reduced, but any difference in impacts compared to the Proposed Action would be minimal and temporary during construction. Installation of only three cables would require less hard cable protection, which would reduce the potential for gear entanglement and loss. While some reduction in impacts would occur—because temporary construction impacts and long-term operational impacts from cable installation would still occur and there would be no change in other offshore components—the overall impact magnitude would be the same as the Proposed Action. The use of an HVDC converter OSP is not anticipated to have a meaningful difference in impacts on commercial fisheries compared to the Proposed Action.

Cumulative Impacts of Alternative F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative F would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative F: The anticipated **minor** to **major** impacts associated with Alternative F would not be substantially different than those of the Proposed Action. Impacts associated with construction and installation would be short-term; however, any impacts resulting from hardtop scour protection would be long-term.

Cumulative Impacts of Alternative F: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative F would result in **major** impacts, the same level as under the Proposed Action, because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely.

3.6.1.10 Proposed Mitigation Measures

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

- **Compensation for Gear Loss and Damage:** Mayflower Wind would implement a gear loss and damage compensation program consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment. BOEM recognizes that Mayflower Wind has an applicable gear loss and damage claims process resulting from survey activities and is proposing a similar process for Project O&M activities described in COP Volume 2, Table 16-1 (Mayflower Wind 2022). This measure, if adopted, would be applicable to the IPF presence of structures during both construction and operations. If adopted, this measure would reduce negative impacts resulting from loss of gear associated with uncharted obstructions resulting from the Proposed Action.
- **Compensation for Lost Fishing Income:** Mayflower Wind would implement a compensation program for lost income for commercial and recreational fishers and other eligible fishing interests for construction and operations consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment. This measure, if adopted, would reduce impacts from the IPF presence of structures by compensating commercial and recreational fishing interests for lost income during construction and a minimum of 5 years post-construction. Levels of funding required by Mayflower Wind to be set aside for fulfilling verified claims would be commensurate with those estimates in the Mayflower COP (COP Volume 2, Section 11.1.1.4.1, Tables 11-10 through 11-12; Mayflower Wind 2022). If adopted, this measure would reduce the minor to major impact level from the presence of structures to minor to moderate. This is because a compensation scheme could mitigate "indefinite" impacts to a level where the fishing community would have to adjust somewhat to account for disruptions due to impacts but income losses would be mitigated.

- **Mobile Gear–Friendly Cable Protection Measures:** Cable protection measures should reflect the pre-existing conditions at the site. This mitigation measure, if adopted, ensures that seafloor cable protection does not introduce new hangs for mobile fishing gear (reducing impacts from the presence of structures IPF). Therefore, the cable protection measures should be trawl-friendly with tapered/sloped edges. If cable protection is necessary in “non-trawlable” habitat, such as rocky habitat, then Mayflower Wind would use materials that mirror that benthic environment.
- **Fishing Gear and Anchor Strike Incident Reporting:** Mayflower Wind would report fishing gear and anchor strike incidents that fall below or are not captured by the regulatory thresholds outlined in 30 CFR §§ 585.832 and 585.833. Reports would be filed annually during construction and decommissioning and every 5 years during operations.

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

3.6 Socioeconomic Conditions and Cultural Resources

3.6.2 Cultural Resources

This section discusses potential impacts on cultural resources from the proposed Project, alternatives, and ongoing and planned activities in the cultural resources geographic analysis area. The cultural resources geographic analysis area, as shown on Figure 3.6.2-1, is equivalent to the Project's area of potential effects (APE), as defined in the implementing regulations for NHPA Section 106 at 36 CFR Part 800 (Protection of Historic Properties). See Appendix I, Section I.1.3, *Area of Potential Effects*, for a complete description of the delineated Project APE. In 36 CFR 800.16(d), the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist." BOEM (2020) defines the Project APE as the following.

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities, constituting the marine portion of the APE.
- The depth and breadth of terrestrial areas potentially impacted by any ground-disturbing activities, constituting the terrestrial portion of the APE.
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible, constituting the visual portion of the APE.
- Any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the APE.

The phrase *cultural resource* refers to a physical resource valued by a group of people. A resource can date to the pre-Contact (i.e., the time prior to the arrival of Europeans in North America), post-Contact, or both periods. The range of common resource types includes archaeological sites, buildings, structures, objects, districts, and traditional cultural properties (TCPs) and may be listed on national, state, or local historic registers or be identified as being important to a particular group during consultation. Federal, state, and local regulations recognize the public's interest in cultural resources. Many of these regulations, including NEPA and NHPA, require a project to consider how it might have impacts on significant cultural resources. For a more detailed discussion of cultural resource types, see Section 3.6.2.1, *Description of the Affected Environment and Future Baseline Conditions*.

The phrase *historic property*, as defined in the NHPA (54 USC § 300308), refers to any "prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places [National Register; NRHP], including artifacts, records, and material remains related to such a property or resource." The term *historic property* also includes National Historic Landmarks (NHLs), as well as properties of traditional religious and cultural importance to tribal nations that meet National Register criteria.

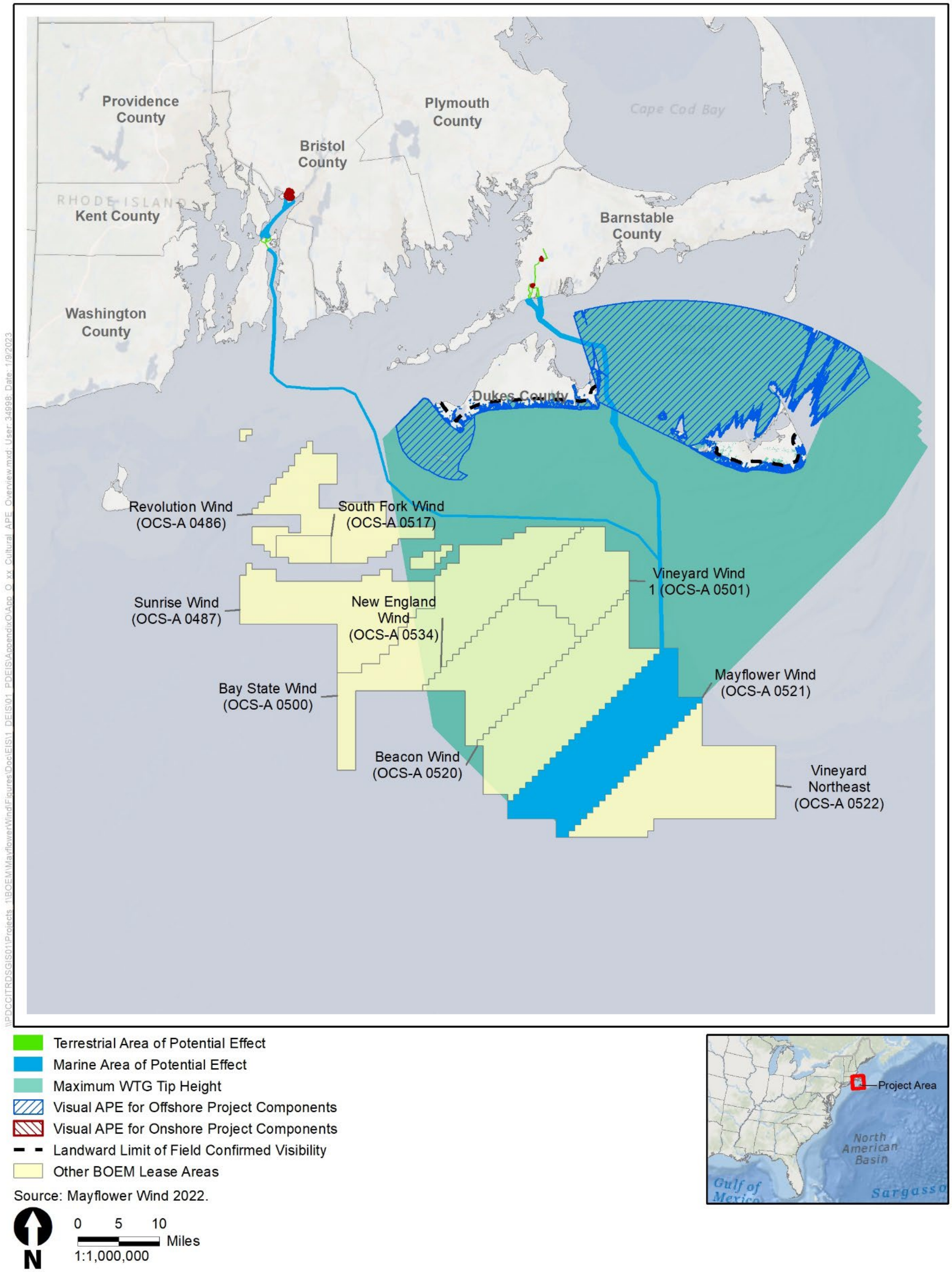


Figure 3.6.2-1. Cultural resources geographic analysis area for the Proposed Action

3.6.2.1 Description of the Affected Environment and Future Baseline Conditions

This section discusses baseline conditions in the geographic analysis area for cultural resources as described in the COP (Volume 2, Section 7.0; Mayflower Wind 2022), supplemental COP cultural resources studies (COP Appendices S, Q, and R; Mayflower Wind 2022), and Appendix I, *Determination of Effect for NHPA Section 106 Consultation*. Specifically, this includes marine and terrestrial areas potentially affected by the proposed Project's seabed- or ground-disturbing activities, areas where structures from the Proposed Action would be visible, and the area of intervisibility where structures from both the Proposed Action and other offshore wind projects would be visible simultaneously.

Mayflower Wind has conducted onshore and offshore cultural resource investigations to identify known and previously undiscovered cultural resources in the marine, terrestrial, and visual portions of the APE. Table 3.6.2-1 presents a summary of the pre-Contact period and post-Contact period cultural context of the Project area in Massachusetts and Rhode Island and is largely based on the Project's Terrestrial Archaeological Resources Assessment (TARA) (COP Appendix R; Mayflower Wind 2022).

Table 3.6.2-1. Cultural context of the Project area in coastal Massachusetts and Rhode Island

Period	Date	Description
Paleoindian	12,500–10,000 BP	Earliest human occupation of American continents. Glacial lakes provided the basis for hunting and gathering opportunities. Populations may have been big-game hunters but also may have favored a flexible generalist subsistence strategy exploiting a wide range of food resources. People organized in small, mobile groups. Use of fluted projectile points, though known affiliated archaeological resources are scarce, likely due to inundation from post-glacial sea level rise.
Archaic	10,000–3,000 BP	Period subdivided into Early (10,000–8,000 BP), Middle (8,000–6,000 BP), and Late (6,000–3,000 BP) phases. Refers to pre-ceramic populations that occupied the deciduous forests of Eastern Woodlands. Compared to Paleoindian period, larger bands, increasing population, longer stays at base camps, and increased activities at camps. Increase in tool types for access to broader resource base.
Woodland	3,000–450 BP	Development of ceramic technologies. Cultivation of domesticated plants and intensification of plant food base. Increased sedentism, permanent settlements, and population sizes. Diversifying stone toolkit over the period.
Contact	450–300 BP/ AD 1500–1620	Evidence of European exploration within New England by 1498, at which time Cape Cod is home to thousands of Native Americans. Native Americans engaged in agricultural activities. Economic exchange among Europeans and Native Americans occurs. Disease and violence brought by Europeans leads to catastrophic depopulation of Native Americans in region, shaping relations.
Plantation	AD 1620–1675	Plymouth Plantation founded in 1620 as the first permanent European settlement within region. Plymouth Colony given legal patent for claim to Cape Cod in 1630, leading to establishment of Sandwich (1638), Barnstable (1638), and Yarmouth (1639). Agriculture, animal husbandry, fishing, and whaling are primary industries within Cape Cod and Plymouth Colony. Increased tensions between Native Americans and Europeans as more European settlers arrive and Native American land disappears. Inequalities grow between the English and Native Americans.

Period	Date	Description
Colonial	AD 1675–1775	King Philip's War (1675 to 1678) spurred by tensions between Wampanoags and English and execution at Plymouth of three Wampanoags. Cape Cod largely unaffected by the war. Following King Philip's War, historical accounts of Native Americans decrease, and English presence within Cape Cod greatly increases. In addition to farming and fishing, whaling becomes important within Cape Cod; Native Americans are employed in industry as means of survival. Dispersed farms settled throughout Cape Cod. French and Indian War occurs from 1754 to 1763, though Cape Cod itself does not see battles. Between the 1760s and 1770s, "English-style" homes begin to replace wigwams as the Mashpee seek to improve perceived social ranking.
Federal	AD 1775–1830	During the Revolution, Cape Cod becomes an important area for defense of the coast. Military service greatly affects Cape Cod. By 1777, people of Cape Cod are lacking basic needs, and industry is at a stand-still. After the war, industry and commerce returns to Cape Cod, including sheep husbandry, agriculture, fishing, salt production, and manufacturing. Transportation within Cape Code increases. War of 1812, between United States and England, lasts from 1812 to 1815 and greatly affects Cape Cod. From 1775 to 1830, Native American population and their land holdings decline. Overall, there is limited information on Native Americans during this time.
Early Industrial	AD 1830–1870	During the nineteenth century, whaling continued to decrease, particularly in towns near the Onshore Project area. There is variety of industrial and agricultural activities including salt production, livestock, and agriculture. Packet boats, steam ships, and stagecoaches are popular modes of travel until the opening of railroad in 1848. Native Americans continue to live on Cape Cod. The Mashpee Revolt of 1833 illustrates how Native Americans were able to exercise political agency over their lands within framework of an otherwise oppressive system. In the three decades leading to the Civil War, Cape Cod acts as a port of entry for the Underground Railroad. Cape Cod was only affected by military recruitments during the Civil War, as battles did not occur north of Pennsylvania; over 2,000 men from Cape Cod served.
Late Industrial	AD 1870–1915	Following the Civil War, Cape Cod experiences general decline in all economic sectors, principally agriculture and fishing. In the 30 years following the Civil War, the fishing industry steadily declines and never returns to its peak. By the end of the nineteenth century, tourism increasingly plays a large role in Cape Cod's economy and is aided by development and improvement of railroads, increase in housing construction, and the vacancy of land formerly used for agriculture. Other commercial ventures include clothing stores, a hardware store, jewelry stores, a shoe store, and druggists. Manufacturing on Cape Cod is not as prevalent until the later nineteenth century. By the end of the century, few records mention Native Americans.
Modern	AD 1915–Present	By the twentieth century, railroad use declines as the automobile becomes the primary means of transportation. Prior to World War II, Cape Cod was identified as a viable candidate for a new National Guard camp, with land on Cape Cod approved for military training. Cape Cod becomes less isolated from construction of roads, establishment of commercial air service, and widening of the Cape Cod Canal. Economy primarily relies on tourism and tourist-related services. Other economic activities included whaling, fishing, and agriculture, with whaling disappearing around 1920. During World War II, farming slightly increases on Cape Cod but continues to decline after the war.

Source: COP Appendix R; Mayflower Wind 2022.
AD = Anno Domini; BP = before present.

For the purposes of this analysis, cultural resources are divided into several types and subtypes: marine cultural resources (i.e., marine archaeological resources and ancient submerged landform features), terrestrial archaeological resources, and historic aboveground resources. These broad categories may include archaeological or historic aboveground resources with cultural or religious significance to Native American tribes.

Archaeological resources are the physical remnants of past human activity that occurred at least 50 years ago. These remnants can include items left behind by past peoples (i.e., artifacts) and physical modifications to the landscape (i.e., features). This analysis divides archaeological resources into those that are submerged underwater (i.e., marine) and those that are not (i.e., terrestrial). *Ancient submerged landform features* (ASLFs) are landforms that have the potential to contain Native American archaeological resources inundated and buried as sea levels rose at the end of the last Ice Age; additionally, Native American tribes in the region may consider ASLFs to be TCPs or tribal resources representing places where their ancestors lived. *Historic aboveground resources* include standing buildings, bridges, dams, and other structures of historic or aesthetic significance. *TCPs* are places, landscape features, or locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community; they may have either or both archaeological and aboveground elements. *Historic districts* may be composed of a collection of any of the resources described above. The discussion of cultural resources in this section is divided by the marine, terrestrial, and visual portions of the APE and may be further discussed in relation to onshore and offshore Project components.

As a subcategory of marine cultural resources, marine archaeological resources in the region include pre-Contact and post-Contact archaeological resources that are submerged underwater. Based on known historic and recent maritime activity in the region, the marine portion of the APE (hereafter referred to as the *marine APE*) has a high probability for containing shipwrecks, downed aircraft, and related debris fields (BOEM 2012; COP Appendix Q; Mayflower Wind 2022). Marine geophysical archaeological surveys performed for the Proposed Action identified 46 potential marine archaeological resources in the marine APE: five in the Lease Area, 16 in the Falmouth ECC, and 25 in the Brayton Point ECC (Appendix I, Table I-4; COP Appendix Q; Mayflower Wind 2022). Four other marine archaeological resources that were identified in Mayflower Wind's surveys are outside of the marine APE and, therefore, not subject to potential impacts from the Project. These resources include both known and potential shipwrecks and related debris fields from the historic and recent (i.e., less than 50 years ago) eras. A total of 32 of the 46 resources in the marine APE were recommended to be historic properties potentially eligible for listing in the NRHP.

Marine cultural resources also include ASLFs on the OCS (BOEM 2012). Marine geophysical archaeological surveys performed for the Proposed Action identified nine ASLFs in the marine APE (Appendix I, Table I-5; COP Appendix Q; Mayflower Wind 2022). Seven other ASLFs that were identified in Mayflower Wind's surveys are below the maximum vertical extent of the marine APE and, therefore, not subject to potential impacts from the Project. Additionally, one TCP previously determined eligible for listing in the NRHP (i.e., Nantucket Sound) was identified in the marine APE. ASLFs within or near the defined Nantucket Sound TCP boundary may be considered as contributing elements to the TCP. The extent of marine cultural investigations performed for the Proposed Action does not enable conclusive determinations of eligibility for listing identified ASLFs in the NRHP; as such, all ASLFs are assumed eligible for listing in the NRHP and are, therefore, historic properties.

Cultural resource investigations performed for the Proposed Action in the terrestrial portion of the APE (hereafter referred to as the *terrestrial APE*) identified two terrestrial archaeological resources that may be eligible for listing in the NRHP and one historic aboveground resource presently listed in the NRHP (Mount Hope Bridge) (COP Appendix R; Mayflower Wind 2022). The terrestrial APE intersects the Mount Hope Bridge boundary as defined by the National Park Service. Mount Hope Bridge has been determined to be significant and eligible for listing in the NRHP under criteria unrelated to potential archaeological elements, and the structure itself is not subject to physical impacts from the Proposed Action.

As of January 2023, terrestrial Phase IB archaeological surveys have not been fully completed in the terrestrial APE. As such, currently undiscovered but potential terrestrial archaeological resources may exist in presently unsurveyed areas of the terrestrial APE. In consultation with BOEM and the relevant state historic preservation office (SHPO), Mayflower Wind will be using a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for the remaining areas of the terrestrial APE identified in the Terrestrial Archaeology Phased Identification Plan (COP Appendix R.2; Mayflower Wind 2022). Completion of Phase IB archaeological surveys during the phased process may lead to the identification of archaeological resources in the terrestrial APE. BOEM will use the Memorandum of Agreement (MOA) to establish commitments for reviewing the sufficiency of any supplemental terrestrial archaeological investigations as phased identification; assessing effects on historic properties; and implementing measures to avoid, minimize, or mitigate impacts in these areas prior to construction. See Appendix I, Section I.5, *Phased Identification and Evaluation*, for additional details on the phased process and Appendix I, Attachment A, for the Draft MOA.

The visual portion of the APE (hereafter referred to as the *visual APE*) includes a visual APE for offshore Project components and visual APE for onshore Project components. Cultural resources review of the visual APE for offshore Project components identified 16 historic aboveground resources and three TCPs (i.e., Chappaquiddick Island, Nantucket Sound, and Vineyard Sound and Moshup's Bridge). Of these resources, 14 would have a potential view of the offshore Project components, including one National Historic Landmark (NHL), three NRHP-listed historic properties, seven historic aboveground resources presently unevaluated for NRHP eligibility, and all three NRHP-eligible TCPs. Cultural resources review of the visual APE for the onshore Project components (i.e., landfall locations of the two export cable corridors and possible substations or converter stations) identified 13 historic aboveground resources; two historic aboveground resources are within the Falmouth, Massachusetts, portion of the visual APE for onshore components, and 11 historic aboveground resources are in the Brayton Point, Massachusetts, portion of the visual APE for onshore components (COP Volume 2, Section 7.3, Appendices S and S.1; Mayflower Wind 2022). Of these 13 historic aboveground resources in the visual APE for onshore Project components, two would have views of the proposed Lawrence Lynch substation in Falmouth. For the purposes of this Project, previously identified historic aboveground resources and TCPs without previous eligibility determinations are considered eligible for listing in the NRHP.

3.6.2.2 Impact Level Definitions for Cultural Resources

This Draft EIS uses a four-level classification scheme to characterize potential impacts on cultural resources (including historic properties under Section 106) resulting from Project alternatives, including the Proposed Action, as shown in Table 3.6.2-2.

Table 3.6.2-2. Definitions of potential adverse impact levels for cultural resources by type

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(1).	A. No cultural resources subject to potential impacts from ground- or seabed-disturbing activities; or B. All disturbances to cultural resources are fully avoided, resulting in no damage to or loss of scientific or cultural value from the resources.	A. No measurable impacts; or B. No physical impacts and no change to the integrity of resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or C. All physical impacts and disruptions are fully avoided.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b). This can include avoidance measures.	A. Some damage to cultural resources from ground- or seabed-disturbing activities, but there is no loss of scientific or cultural value from the resources; or B. Disturbances to cultural resources are avoided or limited to areas lacking scientific or cultural value.	A. No physical impacts (i.e., alteration or demolition of resources) and some limited visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to historic or aesthetic settings are short-term and expected to return to an original or comparable condition (e.g., temporary vegetation clearing and construction vessel lighting).
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be altered in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, but the adversely affected property would remain eligible for the NRHP.	As compared Minor Impacts: A. Greater extent of damage to cultural resources from ground- or seabed-disturbing activities, including some loss of scientific or cultural data; or B. Disturbances to cultural resources are minimized or mitigated to a lesser extent, resulting in some damage to and loss of scientific or cultural value from the resources.	As compared to Minor Impacts: A. No or limited physical impacts and greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to settings are minimized or mitigated; or C. Historic or aesthetic settings may experience some long-term or permanent impacts.

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Major	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be affected in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association to the extent that the property is no longer eligible for listing in the NRHP.	As compared to Moderate Impacts: A. Destruction of or greater extent of damage to cultural resources from ground- or seabed-disturbing activities; or B. Disturbances are minimized or mitigated but do not reduce or avoid the destruction or loss of scientific or cultural value from the cultural resources; or C. Disturbances are not minimized or mitigated resulting in the destruction or loss of scientific or cultural value from the resources.	As compared to Moderate Impacts: A. Physical impacts on cultural resources (for example, demolition of a cultural resource onshore); or B. Greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance, including long-term and/or permanent impacts; or C. Disruptions to settings are not minimized or mitigated.

3.6.2.3 Impacts of Alternative A – No Action on Cultural Resources

When analyzing the impacts of the No Action Alternative on cultural resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for cultural resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario.*

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.6.2.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities in the geographic analysis area that contribute to impacts on cultural resources in onshore areas include ground-disturbing activities and the introduction of intrusive visual elements, while the primary sources of impacts on cultural resources in offshore areas include seabed-disturbing activities. Onshore and offshore construction activities and associated impacts are expected to continue at current trends, range in severity from minor to major, and have the potential to result in impacts on cultural resources.

Ongoing offshore wind activities in the geographic analysis area that would contribute to impacts on cultural resources include ongoing construction of the Vineyard Wind 1 project (62 WTGs and 1 OSP) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSP) in OCS-A 0517. Ongoing construction of these projects would result in impacts on cultural resources through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, gear utilization, land disturbance, lighting, noise, presence of structures, and traffic. Ongoing construction of the Vineyard Wind 1 and South Fork projects would have the same type of impacts on cultural resources that are described in *Cumulative Impacts of the No Action Alternative* for all ongoing and planned offshore wind activities in the geographic analysis area, but would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Other planned non-offshore wind activities that may have impacts on cultural resources include new submarine cables and pipelines, oil and gas activities, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Appendix D, Section D.2, for a complete description of planned activities). These activities may result in short-term, long-term, and permanent onshore and offshore impacts on cultural resources.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on cultural resources during construction, O&M, and decommissioning of the projects. Ongoing and planned offshore wind projects in the geographic analysis area that would contribute to impacts on cultural resources include those projects within all or portions of OCS-A-0486 (Revolution Wind), OCS-A-0487 (Sunrise Wind), OCS-A-0500 (Bay State Wind), OCS-A 0501 (Vineyard Wind 1), OCS-A 0517 (South Fork Wind), OCS-A-0520 (Beacon Wind), OCS-A 0522 (Vineyard Wind Northeast, formerly Liberty Wind), and OCS-A 0534 (New England Wind) (Appendix D, Table D2-1). Impacts on cultural resources are expected through the following primary IPFs.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, may pose long-term, infrequent risks to cultural resources. The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils. In the planned activities scenario, there would be a low risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs or substations offshore Massachusetts. The potential for accidental releases, volume of released material, and associated need for cleanup activities from offshore wind projects aside from the Proposed Action in the geographic analysis area would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard best management practices to prevent releases, and localized nature of such events. As such, the majority of individual accidental releases from offshore wind development would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts.

Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete removal of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment;

temporary or permanent impacts on the setting of coastal historic aboveground resources such as historic buildings, structures, objects, districts, significant landscapes, and TCPs; and damage to or removal of nearshore marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources.

Anchoring: Anchoring associated with ongoing commercial and recreational activities and the development of future offshore wind projects has the potential to cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction, O&M, and eventual decommissioning of future offshore wind energy facilities. Construction of offshore wind projects could result in impacts on cultural resources on the seafloor caused by anchoring in the geographic analysis area. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb marine archaeological resources and ASLFs on or just below the seafloor surface. The damage or destruction of marine cultural resources from these activities would result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts.

The scale of impacts on cultural resources would depend on the number of marine archaeological resources and ASLFs in offshore wind lease areas and offshore export cable corridors. Impacts on marine archaeological resources can typically be avoided through project design. The number, extent, and dispersed character of the ASLFs make avoidance difficult, while the depth of these resources makes mitigative measures difficult and expensive. It is unlikely that offshore wind projects would be able to avoid all of these resources. The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources. Specifically, as part of its compliance with the NHPA, BOEM requires offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, or mitigate impacts on these resources. As a result, impacts on marine cultural resources from anchoring would be localized and permanent, and range from negligible to major on a case-by-case basis, depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Cable emplacement and maintenance: Construction of future offshore wind infrastructure would have permanent, geographically extensive, adverse impacts on cultural resources. Future offshore wind projects would result in seabed disturbance from construction of structure foundations and interarray and offshore export cables. Other offshore wind development projects that are expected to lay cable in the geographic analysis area include Vineyard Wind 1 (Lease Area OCS-A 0501) and New England Wind (OCS-A 0534 and portion of OCS-A 0501), which would lay cables that cross the same offshore export cable corridor as the Proposed Action. There is the potential that other proposed projects in the

Massachusetts and Rhode Island lease areas that do not yet have published COPs may propose cable routes that also intersect the geographic analysis area. The 2012 BOEM study and the Proposed Action studies (BOEM 2012; COP Appendix Q; Mayflower Wind 2022) suggest that the offshore wind lease areas and export cable corridors of the future offshore wind projects would likely contain a number of marine archaeological resources and ASLFs, which could be subject to impacts from offshore construction activities.

As part of compliance with the NHPA, BOEM and SHPOs will require future offshore wind project applicants to conduct extensive geophysical surveys of offshore wind lease areas and export cable corridors to identify marine cultural resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction on marine cultural resources would be infrequent and isolated, and in cases where conditions are imposed to avoid marine cultural resources, impacts would be negligible to minor. However, if marine cultural resources cannot be avoided, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts. As such, across potential circumstances, the magnitude of impacts would range from negligible to major.

If present in a project area, the number, extent, and dispersed character of ASLFs make avoidance impossible in many situations and make extensive archaeological investigations of formerly terrestrial archaeological resources in these features logistically challenging and prohibitively expensive. As a result, offshore construction would result in geographically widespread and permanent adverse impacts on portions of these resources. For ASLFs that cannot be avoided, mitigation would likely be considered under the NHPA Section 106 review process, including studies to document the nature of the paleontological environment during the time these now-submerged landscapes were occupied and provide Native American Tribes with the opportunity to include their history in these studies. However, the magnitude of these impacts would remain moderate to major, due to their permanent, irreversible nature.

Gear utilization: Construction, O&M, and decommissioning of offshore wind activities may necessitate additional monitoring or geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. Other offshore wind projects in the geographic analysis area (i.e., Bay State Wind, Beacon Wind, Vineyard Wind Northeast [formerly Liberty Wind], New England Wind, Revolution Wind, South Fork Wind, Sunrise Wind, and Vineyard Wind 1) have the potential to conduct these additional surveys. The 2012 BOEM study and the Proposed Action studies (BOEM 2012; COP Appendix Q; Mayflower Wind 2022) suggest that the offshore wind lease areas and offshore export cable corridors of the offshore wind projects would likely contain a number of marine archaeological resources which could be subject to impacts from gear utilization.

As part of compliance with the NHPA, BOEM and SHPOs will require offshore wind project applicants to conduct extensive geophysical surveys of offshore wind lease areas and export cable corridors to identify marine cultural resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction on marine cultural resources would be infrequent and isolated. However, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided.

Land disturbance: The construction of onshore components associated with offshore wind projects, such as electrical export cables and onshore substations, could result in physical adverse impacts on known and undiscovered cultural resources. Ground-disturbing construction activities, including vegetation removal, excavation, grading, and placement of fill material, could disturb or destroy undiscovered archaeological resources and TCPs, if present. The number of cultural resources subject to impacts, scale and extent of impacts, and severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources and the proportion of the resource subject to impacts. State and federal requirements to identify cultural resources, assess project impacts, and develop historic property treatment plans (HPTPs) to avoid, minimize, or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources; as a result, if adverse impacts from this IPF occur, they would likely be permanent but localized, and range from negligible to major.

Lighting: Development of future offshore wind projects would increase the amount of offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night), and use of aircraft and vessel hazard/warning lighting on WTGs and OSPs during operation. Up to 901 WTGs, associated with other offshore wind projects excluding the Proposed Action, with a maximum blade tip height of 1,171 feet (357 meters) would be added within the geographic analysis area for cumulative visual effects on historic properties between 2023 and 2030 (Appendix D, Table D2-1).

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Some of the offshore wind projects could require nighttime construction lighting, and all would require nighttime hazard lighting during operations. Construction lighting from any project would be temporary, lasting only during nighttime construction, and could be visible from shorelines and elevated locations, although such light sources would be limited to individual WTGs or offshore substation sites rather than the entirety of the lease areas in the geographic analysis area. Aircraft and vessel hazard lighting systems would be in use for the entire operational phase of each future offshore wind project, resulting in long-duration impacts. The intensity of these impacts would be relatively low, as the lighting would consist of small, intermittently flashing lights at a significant distance from the resources.

The impacts of construction and operational lighting would be limited to aboveground cultural resources, such as historic aboveground resources and TCPs, on the coast of Massachusetts for which a dark nighttime sky is a character-defining feature that contributes to the historic significance and integrity of the resource. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources. While some WTGs in the geographic analysis area are as close as 12 miles (19 kilometers) from viewing areas, the vast majority of WTGs are over 15 miles (24 kilometers) from shoreline (Section 3.6.8, *Recreation and Tourism*). The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As a result, nighttime construction and decommissioning lighting would have temporary, intermittent, and localized minor impacts on a limited number of cultural resources. Operational lighting would have longer-term, continuous, and localized adverse impacts on a limited number of cultural resources.

Lighting impacts would be reduced if ADLS is used to meet FAA aircraft hazard lighting requirements. ADLS would activate the aviation lighting on WTGs and offshore substations only when an aircraft is within a predefined distance of the structures (for a detailed explanation, see Section 3.6.9, *Scenic and Visual Resources*). For the Proposed Action, the reduced time of FAA hazard lighting resulting from an ADLS, if implemented, would reduce the duration of the potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. The use of ADLS on future offshore wind projects other than the Proposed Action would likely result in similar limits on the frequency of WTG and offshore substation aviation warning lighting use. This technology, if used, would reduce the already low-level impacts of lighting on cultural resources. As such, lighting impacts on cultural resources would range from negligible to moderate.

Onshore structure lighting associated with future offshore wind projects could impact cultural resources. The magnitude of impact would depend on the height of the buildings or towers and the intensity of the lighting fixtures. The impacts on cultural resources from these lights would be minimized by the distance between the facilities and cultural resources, and the presence of vegetation, buildings, or other visual buffers that may diffuse or obscure the light. As such, lighting associated with onshore components from future offshore wind activities could have long-term, continuous, negligible to minor impacts on cultural resources.

Presence of structures: The development of other offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coasts of Massachusetts and Rhode Island. Up to 920 WTGs and OSPs would be added in the geographic analysis area for cumulative visual impacts on historic properties (Appendix D, Table D-2).

Impacts on cultural resources from the presence of structures would be limited to those cultural resources from which offshore wind projects would be visible, which would typically be limited to historic aboveground resources (e.g., buildings, structures, objects, districts, significant landscapes, and TCPs) relatively close to shorelines and on elevated landforms near the coast. The magnitude of impacts from the presence of structures would be greatest for historic aboveground 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 in the NRHP. While some WTGs in the geographic analysis area are as close as 12 miles (19 kilometers) from viewing areas, the vast majority of WTGs are over 15 miles (24 kilometers) from shoreline. Due to the distance between the reasonably foreseeable wind development projects and the nearest historic aboveground resources and TCPs, WTGs of individual projects would appear relatively small on the horizon, and the visibility of individual structures would be further affected by environmental and atmospheric conditions such as vegetation, clouds, fog, sea spray, haze, and wave action (for a detailed explanation, see Section 3.6.9). While these factors would limit the intensity of impacts, the presence of visible WTGs from offshore wind activities would have long-term, continuous, negligible to major impacts on cultural resources.

Additionally, the presence of onshore components associated with offshore wind projects, including substations, transmission lines, O&M facilities, and other components, would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources located within sight of these components in Massachusetts and Rhode Island. The magnitude of impacts from the presence of structures would be greatest for historic aboveground resources for which a setting free of modern visual elements is an integral part of their historic integrity and contributes to their eligibility for listing in the NRHP. Factors such as distance and visual buffers, including vegetation and buildings, would also affect the intensity of these impacts. While these factors would limit the intensity of impacts, the presence of onshore components associated with offshore wind activities would have long-term, continuous, negligible to major impacts on cultural resources.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, cultural resources would continue to be subject to impacts from existing environmental trends and ongoing activities. Ongoing activities are expected to have continued short-term, long-term, and permanent impacts (e.g., via disturbance, damage, disruption, destruction) on cultural resources. These impacts would be primarily driven by offshore construction impacts and the presence of structures and, to a lesser extent, onshore construction impacts. The primary sources of onshore impacts from ongoing activities include ground-disturbing activities and the introduction of intrusive visual elements, while the primary source of offshore impacts include activities that disturb the seafloor. Given the extent of known cultural resources in the region and extent of planned development on the OCS, ongoing offshore wind activities would noticeably contribute to impacts on cultural resources. While long-term and permanent impacts may occur as a result of offshore wind development, impacts would be reduced through the NHPA Section 106 consultation process to resolve adverse effects on historic properties. The No Action Alternative would result in **moderate** impacts on cultural resources.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and cultural resources would continue to be subject to impacts from natural and human-caused IPFs. Planned activities would contribute to impacts on cultural resources due to disturbance, damage, disruption, and destruction of individual cultural resources located onshore and offshore. BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **major** due to the extent of known cultural resources in the region subject to impacts.

3.6.2.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on cultural resources:

- Physical impacts on marine cultural resources (i.e., archaeological resources and ASLFs), depending on the location of offshore bottom-disturbing activities, including the locations where Mayflower Wind would embed the WTGs and OSPs into the seafloor in the Lease Area, and the location of the cables in the offshore ECCs.
- Physical impacts on terrestrial cultural resources (i.e., archaeological resources, historic aboveground resources, TCPs), depending on the location of onshore ground-disturbing activities.
- Visual impacts on cultural resources (e.g., historic aboveground resources), depending on the design, height, number, and distance of WTGs, offshore substations, and onshore Project components (e.g., onshore cables, substations, converter stations) visible from these resources.

Variability of the proposed Project design exists as outlined in Appendix C. The following summarizes the potential variances in impacts.

- WTG and OSP number, size, and location: If marine cultural resources cannot be avoided, impacts can be minimized with fewer WTGs and OSP footprints, smaller footprints, and the selection of footprint locations in areas of lower archaeological or ASLF sensitivity. Fewer WTGs could also decrease visual impacts on cultural resources for which unobstructed ocean views or a setting free of modern visual elements is a contributing element to historical integrity.
- WTG and OSP lighting: Arrangement and type of lighting systems could affect the degree of nighttime visibility of WTGs onshore and decrease visual impacts on cultural resources for which a dark nighttime sky is a contributing element to historical integrity.
- Size of scour protection around foundations: If marine cultural resources cannot be avoided, a smaller size of scour protection around foundations can minimize disturbance or destruction of marine cultural resources.
- Offshore cable (interarray, substation interconnector) burial location, length, depth of burial, and burial method: If marine cultural resources cannot be avoided entirely, specific location, length, depth of burial, and burial method could minimize disturbance or destruction of marine cultural resources.
- Onshore export cable corridor width and burial depth: Reduced width and burial depth to reduce overall volume of excavation in the export cable construction corridor could decrease potential for unanticipated disturbance of terrestrial archaeological resources.
- Landfall for offshore export cable installation method: Selection of trenchless installation over open-cut installation could have decreased potential for unanticipated disturbance of terrestrial archaeological resources.
- Onshore export cable corridor width and burial depth: Reduced width and burial depth to reduce overall volume of excavation in the export cable construction corridors could decrease potential for unanticipated disturbance of terrestrial archaeological resources. Additionally, the installation of

aboveground onshore export cables and associated towers would have lesser adverse impacts on terrestrial archaeology than the installation of underground onshore export cables.

Mayflower Wind has committed to several measures to avoid, minimize, or mitigate impacts on cultural resources as described in Appendix G, *Mitigation and Monitoring*, Table G-1 *Applicant-proposed measures*. Additionally, Mayflower Wind has committed to avoid impacts on specific marine cultural resources. See the Draft MOA (Appendix I, Attachment A) for additional information.

3.6.2.5 Impacts of Alternative B – Proposed Action on Cultural Resources

Under the Proposed Action, Mayflower Wind would install up to 147 WTGs, up to five OSPs, one onshore substation, one onshore converter station, and onshore and offshore cables, which would have negligible to minor impacts on most cultural resources but would potentially have moderate to major impacts on marine archaeological resources, ASLFs, terrestrial archaeological resources, historic aboveground resources, and TCPs.

Specifically, the Proposed Action may have negligible to major physical impacts on 46 marine archaeological resources (COP Appendix Q; Mayflower Wind 2022), nine ASLFs (COP Appendix Q; Mayflower Wind 2022), and two known terrestrial archaeological resources (COP Appendix R; Mayflower Wind 2022). The proposed Project may also have moderate visual impacts on two aboveground historic properties (Nantucket Historic District NHL and Oak Grove Cemetery) and one TCP (Chappaquiddick Island) (COP Appendices S and S.1; Mayflower Wind 2022). Lastly, the Project may have moderate physical and visual impacts on one TCP (Nantucket Sound) (COP Appendices S and S.1; Mayflower Wind 2022). See Appendix I, *Determination of Effect for NHPA Section 106 Consultation*, for a complete list of historic properties in the marine, terrestrial, and visual APEs for the Project.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, could have impacts on cultural resources. The WTGs, OSPs, and onshore substation associated with the Proposed Action would include storage for a variety of potential chemicals such as coolants, oils, lubricants, and diesel fuel (COP Volume 1, Table 3-26; Mayflower Wind 2022). The Proposed Action would also require use of several types of machinery, vehicles, ocean-going vessels, and aircraft from which there may be unanticipated release or spills of substances onto land or into receiving waters (COP Volume 1, Section 3.3.14; Mayflower Wind 2022). Overall, the potential for accidental releases, volume of released material, and associated need for cleanup activities from the Proposed Action would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard best management practices to prevent releases, and localized nature of such events.

The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils, trash, or debris. As such, the majority of potential individual accidental releases from the Proposed Action would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete destruction of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic aboveground resources such as buildings, structures, objects, and districts, significant landscapes, and TCPs; and damage to or destruction of nearshore marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources. Overall, the impacts on cultural resources from accidental releases from the Proposed Action would be localized, short-term, and negligible to major depending on the number and scale of accidental releases.

Anchoring: Anchoring associated with offshore activities of the Proposed Action could have impacts on marine cultural resources. Mayflower Wind's marine geophysical archaeological surveys identified 46 marine archaeological resources in the marine APE: five in the Lease Area, 16 in the Falmouth ECC, and 25 in the Brayton Point ECC. Additionally, the Nantucket Sound TCP and nine ASLFs—some of which may be contributing elements to the Nantucket Sound TCP—were identified in the marine APE.

The severity of impacts of this IPF would depend on the horizontal and vertical extent of disturbance relative to the size of the marine archaeological resource or ASLF subject to impacts. Mayflower Wind has presently committed to avoiding 11 of the 32 marine archaeological resources and two of the nine ASLFs recommended to be historic properties potentially eligible for listing in the NRHP; therefore, the Proposed Action would have negligible impacts on these resources (see Appendix I, Tables I-4 and I-5 for details). Mayflower Wind is presently determining the extent to which adverse impacts on the other 21 marine archaeological resources and seven ASLFs could be avoided; as such, BOEM finds that these resources would be subject to negligible to major impacts from the Proposed Action. If the Proposed Action is unable to avoid marine cultural resources due to design (e.g., the cultural resource crosses the entire offshore ECC), engineering, or environmental constraints, Mayflower Wind would work with the consulting parties, federally recognized Native American Tribes, BOEM, the Massachusetts Historical Commission (MHC; the Massachusetts SHPO), the Rhode Island Historical Preservation & Heritage Commission (RIHPHC; the Rhode Island SHPO), and the Massachusetts Board of Underwater Archaeological Resources (BUAR) to develop and implement minimization and mitigation plans for disturbance of known resources. BOEM anticipates that the number of adversely affected marine cultural resources that are historic properties may be refined through ongoing Section 106 consultations.

Based on this information, the impacts of the Proposed Action on marine cultural resources are expected to be localized and permanent, and would range from negligible to major depending on the ability of Mayflower Wind to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Cable emplacement and maintenance: The installation of interarray cables and offshore export cables would include site preparation activities (e.g., dredging, trenching), cable installation via jet trenching, plowing/jet plowing, or mechanical trenching, which could have impacts on marine cultural resources. The specific cultural resources subject to potential impacts, AMM measures, and potential range of severity and extent of impacts on cultural resources under this IPF are the same as those described under the *Anchoring* IPF for the Proposed Action. Overall, the impacts of the Proposed Action on marine cultural resources from this IPF are expected to be localized and permanent, and range from negligible to major depending on the ability of Mayflower Wind to avoid, minimize, or mitigate impacts.

Gear utilization: Construction, O&M, and decommissioning of the Proposed Action may necessitate additional monitoring or geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. The specific marine archaeological resources subject to potential impacts, AMM measures, and potential range of severity and extent of impacts on marine archaeological resources under this IPF would be the same as those described under the *Anchoring* IPF for the Proposed Action. Overall, the impacts of the Proposed Action on marine cultural resources from this IPF are expected to be localized and permanent, and range from negligible to major depending on the ability of Mayflower Wind to avoid, minimize, or mitigate impacts.

Land disturbance: Land disturbance associated with the construction of onshore Project components could have impacts on cultural resources. Components of the onshore facilities that are proposed to be buried underground or constructed in areas that are historically and currently used for industrial purposes may involve visual impacts during construction. However, these would be temporary, short-term impacts, and the underground components would not have any long-term visual impacts once built and operational (COP Volume 2, Section 7.3.2.1.1 and Appendix S; Mayflower Wind 2022). Overall, for historic aboveground resources, visual impacts of land disturbance related to the construction of onshore Project components would have negligible to minor impacts on the 13 historic aboveground resources identified in the visual APE for onshore Project components.

Ground-disturbing activities associated with construction (e.g., site clearing, grading, excavation, and filling) could have impacts on terrestrial archaeological resources. The number of resources subject to impacts would depend on the location of specific Project components relative to known and undiscovered cultural resources, and the severity of impacts would depend on the horizontal and vertical extent of disturbance relative to the size of the resources subject to impacts. Onshore cultural resource investigations conducted for the Proposed Action determined the Project could potentially impact two terrestrial archaeological resources and one historic aboveground resource (the Mount Hope Bridge) (COP Appendices R and S; Mayflower Wind 2022). The terrestrial APE intersects the Mount Hope Bridge boundary as defined by the National Park Service; however, the structure itself is not subject to physical impacts from the Proposed Action, and the Mount Hope Bridge has been determined to be significant and eligible for listing in the NRHP unrelated to potential archaeological elements. As such, BOEM anticipates negligible impacts on this historic property.

As of January 2023, terrestrial Phase IB archaeological surveys have not been fully completed in the terrestrial APE. As such, presently undiscovered terrestrial archaeological resources may exist in presently unsurveyed areas of the terrestrial APE. In consultation with BOEM and the relevant SHPO, Mayflower Wind will be using a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for the remaining areas of the terrestrial APE identified in the Terrestrial Archaeology Phased Identification Plan (COP Appendix R.2; Mayflower Wind 2022). Completion of Phase IB archaeological surveys during the phased process may lead to the identification of archaeological resources in the terrestrial APE. BOEM will use the MOA to establish commitments for reviewing the sufficiency of any supplemental terrestrial archaeological investigations; assessing effects on historic properties; and implementing measures to avoid, minimize, or mitigate impacts in these areas prior to construction. See Appendix I, Section I.5, *Phased Identification and Evaluation*, for additional details on the phased process and Appendix I, Attachment A, for the Draft MOA. Furthermore, Mayflower Wind has proposed to implement several AMM measures to reduce the risk of impacts on terrestrial archaeological resources, including siting onshore Project components to minimize impacts on terrestrial archaeological resources and monitoring in areas determined to have moderate to high potential for undiscovered archaeological resources (Appendix G, *Mitigation and Monitoring*).

Based on this information, the impacts of land disturbance from the Proposed Action on cultural resources are expected to be localized, range from short-term to permanent, and range from negligible to major. The degrees of impact on terrestrial archaeological resources depend on the findings from the completed Phase IB archaeological surveys and ability of Mayflower Wind to avoid, minimize, or mitigate impacts. BOEM anticipates that Mayflower Wind would implement plans to avoid, minimize, or mitigate impacts on cultural resources as aligned with MHC, RIHPHC, and NHPA requirements. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting: Use of lighting on onshore and offshore Project components associated with the Proposed Action could result in a change to the integrity of the historic setting of historic aboveground resources or TCPs by introducing new sources of light into historic contexts, both onshore and offshore (COP Volume 2, Section 7.3.2.2; Mayflower Wind 2022). Operational lighting would be required for the onshore substations and converter stations. Mayflower Wind has committed to minimizing and mitigating lighting impacts by working with the Towns of Falmouth, Somerset, and Portsmouth to ensure the lighting scheme complies with Town requirements, by ensuring that the design of outdoor light fixtures at the onshore substation complies with night sky lighting standards to the extent practicable, and by keeping lighting at the onshore substation to a minimum, with only a few lights illuminated for security reasons on dusk-to-dawn sensors and other lights utilizing motion-sensing switches so that the majority of lights will be switched on for emergency situations only (COP Volume 2, Section 16; Mayflower Wind 2022). Due to the developed nature of the visual APE for onshore Project components, the lights are not expected to contribute significantly to the sky glow given the existing light sources present in their respective areas. As a result, the 13 historic aboveground resources identified in the visual APE for onshore Project components in Falmouth and Brayton Point, Massachusetts, would likely experience negligible impacts from lighting.

The construction and decommissioning lighting impacts from the Proposed Action would be short term, and the intensity of nighttime construction lighting would be limited to the active construction area at any given time. Impacts would be reduced by the distance between the nearest construction area (i.e., the closest line of WTGs, which is approximately 23 miles from the southern shore of Nantucket Island) and the nearest cultural resources on the Massachusetts and Rhode Island coasts. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a character-defining feature that contributes to the historic significance and integrity of the resource. Additionally, lighting for construction and decommissioning activities at Brayton Point would be visible but temporary and would result in short-term and negligible visual impacts (COP Appendix S.1; Mayflower Wind 2022). Therefore, construction and decommissioning area lighting from the Proposed Action alone would have negligible impacts on cultural resources.

Construction of other offshore wind projects in the geographic analysis area would contribute similar lighting impacts from nighttime vessel and construction and decommissioning area lighting as under the Proposed Action. Nighttime construction and decommissioning lighting associated with the Proposed Action and other ongoing and planned activities including offshore wind would have negligible impacts on cultural resources.

The Proposed Action would include nighttime and daytime use of operational phase aviation and vessel hazard avoidance lighting on WTGs and OSPs. Mayflower Wind has committed to voluntarily implementing ADLS to reduce operational phase nighttime lighting impacts (COP Volume 1, Section 3.3.12; Mayflower Wind 2022; Appendix G, *Mitigation and Monitoring*). ADLS would only activate the required FAA aviation obstruction lights on WTGs and OSPs when aircraft enter a predefined airspace and turn off when the aircraft are no longer in proximity to the Wind Farm Area. Based on estimates from Mayflower Wind, ADLS-controlled obstruction lights would be activated for less than 5 hours per year (COP Appendix T, Section 5.1.3; Mayflower Wind 2022). It is estimated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. Therefore, the use of operational lighting on WTGs by the Proposed Action would result in negligible impacts on cultural resources.

Presence of structures: The presence of structures, including foundations and scour protection for WTGs and OSPs, in the Lease Area could have impacts on cultural resources. The presence of onshore substations, converter stations, transmission lines, and other project components could also have impacts on cultural resources in Falmouth and Brayton Point, Massachusetts. An Analysis of Visual Effects to Historic Properties (AVEHP) for the Proposed Action determined that the construction of the WTGs would adversely impact the Nantucket Historic District NHL and that the construction of onshore Project components would adversely impact the Oak Grove Cemetery (COP Appendix S; Mayflower Wind 2022). BOEM, in review of this analysis, has determined that the Nantucket Sound TCP and Chappaquiddick Island TCP would also experience an adverse effect. The study determined that an unobstructed ocean view, free of modern visual elements, is a contributing element to the NRHP eligibility of the NHL and both TCPs. Although the operational life of the Project is 35 years, and the WTGs and OSPs would be removed after that period, the presence of visible WTGs from the Proposed Action alone would have long-term, continuous, widespread, moderate impacts on these resources.

The AVEHP further determined that NRHP-eligible Oak Grove Cemetery, would experience an adverse impact due to the presence of the proposed Lawrence Lynch substation in Falmouth. The cemetery is associated with the rural cemetery movement and, as such, setting is an integral part of its significance. The introduction of the immediately adjacent modern substation will change this setting and, while vegetation between the building and cemetery would minimize visibility, there would be views of the building from the cemetery (COP Appendix S; Mayflower Wind 2022). Therefore, the presence of onshore Project components would have long-term, continuous, moderate impacts on this resource.

An AVEHP was also completed for the proposed onshore Project components in Brayton Point, Massachusetts. This AVEHP determined that the introduction of the onshore converter station site at Brayton Point would not adversely impact historic aboveground resources. While the introduction of new visual elements may result in viewshed impacts, they would either be temporary in nature or negligible. All but the uppermost portions of the highest converter station components would be screened from view and the remaining visible lightning-protection masts or other narrow, vertical components would be seen at a minimum distance of 0.44 mile (0.7 kilometer) and interspersed with existing industrial infrastructure, screening vegetation, or both. Therefore, potential visual impacts would not occur to an extent that would erode the historic integrity of setting for historic properties (COP Appendix S.1; Mayflower Wind 2022). To further minimize and mitigate the Proposed Action's impacts, Mayflower Wind has proposed to implement several AMM measures, including consulting with Tribal Nations and SHPOs and designing the onshore substation to mitigate visual impacts (Appendix G, *Mitigation and Monitoring*).

The final resolution of adverse effects on historic properties will be determined through BOEM's NHPA Section 106 consultation process and included as conditions of COP approval as established in the MOA.

Cumulative Impacts of the Proposed Action

Construction and installation, O&M, and decommissioning of the Proposed Action and other offshore wind projects could potentially have impacts on cultural resources. The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities.

In context of reasonably foreseeable trends, impacts from accidental releases from offshore wind projects would be similar to those of the Proposed Action and be negligible in most cases, except for rare cases of large-scale accidental release that represent major impacts. The overall impacts on marine cultural resources from accidental releases from the Proposed Action combined with those from ongoing and planned activities would range from localized, short-term, and negligible to geographically extensive, permanent, and major depending on the number and scales of accidental releases, if any. The Proposed Action, combined with impacts from ongoing and planned activities, could also impact marine cultural resources through anchoring, cable emplacement and maintenance, and gear utilization. BOEM anticipates that lead federal agencies and relevant SHPOs would require the applicants for offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. BOEM would also continue to require developers to avoid, minimize, or mitigate impacts on any identified marine cultural resources that are historic properties during construction, O&M, and decommissioning. BOEM has committed to working with applicants, consulting parties, federally recognized Native American Tribes, MHC, RIHPHC, and BUAR to develop specific HPTPs to address effects on marine cultural resources that cannot be avoided by proposed offshore wind development projects. Development and implementation of Project-specific HPTPs would likely reduce the magnitude of unmitigated impacts on marine cultural resources; however, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided. As a result, in context of reasonably foreseeable trends, the impacts on marine cultural resources from anchoring, cable emplacement and maintenance, and gear utilization from the Proposed Action, combined with impacts from ongoing and planned activities, would be localized and permanent, and range from negligible to major depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

In context of reasonably foreseeable trends, land disturbance (e.g., ground-disturbing construction activities) from offshore wind developments could result in impacts on known and undiscovered cultural resources (if present). BOEM anticipates that federal (i.e., NEPA and NHPA Section 106) and state-level requirements to identify cultural resources, assess impacts, and implement measures to avoid, minimize, or mitigate impacts would minimize impacts on cultural resources from the reasonably foreseeable wind developments. In context of reasonably foreseeable environmental trends, the Proposed Action, combined with ongoing and planned activities, would result in localized, short-term to permanent, and negligible to major impacts on cultural resources depending on the developers' abilities to avoid, minimize, or mitigate impacts of ground-disturbing activities. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting from the offshore wind developments could result in impacts on cultural resources. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a character-defining feature that contributes to the historic significance and integrity of the resource. Permanent aviation and vessel warning lighting would be required on all WTGs and OSPs built by offshore wind projects. The Proposed Action would account for 14 percent of the WTGs and OSPs in the geographic analysis area that could potentially have cumulative visual impacts on historic properties. If ADLS were used by offshore wind developments, nighttime hazard lighting impacts on cultural resources from ongoing and planned activities including offshore wind and the Proposed Action, would be negligible. If offshore wind projects do not commit to using ADLS, operational lighting from the Proposed Action combined with ongoing and planned activities including offshore wind would have negligible to moderate impacts on cultural resources. Therefore, in the context of reasonably foreseeable environmental trends, the Proposed Action, combined with ongoing and planned activities, would result in negligible to moderate impacts on cultural resources.

BOEM conducted a Cumulative Historic Resources Visual Effects Assessment (CHRVEA) to evaluate visual impacts from the presence of structures on the adversely affected aboveground historic properties in the visual APE for offshore Project components, which are the Nantucket Historic District NHL, Nantucket Sound TCP, and Chappaquiddick Island TCP (BOEM 2023). The planned activities scenario assessment determined the maximum number of WTGs from the Proposed Action and future offshore wind projects that could be theoretically visible (based on distance, topography, vegetation, and intervening structures) from each historic property. Other offshore wind projects included in the cumulative WTG count from historic properties are Vineyard Wind Northeast (formerly Liberty Wind), Beacon Wind, Vineyard Wind 1, New England Wind, Bay State Wind, Sunrise Wind, South Fork Wind, and Revolution Wind.

The CHRVEA demonstrated that portions of the WTGs could theoretically be visible from all three historic properties. The study demonstrated that from the southern boundary of the Nantucket Sound TCP, portions of up to 744 WTGs would be theoretically visible and the closest WTG would be approximately 14.3 miles (23 kilometers) away. The Nantucket Historic District NHL would be subject to similar viewshed impacts, with portions of up to 743 WTGs theoretically be visible from the southern shores of the district and the closest WTG approximately 14.8 miles (23.8 kilometers) away from the resource. Finally, the study demonstrated that from the Chappaquiddick Island TCP, portions of up to 679 WTGs would be visible, the closest of which would be approximately 14.7 miles (23.6 kilometers) away. The Project WTG locations represent 12.66 to 17.36 percent of the total WTGs that are theoretically visible from the three historic properties in the planned activities scenario. For this reason, the Project WTGs would foreseeably be surrounded by other offshore wind energy development activities that would constitute 82.64 to 87.34 of the total WTGs potentially visible from the three historic properties.

The intensity of cumulative visual impacts on these historic properties would be limited by distance and environmental and atmospheric factors. As discussed in the VIA (COP Appendix T; Mayflower Wind 2022), the visibility of WTGs would be further reduced by environmental and atmospheric factors such as meteorological conditions like low cloud cover, fog, or haze. While these factors would limit the intensity of impacts, the presence of visible WTGs from ongoing and planned activities, including the Proposed Action, would have long-term, continuous, and moderate impacts on the Nantucket Historic District NHL, Nantucket Sound TCP, and Chappaquiddick Island TCP. The Proposed Action would contribute a noticeable increment to these impacts.

Conclusions

Impacts of the Proposed Action: The Proposed Action would have negligible to major impacts on individual cultural resources. Impacts would be reduced through the NHPA Section 106 consultation process as a result of the commitments made by Mayflower Wind and implementation of AMM measures to resolve adverse effects on historic properties. Similarly, the analysis of impacts is based on a maximum-case scenario; impacts would be reduced by implementation of a less-impactful construction or infrastructure development scenario in the PDE. Greater impacts, ranging from moderate to major, would occur without the preconstruction NHPA requirements to identify historic properties, assess potential effects, and develop HPTPs to resolve effects through avoidance, minimization, or mitigation. These NHPA-required, “good-faith” efforts to identify historic properties and address impacts resulted in or contributed to Mayflower Wind proposing several AMM measures to reduce the magnitude of impacts on cultural resources (Appendix G, *Mitigation and Monitoring*).

BOEM anticipates that NHPA requirements to identify historic properties and resolve adverse effects would similarly reduce the significance of potential impacts on historic properties from offshore wind projects as they complete the NHPA Section 106 review process. However, mitigation of both physical and visual adverse effects on historic properties would still be needed under the Proposed Action. Therefore, the overall impacts on historic properties from the Proposed Action would likely qualify as **major** because a notable and measurable impact requiring mitigation is anticipated.

Cumulative Impacts of the Proposed Action: In context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from the Proposed Action in combination with other ongoing and planned activities would be appreciable. Considering all of the IPFs together, BOEM anticipates that the cumulative impacts on cultural resources associated with the Proposed Action and other ongoing and planned activities would be **minor** to **major** due to the long-term or permanent and irreversible impacts on archaeological (terrestrial and marine) resources and ASLFs if they cannot be avoided, and long-term impacts on historic aboveground resources, including the Nantucket Historic District NHL, Nantucket Sound TCP, Chappaquiddick Island TCP, and Oak Grove Cemetery.

3.6.2.6 Impacts of Alternative C on Cultural Resources

Impacts of Alternative C: Alternative C includes two sub-alternatives (C-1 and C-2) to analyze alternate onshore cable route options developed to avoid installation of a portion of the proposed Brayton Point offshore export cable that runs through the Sakonnet River. Physical impacts from seabed- and ground-disturbing activities on marine cultural resources, terrestrial archaeological resources, and historic aboveground resources are subject to differ under Alternative C as compared to those anticipated under the Proposed Action. Since the cable route alternates proposed under Alternative C would be buried, no visual impacts on cultural resources are anticipated; as such, visual impacts on cultural resources are anticipated to be the same as the Proposed Action under this alternative.

The following analysis is based on the findings solely from cultural resources background research (PAL 2022; RCG&A 2022). As notated where applicable in the discussion, cultural resource and historic property identification and evaluation efforts for Alternative C have not been fully completed. Previously recorded cultural resources identified through background research and discussed here are those that are recorded through identification processes that have circumstantially occurred in areas overlapping with the Alternative C route options. These identification processes are unrelated to the Project’s own cultural resource investigations and, therefore, do not necessarily encompass all areas subject to impacts under Alternative C. As such, the absence of previously recorded cultural resources in any of the Alternative C areas does not preclude the presence of currently unidentified but potential cultural resources to exist in those areas. Uninvestigated portions of Alternatives C-1 and C-2 may contain currently unidentified but potential cultural resources on which the Project may have adverse impacts should either sub-alternative be adopted.

Should federal and state permitted agencies approve one of the Alternative C cable route options and not the full Brayton Point ECC as proposed under the Proposed Action, Mayflower Wind will use a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for completing cultural surveys for presently uninvestigated areas (COP Appendix R.2, Section 3.1; Mayflower Wind 2022). BOEM will use the MOA to establish commitments for reviewing the sufficiency of any supplemental archaeological investigations; assessing effects on historic properties; and implementing measures to avoid, minimize, or mitigate impacts in these areas prior to construction. See Appendix I, Section I.5, *Phased Identification and Evaluation*, for additional details on the phased process and Appendix I, Attachment A, for the Draft MOA.

Alternative C-1

Alternative C-1 (Aquidneck Island, Rhode Island Route) involves the use of a cable route located west of the Sakonnet River. Diverting from the Proposed Action’s Brayton Point Offshore ECC to the west, this alternate route would traverse an offshore area that makes landfall at the Second Beach parking lot in Middletown, Rhode Island. The onshore route would then run the length of Aquidneck Island with two variations: the western variation (approximately 4.1 miles total distance) and eastern variation (approximately 4.0 miles total distance). From the point at which the western and eastern variations would rejoin, this alternate cable route would continue for approximately 4.5 miles before reaching Boyd’s Lane, where the route continuing to Brayton Point, including the three options for entering Mount Hope Bay, would be the same as the Proposed Action. Alternative C-1 would decrease the total offshore area subject to Project development for the Brayton Point Offshore ECC, thereby potentially decreasing the potential for adverse impacts on marine cultural resources. Implementation of this sub-alternative would result in full avoidance of impacts that would otherwise occur from the Proposed Action on five marine archaeological resources and two ASLFs located in the Sakonnet River (COP Appendix Q; Mayflower Wind 2022). BOEM would require Mayflower Wind to uphold the same applicable commitments to avoid specific marine cultural resources should this alternative be adopted (see the Draft MOA in Appendix I, Attachment A for additional information). Though this sub-alternative would result in avoidance of the aforementioned resources, adoption of Alternative C-1 would have the same or similar adverse impacts as the Proposed Action on others or introduce new impacts to other individual marine cultural resources. Background research determined one potential marine archaeological resource may be subject to adverse impacts from the adoption of Alternative C-1 (RCG&A 2022). This potential resource and other, currently unidentified but potential marine cultural resources may be present within a potential offshore ECC that would encompass this alternate route. Based on the available information, impacts on marine cultural resources under Alternative C-1 may be reduced, similar to, or increased as compared to those under the Proposed Action depending on the presence of marine cultural resources located within an offshore ECC for this sub-alternative.

Additionally, the onshore portion of the Alternative C-1 route would increase the potential for adverse impacts on terrestrial archaeological and historic aboveground resources. No cultural survey efforts have been completed for Alternative C-1. However, background research found that a total of ten known terrestrial archaeological resources and 21 known historic aboveground resources, including six historic properties listed in the NRHP and six historic cemeteries,[1] have the potential to be subject to adverse impacts under Alternative C-1 (PAL 2022). Of the individual known cultural resources identified in background research, adoption of the Alternative C-1 route with the western route variation would have the potential to impact nine terrestrial archaeological resources and 18 historic aboveground resources, including five historic properties listed in the NRHP and five historic cemeteries (PAL 2022). Should Alternative C-1 adopt the eastern route variation, seven known terrestrial archaeological resources and 15 known historic aboveground resources, including three historic properties listed in the NRHP and four historic cemeteries, may be subject to impacts (PAL 2022). A table listing resources potentially subject to impacts under Alternative C-1 can be found in Appendix I, *Determination of Effect for NHPA Section 106 Consultation.*

A terrestrial archaeological sensitivity assessment was also conducted to determine the potential for a given area of the Alternative C-1 cable route to contain terrestrial archaeological resources (PAL 2022). Areas assessed as having high sensitivity are those in which previously unrecorded but potential terrestrial archaeological resources are most likely to be present; whereas areas assessed as having low sensitivity are those in which such resources are least likely to be present. This assessment found that the Alternative C-1 cable route contains 28 percent high sensitivity, 21 percent moderate sensitivity, and 51 percent low sensitivity areas.

Alternative C-2

Alternative C-2 (Little Compton/Tiverton, Rhode Island Route) involves the use of a cable route located east of the Sakonnet River. Diverting from the Proposed Action's Brayton Point Offshore ECC to the east, this alternate route traverses an offshore area that makes landfall on the ocean-facing side of Breakwater Point. The onshore route then runs approximately 15.8 miles before entering into Mount Hope Bay and then continuing to Brayton Point along the same route as the Proposed Action.

Alternative C-2 would decrease the total offshore area subject to Project development for the Brayton Point Offshore ECC, thereby potentially decreasing the potential for adverse impacts on marine cultural resources. Implementation of this sub-alternative would result in full avoidance of impacts that would otherwise occur from the Proposed Action on eight marine archaeological resources and two ASLFs (COP Appendix Q; Mayflower Wind 2022; RCG&A 2022). BOEM would require Mayflower Wind to uphold the same applicable commitments to avoid specific marine cultural resources should this alternative be

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[1] Rhode Island General Law (RIGL) 23-18-11 et seq. (State Cemeteries Act) conditionally prohibits any town or city from permitting "construction, excavation or other ground disturbing activity within twenty-five (25) feet of a recorded historic cemetery" unless the "boundaries of the cemetery are adequately documented and there is no reason to believe additional graves exist outside the recorded cemetery." As such, BOEM assumes historic cemeteries within 25 feet of the Project would be subject to adverse impacts without the adoption of AMM measures.

adopted (see the Draft MOA in Appendix I, Attachment A for additional information). Though this sub-alternative would result in avoidance of the aforementioned resources, adoption of Alternative C-2 may introduce impacts on other individual marine cultural resources. Unlike the Alternative C-1 cable route, the Alternative C-2 cable route has two, noncontiguous offshore portions: one portion in Mount Hope Bay and another in Rhode Island Sound. Background research has demonstrated there are no known marine cultural resources in either offshore portions of this alternate route (RCG&A 2022); however, cultural surveys for these presently uninvestigated areas have not been completed. Other, currently unidentified but potential marine cultural resources may be present in a potential offshore ECC that would encompass this alternate route. Based on the available information, impacts on marine cultural resources under Alternative C-2 may be reduced, similar to, or increased as compared to those under the Proposed Action depending on the presence of marine cultural resources located in an offshore ECC for this sub-alternative.

Additionally, the onshore portion of the Alternative C-2 route would increase the potential for adverse impacts on terrestrial archaeological and historic aboveground resources. No cultural survey efforts have been completed for Alternative C-2. However, background research found that three known terrestrial archaeological resources and 23 known historic aboveground resources, including four historic properties listed in the NRHP and eight historic cemeteries, have the potential to be subject to adverse impacts under Alternative C-2 (PAL 2022). A table listing resources potentially subject to impacts under Alternative C-2 can be found in Appendix I.

A terrestrial archaeological sensitivity assessment was also conducted to determine the potential for a given area of the Alternative C-2 cable route to contain terrestrial archaeological resources (PAL 2022). This assessment found that the Alternative C-2 cable route contains 8 percent high sensitivity, 61 percent moderate sensitivity, and 31 percent low sensitivity areas.

Cumulative Impacts of Alternative C: In the context of other reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be the same as under the Proposed Action.

Conclusions

Impacts of Alternative C: The impacts resulting from individual IPFs associated with Alternative C alone on cultural resources may be reduced, the same as, similar to, or increased compared to impacts under the Proposed Action depending on the presence of cultural resources in areas subject to seabed- or ground-disturbing activities under this alternative. Based on the preliminary background research, quantitative and qualitative assessments suggest adoption of either Alternative C-1 or C-2 would introduce adverse impacts on a larger number of individual cultural resources as compared to the Proposed Action. However, the Alternatives C-1 and C-2 routes are predominantly proposed to occur within or along public road ROWs, shoulders, and medians and may not contribute any additional adverse impacts on potential cultural resources located in these previously disturbed areas.

BOEM anticipates that Alternative C would have similar **major** impacts on cultural resources as the Proposed Action that may be avoided, minimized, or mitigated depending on Mayflower Wind's implementation of AMM measures developed through the NHPA Section 106 consultation process.

Should federal- and state-permitted agencies approve one of the Alternative C cable route options and not the full Brayton Point ECC as proposed under the Proposed Action, Mayflower Wind would use a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for completing offshore and onshore cultural resources investigations (COP Appendix R.2, Section 3.1; Mayflower Wind 2022). BOEM would use the MOA to establish commitments for reviewing the sufficiency of any supplemental archaeological investigations as phased identification; assessing effects on historic properties; and implementing measures to avoid, minimize, or mitigate impacts in these areas prior to construction.

Cumulative Impacts of Alternative C: In the context of other reasonably foreseeable environmental trends, the cumulative impacts associated with Alternative C would be the same as for the Proposed Action—**major**.

3.6.2.7 Impacts of Alternative D on Cultural Resources

Impacts of Alternative D: Alternative D involves the elimination of up to six WTGs in the northeastern portion of the Lease Area to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals. Proposed activities under Alternative D would not involve changes to any onshore Project components; therefore, impacts on historic aboveground resources and TCPs in the visual APE for onshore Project components and terrestrial archaeological resources under Alternative D would be the same as those under the Proposed Action. Impacts on marine cultural resources, as well as historic aboveground resources and TCPs located in the visual APE for offshore Project components are subject to differ under Alternative D as compared to those anticipated under the Proposed Action.

Implementation of this alternative is not anticipated to result in a reduction of impacts or impact severity on marine cultural resources as no known marine cultural resources are located in the area from which WTG positions would be eliminated. However, removal of these offshore Project components would reduce potential impacts on currently undiscovered marine archaeological resources that may be present in these areas. Additionally, while Alternative D would slightly reduce the visibility of the Project on historic aboveground resources in the visual APE for offshore Project components, the visual impacts from the size, location, and number of retained WTGs under this alternative would not be substantially different from those of the Proposed Action. As such, the impacts and severity of impacts on historic aboveground resources in the visual APE for offshore Project components are anticipated to be similar compared to those under the Proposed Action despite the slight decreased visibility of the Project.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative D: The impacts resulting from individual IPFs associated with Alternative D on cultural resources would be the same as or similar to those of the Proposed Action. This is because the nature and physical extent of proposed activities under this alternative would be largely comparable to those of the Proposed Action. As a result, Alternative D would have similar **major** impacts on cultural resources as the Proposed Action that may be avoided, minimized, or mitigated depending on Mayflower Wind's implementation of AMM measures developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative D. In the context of other reasonably foreseeable environmental trends, the cumulative impacts associated with Alternative D would be the same as the Proposed Action—**major**.

3.6.2.8 Impacts of Alternative E on Cultural Resources

Impacts of Alternative E: Alternative E includes three sub-alternatives (E-1, E-2, and E-3) to analyze the maximum design scenario for each of the three different foundation categories that could be used for WTGs and OSPs. Proposed activities under Alternative E would not involve changes to any onshore Project components; therefore, impacts on historic aboveground resources in the visual APE for onshore Project components and terrestrial archaeological resources under Alternative E would be the same as those under the Proposed Action. Additionally, differences in foundation type are not anticipated to result in measurable differences in visual impact on historic aboveground resources or TCPs in the visual APE for offshore Project components. As such, impacts on historic aboveground resources overall (i.e., those in the visual APE for both onshore and offshore Project components) under Alternative E are anticipated to be the same as those under the Proposed Action.

Impacts on marine cultural resources are subject to differ under Alternative E as compared to those anticipated under the Proposed Action. These impacts would be caused by seabed disturbances that would occur during construction of WTGs and OSPs. The maximum area of seabed disturbance for each of the foundation types is anticipated to differ (COP Volume 1, Tables 3-26 and 3-37; Mayflower Wind 2022). Under Alternative E-1, piled foundations would be used for all WTGs and OSPs. While the pin-pile jacket foundation subtype would cause greater maximum seabed disturbance than the monopile subtype, the difference in disturbance between the two subtypes of piled foundations would be negligible in terms of impacts on cultural resources. Piled foundations involve the least amount of seabed disturbance compared to suction-bucket or GBS foundations. Under Alternative E-2, suction-bucket foundations would be used for all WTGs and OSPs. Suction-bucket foundations involve a greater amount of seabed impacts compared to piled foundations and a lesser amount compared to GBS foundations. Under Alternative E-3, GBS foundations would be used for all WTGs and OSPs. GBS foundations involve the greatest amount of seabed disturbance compared to piled or suction-bucket foundations.

In summary, foundations proposed under Alternative E-1 would result in the least potential for, and severity of, impacts on marine cultural resources as a result of having the least area of maximum seabed disturbance. Alternative E-3 would result in the greatest potential for and severity of impacts on marine cultural resources as a result of having the greatest area of maximum seabed disturbance. Overall, the anticipated range of impact severity on individual marine cultural resources under Alternative E would be the same as those under the Proposed Action; while some individual marine cultural resources may experience reduced negligible or minor impacts due to use of a foundation type with a smaller seabed disturbance area, other individual marine cultural resources may still experience moderate or major impacts due to use of the same foundation type regardless of its smaller seabed disturbance area.

Cumulative Impacts of Alternative E: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative E would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative E: The impacts resulting from individual IPFs associated with Alternative E alone on cultural resources may be reduced, the same, similar, or increased compared to those under the Proposed Action depending on the final foundation type(s) selected under the Proposed Action and specific locations of marine cultural resources in relation to proposed WTGs and OSPs. The severity of impacts on marine cultural resources increases with the size of the foundation type and anticipated seabed disturbance. However, overall, the nature and physical extent of proposed activities under this alternative would be largely comparable to those of the Proposed Action. As a result, Alternative E would have similar **major** impacts on cultural resources as the Proposed Action that may be avoided, minimized, or mitigated depending on Mayflower Wind's implementation of AMM measures developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative E: In the context of other reasonably foreseeable environmental trends, the cumulative impacts associated with Alternative E would be the same as under the Proposed Action—**major**.

3.6.2.9 Impacts of Alternative F on Cultural Resources

Impacts of Alternative F: Under Alternative F, the Falmouth offshore export cable route would be limited to the installation of up to three cables (as opposed to up to five cables under the Proposed Action). Proposed activities under this alternative are not anticipated to change impacts on terrestrial archaeological or historic aboveground resources; therefore, impacts on these resource types under Alternative F would be the same as those under the Proposed Action.

Impacts on marine cultural resources—including marine archaeological resources, ASLFs, and the Nantucket Sound TCP—are subject to differ under Alternative F as compared to those anticipated under the Proposed Action. The Nantucket Sound TCP and four ASLFs—some of which may be contributing elements to the TCP—have been identified in the Falmouth Offshore ECC. Reduction of the number of installed cables would reduce the overall area subject to potential seabed disturbance, thereby reducing potential adverse impacts on marine cultural resources including the Nantucket Sound TCP. BOEM would require Mayflower Wind to uphold the same applicable commitments to avoid specific marine archaeological resources and ASLFs located in the Falmouth Offshore ECC should this alternative be adopted (see the Draft MOA in Appendix I, Attachment A for additional information). However, BOEM finds that the resources for which there are presently no commitments to avoidance from Mayflower Wind would still be subject to physical adverse impacts. Additionally, the majority of marine cultural resources, and cultural resources in general, subject to impacts from the Project are located in other areas unaffected by this alternative.

Cumulative Impacts of Alternative F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative F would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative F: The impacts resulting from individual IPFs associated with Alternative F alone on cultural resources may be reduced or similar compared to those under the Proposed Action. A reduction in impacts would depend on the presence of marine cultural resources in the areas subject for offshore Project component removal under this alternative. If no marine cultural resources are located in these areas, no reduction in impacts on cultural resources would occur. However, overall, the nature and physical extent of proposed activities under this alternative would be largely comparable to those of the Proposed Action and would result in similar impacts. As a result, Alternative F would have similar **major** impacts on cultural resources as the Proposed Action that may be avoided, minimized, or mitigated depending on Mayflower Wind's implementation of AMM measures developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative F. In the context of other reasonably foreseeable environmental trends, the cumulative impacts associated with Alternative F would be the same as for the Proposed Action—**major**.

3.6.2.10 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on cultural resources (Appendix G, Section G-2, *Agency-Proposed Mitigation Measures*). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts on cultural resources would be reduced.

- **Marine cultural resources avoidance or additional investigation:** Mayflower Wind must establish and comply with requirements for all protective buffers recommended by the Qualified Marine Archaeologist for each marine cultural resource (i.e., archaeological resource and ASLFs) based on the size and dimension of the resource. Protective buffers extend outward from the maximum discernable limit of each resource and are intended to minimize the risk of disturbance during construction. If Mayflower Wind cannot avoid a resource, it must perform additional investigations for the purpose of determining eligibility for listing the resource in the NRHP. Should the resource be determined to be a historic property eligible for listing in the NRHP, additional Section 106 consultation will be required to minimize adverse effects. Avoidance would result in negligible impacts on these cultural resources whereas additional investigations could result in minor to major impacts on individual resources on a case-by-case basis.
- **Ancient submerged landform feature monitoring program and post-review discovery plan:** Mayflower Wind must establish and implement a monitoring program and post-review (unanticipated) discovery plan to review impacts of construction or any seabed-disturbing activities on ASLF locations if such landforms will not be avoided and will be impacted. Implementation of

monitoring and a post-review discovery plan, which would include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and post-review discoveries procedures and contacts, would reduce potential impacts on any previously undiscovered but potential marine archaeological resources encountered during construction. Depending on the location of the ASLF, enforcement of this measure would be under the jurisdiction of BOEM, MHC, or RIHPHC. Implementation of a post-review discoveries plan would reduce potential impacts on previously undiscovered archaeological resources to a minor level by preventing further physical impacts on the resource during construction.

- **Terrestrial archaeological resource avoidance or additional investigation:** Mayflower Wind must avoid any identified terrestrial archaeological resource. If avoidance of a resource is not feasible, additional investigations must be conducted for the purpose of determining eligibility for listing in the NRHP. If any such resource is determined eligible for listing, Mayflower Wind must conduct Phase III data recovery investigations for the purposes of resolving adverse effects in accordance with 36 CFR 800.6. Avoidance would result in negligible impacts on these cultural resources whereas additional investigations could result in minor to major impacts on individual resources on a case-by-case basis.
- **Terrestrial archaeological resource monitoring program and post-review discovery plan:** Mayflower Wind must conduct archaeological monitoring during onshore construction in areas identified as having high or moderate archaeological sensitivity and must prepare and implement a terrestrial archaeological post-review (unanticipated) discoveries plan. Implementation of monitoring and a post-review discovery plan, which would include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and post-review discoveries procedures and contacts, would reduce potential impacts on any previously undiscovered but potential terrestrial archaeological resources encountered during construction. Depending on the location of the resource, enforcement of this measure would be under the jurisdiction of MHC or RIHPHC. Implementation of a post-review discoveries plan would reduce potential impacts on previously undiscovered archaeological resources to a minor level by preventing further physical impacts on the resource during construction.
- **Historic Properties Treatment Plans:** BOEM, with the assistance of Mayflower Wind, will develop and implement one or more HPTPs to address impacts on historic properties that cannot be avoided. The HPTP(s) will be developed in consultation with property owners and consulting parties who have demonstrated interest in specific historic properties. The HPTP(s) will provide details and specifications for mitigation measures to resolve adverse visual effects, including cumulative effects on aboveground historic properties. Development and implementation of HPTPs would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would guide fulfillment of mitigation actions.

3.6 Socioeconomic Conditions and Cultural Resources

3.6.3 Demographics, Employment, and Economics

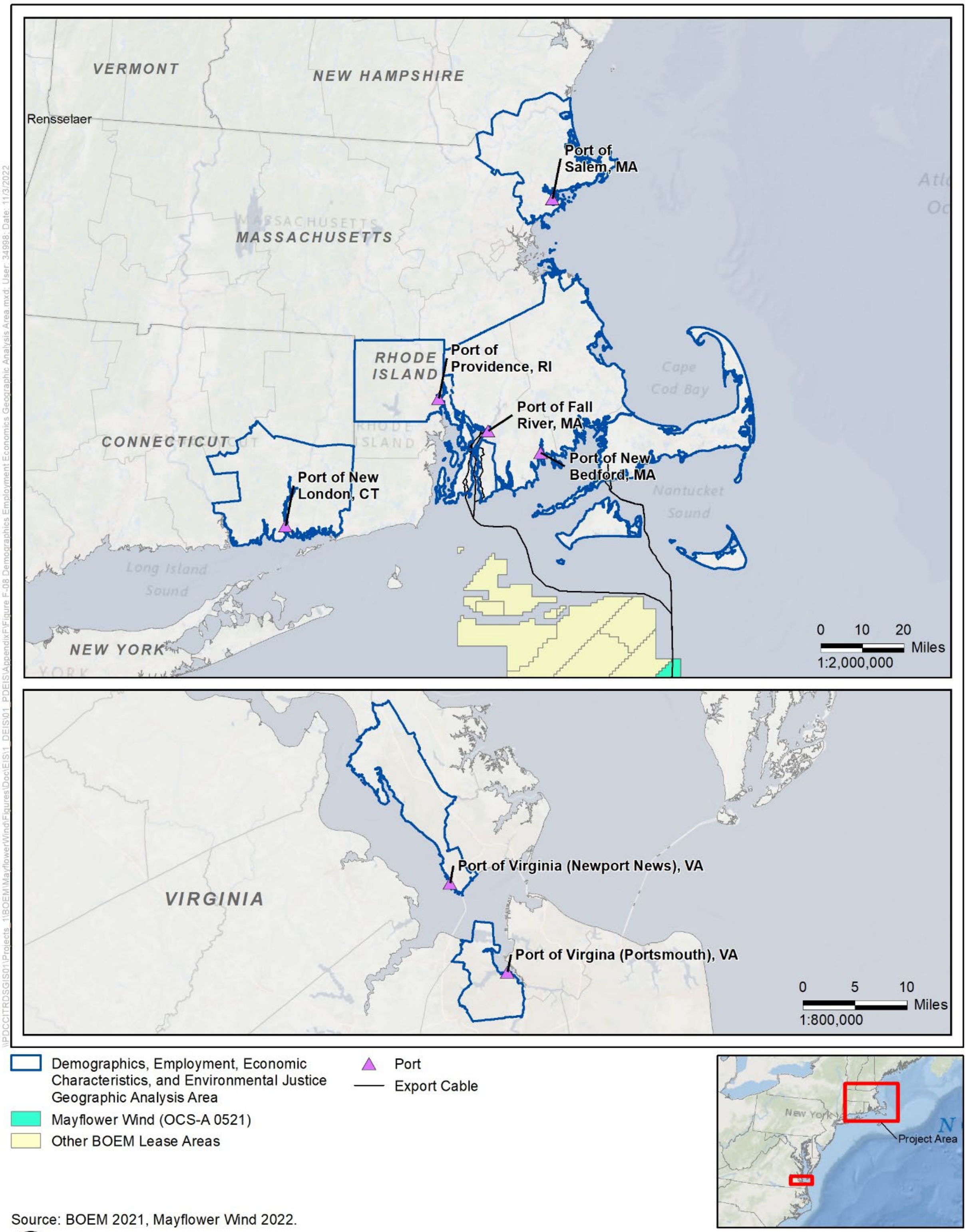
This section discusses potential impacts on demographics, employment, and economics from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for demographics, employment, and economics. The geographic analysis area, as shown on Figure 3.6.3-1, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties closest to the Wind Farm Area: Barnstable, Bristol, Dukes, Nantucket, Plymouth, and Essex County Massachusetts; Bristol, Newport, and Providence County, Rhode Island; New London County, Connecticut; and Portsmouth and Newport News, Virginia. These counties are the most likely to experience beneficial or adverse economic impacts from the proposed Project.

3.6.3.1 Description of the Affected Environment and Future Baseline Conditions

Barnstable, Dukes, and Nantucket Counties, Massachusetts

Barnstable, Dukes, and Nantucket Counties are notable for the importance of coastal tourism and recreation to their economy and their high proportion of seasonal housing. Barnstable County is made up of the 15 municipalities that form the Cape Cod peninsula, while Dukes and Nantucket Counties cover the islands of Martha's Vineyard and Nantucket, respectively. Each of these areas has a significant seasonal population that, when considered, greatly increases the population density of the area.

Data on population, demographics, income, and employment for the state of Massachusetts and for Barnstable, Dukes, and Nantucket Counties are provided in Table 3.6.3-1 and Table 3.6.3-2. The population of Barnstable County declined by 1.8 percent from 2010 to 2019, while the population of Dukes and Nantucket Counties grew by 7.2 and 10.9 percent, respectively. Dukes and Nantucket Counties have the smallest population of any counties in Massachusetts. The population of Barnstable and Dukes Counties are older, on average, than the population of surrounding counties and Massachusetts as a whole, with a median age of 53.3 and 47.1, respectively, compared to the statewide median age of 39.5. These communities also have a higher percentage of residents aged 65 and up, with 29.8 percent in Barnstable County and 23.3 percent in Dukes County, compared to 16.2 percent in Massachusetts (U.S. Census Bureau 2022a). Unemployment rates in the three-county area are similar to those of Massachusetts as a whole. In 2020 unemployment was 5.8 percent in Nantucket County, 4.1 percent in Barnstable County, and 5.1 percent in Dukes County, as opposed to 5.1 percent in Massachusetts. Nantucket County's per capita income of $57,246 is greater than the statewide average of 45,555, while Barnstable and Dukes Counties are 47,315 and 43,994, respectively (U.S. Census Bureau 2022b).



Source: BOEM 2021, Mayflower Wind 2022.

Figure 3.6.3-1. Demographics, employment, and economics geographic analysis area

Table 3.6.3-1. Demographic trends (2010–2019)

Jurisdiction	2010 Population	2019 Population	Population Change, percent (2010–2019)	2019 Percent Population 18–64 Years	2019 Percent of Population 65 or Older	2019 Median Age
Massachusetts	6,477,096	6,850,553	5.8%	64%	16.2%	39.5
Barnstable County	217,483	213,496	-1.8%	55%	29.8%	53.3
Bristol County	546,433	561,037	2.7%	63%	16.6%	41.0
Dukes County	16,155	17,312	7.2%	58%	23.3%	47.1
Nantucket County	10,069	11,168	10.9%	65%	14.6%	40.3
Plymouth County	490,784	515,303	5.0%	61%	17.6%	42.7
Essex County	735,642	783,676	6.5%	62%	16.7%	40.9
Rhode Island	1,056,389	1,057,231	0.1%	64%	16.8%	39.9
Bristol County	50,501	48,764	-3.4%	62%	19.4%	44.3
Newport County	83,253	82,801	-0.5%	61%	21.7%	45.2
Providence County	628,413	635,737	1.2%	64%	15.0%	37.4
Connecticut	3,545,837	3,575,074	0.8%	62%	16.8%	41.0
New London County	272,360	267,390	-1.8%	63%	17.7%	41.4
Virginia	7,841,754	8,454,463	7.8%	63%	15.0%	38.2
Portsmouth	96,785	95,097	-1.7%	62%	14.5%	35.3
Newport News	181,822	179,673	-1.2%	64%	12.7%	33.5

Source: U.S. Census Bureau 2022a.

Table 3.6.3-2. Population, income, and employment data

Jurisdiction	Population (2019)	Population Density (persons per mi^2)	Per Capita Income (2019)	Total Employment (jobs, 2020)	Unemployment Rate (2020)
Massachusetts	6,850,553	648.42	45,555	3,615,725	5.1%
Barnstable County	213,496	163.47	47,315	105,798	4.1%
Bristol County	561,037	811.92	36,900	283,747	5.4%
Dukes County	17,312	35.26	43,994	8,902	5.1%
Nantucket County	11,168	106.06	57,246	6,419	5.8%
Plymouth County	515,303	471.46	45,378	269,959	5.1%
Essex County	783,676	843.57	43,948	409,549	5.2%
Rhode Island	1,057,231	870.87	37,504	535,140	5.5%
Bristol County	48,764	1083.64	48,321	24,636	3.4%
Newport County	82,801	263.70	50,514	41,154	5.8%
Providence County	635,737	1458.11	32,739	316,776	5.9%
Connecticut	3,575,074	644.97	45,668	1,807,525	6.0%

Jurisdiction	Population (2019)	Population Density (persons per mi²)	Per Capita Income (2019)	Total Employment (jobs, 2020)	Unemployment Rate (2020)
New London County	267,390	346.36	40,995	132,072	5.3%
Virginia	8,454,463	197.65	41,225	4,179,739	4.6%
Portsmouth	95,097	2037.21	27,276	41,059	6.3%
Newport News	179,673	1502.28	33,670	81,820	5.7%

Source: U.S. Census Bureau 2022b.
mi^2 = square mile.

Barnstable, Dukes, and Nantucket Counties are notable for the importance of tourism and visitors to their economy and their high proportion of seasonal housing. Table 3.6.3-3 includes housing data for the geographic area of interest. In Massachusetts as a whole, approximately 4.4 percent of housing units are seasonally occupied, as compared to 38.3 percent of homes in Barnstable County, 59.7 percent of homes in Dukes County, and 63.7 percent of homes in Nantucket County. The median owner-occupied home value in Dukes and Nantucket Counties is significantly higher than the statewide average. The median values in Dukes and Nantucket Counties are $699,500 and $1,084,700, respectively, while the median home value across Massachusetts is $381,600 (U.S. Census Bureau 2022c).

Table 3.6.3-3. Housing data (2019)

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Non-Seasonal Vacancy Rate	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
Massachusetts	2,897,259	127,398	152,364	5%	381,600	1,282
Barnstable County	163,557	62,643	6,591	4%	393,500	1,311
Bristol County	235,275	2,892	14,471	6%	299,800	901
Dukes County	17,902	10,681	456	3%	699,500	1,459
Nantucket County	12,345	7,860	772	6%	1,084,700	1,764
Plymouth County	207,003	10,514	9,029	4%	370,300	1,279
Essex County	313,956	5,236	11,466	4%	436,600	1,298
Rhode Island	468,335	17,478	40,368	9%	261,900	1,004
Bristol County	21,053	224	1,612	8%	358,100	1,037
Newport County	42,563	4,284	3,502	8%	387,900	1,285
Providence County	266,624	1,669	27,637	10%	248,500	989
Connecticut	1,521,199	29,669	106,093	7%	279,700	1,201
New London County	123,849	4,981	9,252	7%	246,800	1,144
Virginia	3,537,788	82,998	270,669	8%	282,800	1,257
Portsmouth	40,876	140	4,677	11%	174,200	1,083
Newport News	77,851	241	6,772	9%	194,700	1,075

Source: U.S. Census Bureau 2022c

Table 3.6.3-4 includes data on the industries where residents in these counties work. The industries that employ workers reflect recreation and tourism's importance to these counties. A greater proportion of residents in these counties work jobs in arts, entertainment, and recreation and accommodation and food services (11.7 percent in Barnstable County and 10.3 percent in Nantucket County) than in Massachusetts as a whole (8.7 percent). Table 3.6.3-5 contains data on at-place employment by industry in the geographic area of interest. A higher proportion of jobs in these counties are again in arts, entertainment, and recreation and accommodation and food services (8.5 percent in Barnstable County, 9.4 percent in Dukes County, and 7.3 percent in Nantucket County), as well as retail trade (11.2 percent in Barnstable County, 6.3 percent in Dukes County, and 11.2 percent in Nantucket County) than in Massachusetts as a whole (5.7 and 8.2 percent, respectively) (U.S. Census Bureau 2022d).

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally include, among other categories, commercial fishing and seafood processing, marine construction, commercial shipping, and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation. Tourism and recreation accounted for 86 percent of the overall Ocean Economy Gross Domestic Product (GDP) in Barnstable County, and 100 percent in Dukes and Nantucket Counties (NOAA 2022). 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 locations. The Woods Hole, Martha's Vineyard, and Nantucket Steamship Authority generated over $104 million in revenue in 2018 with almost 24,000 trips and 3,055,347 passengers carried (Steamship Authority 2018).

The "living resource" sector of the Ocean Economy includes commercial fishing, aquaculture, seafood processing, and seafood markets. The living resource sector accounts for 2.6 percent of employment and 3.2 percent of the GDP of the U.S marine economy. Seafood markets are the largest producer in the living resources sector, accounting for 41.5 percent of the sector's GDP and accounting for the most employed workers in the sector (NOAA 2021). Although the number employed or self-employed in this sector in Barnstable, Dukes, and Nantucket Counties is small compared to recreation and tourism, local fishing fleets form an important part of the identity and tourist attraction of local communities. In Martha's Vineyard, the fishing industry has formed the Martha's Vineyard Fishermen's Preservation Trust, a nonprofit organization that raises funds to purchase fishing permits and lease their affiliated quota, or the right to catch a certain number of fish or shellfish, to local small-scale fishermen, in an effort to ensure a viable commercial fishing community (MV Fishermen's Preservation Fund 2017).

Table 3.6.3-4. Employment of residents by industry (2019)

Industry	Massachusetts	Barnstable County	Bristol County	Dukes County	Nantucket County	Plymouth County	Essex County	Rhode Island	Bristol County	Newport County	Providence County	Connecticut	New London County	Virginia	Portsmouth	Newport News
Agriculture, forestry, fishing and hunting, and mining	0.4%	1.0%	0.6%	2.8%	1.6%	0.6%	0.4%	0.4%	0.3%	1.0%	0.3%	0.4%	0.6%	0.8%	0.2%	0.4%
Construction	5.7%	9.8%	7.6%	14.7%	15.8%	7.6%	5.7%	5.5%	4.3%	6.8%	5.9%	6.1%	5.9%	6.6%	6.7%	5.6%
Manufacturing	8.8%	3.9%	11.0%	3.0%	2.6%	6.7%	10.6%	10.8%	8.8%	7.2%	11.2%	10.5%	13.9%	7.1%	11.5%	13.0%
Wholesale trade	2.2%	1.9%	3.2%	1.8%	2.6%	2.7%	2.1%	2.4%	1.9%	2.3%	2.3%	2.4%	1.7%	1.8%	2.7%	2.1%
Retail trade	10.3%	13.7%	12.8%	9.0%	12.7%	12.0%	11.0%	11.8%	9.7%	9.3%	12.2%	10.5%	10.5%	10.1%	12.4%	11.5%
Transportation and warehousing, and utilities	3.9%	3.8%	4.4%	5.6%	2.6%	4.8%	4.3%	4.0%	2.6%	3.1%	4.5%	4.3%	4.0%	4.5%	5.6%	4.6%
Information	2.3%	1.7%	1.6%	1.9%	0.6%	1.9%	2.1%	1.6%	1.6%	1.5%	1.5%	2.0%	1.3%	1.9%	1.4%	1.2%
Finance and insurance, and real estate and rental and leasing	7.3%	5.9%	5.8%	6.7%	7.3%	8.7%	6.9%	6.8%	8.1%	6.9%	6.3%	9.1%	4.5%	6.3%	3.9%	4.0%
Professional, scientific, and management, and administrative and waste management services	14.0%	12.1%	9.1%	13.3%	16.0%	11.4%	14.0%	10.3%	10.2%	12.6%	10.3%	11.7%	9.0%	15.9%	9.9%	11.6%

Industry	Massachusetts	Barnstable County	Bristol County	Dukes County	Nantucket County	Plymouth County	Essex County	Rhode Island	Bristol County	Newport County	Providence County	Connecticut	New London County	Virginia	Portsmouth	Newport News
Educational services, and health care and social assistance	28.2%	24.1%	27.0%	23.2%	18.1%	25.4%	25.3%	27.5%	34.2%	26.0%	27.3%	26.5%	24.9%	22.2%	23.2%	23.2%
Arts, entertainment, and recreation, and accommodation and food services	8.7%	11.7%	8.7%	7.9%	10.3%	9.3%	8.7%	10.4%	10.5%	12.8%	9.7%	8.3%	14.3%	8.7%	8.1%	10.7%
Other services, except public administration	4.5%	5.5%	4.2%	6.0%	5.1%	4.6%	4.7%	4.5%	3.8%	5.0%	4.9%	4.6%	4.3%	5.3%	5.3%	4.3%
Public administration	3.8%	4.9%	4.0%	4.1%	4.8%	4.3%	4.0%	4.0%	4.1%	5.5%	3.7%	3.7%	5.2%	8.8%	9.2%	7.8%

Source: U.S. Census Bureau 2022d.

Table 3.6.3-5. At-place employment by industry (2019)

Industry	Massachusetts	Barnstable County	Bristol County	Dukes County	Nantucket County	Plymouth County	Essex County	Rhode Island	Bristol County	Newport County	Providence County	Connecticut	New London County	Virginia	Portsmouth	Newport News
Agriculture, forestry, fishing and hunting, and mining	0.3%	0.6%	0.5%	3.5%	0.6%	0.6%	0.4%	0.4%	0.1%	0.6%	0.3%	0.4%	0.7%	0.9%	0.2%	0.4%
Construction	6.3%	11.6%	8.6%	15.7%	16.3%	8.9%	6.2%	5.9%	4.5%	6.6%	6.4%	6.5%	6.3%	7.1%	7.3%	6.4%
Manufacturing	11.2%	5.2%	14.0%	2.4%	2.0%	8.4%	13.4%	13.7%	11.5%	9.1%	14.0%	13.3%	18.5%	8.5%	14.3%	16.0%
Wholesale trade	2.6%	2.4%	4.0%	0.8%	3.1%	3.3%	2.5%	3.0%	2.5%	2.8%	2.9%	2.9%	2.0%	2.0%	3.0%	2.6%
Retail trade	8.2%	11.2%	10.6%	6.3%	11.2%	9.2%	8.7%	10.0%	7.9%	8.5%	10.2%	8.4%	8.7%	8.2%	9.7%	9.4%
Transportation and warehousing, and utilities	4.2%	4.2%	4.8%	4.9%	3.2%	5.3%	4.6%	4.2%	2.3%	3.2%	4.6%	4.6%	4.3%	4.9%	6.2%	4.9%
Information	2.6%	1.9%	1.8%	1.5%	0.8%	2.3%	2.6%	1.7%	1.7%	1.7%	1.5%	2.2%	1.5%	2.0%	1.6%	1.1%
Finance and insurance, and real estate and rental and leasing	9.0%	6.9%	7.3%	8.1%	9.1%	10.8%	8.3%	8.4%	9.9%	8.0%	7.9%	11.3%	5.5%	7.4%	4.5%	4.3%
Professional, scientific, and management, and administrative and waste management services	15.4%	12.6%	9.7%	14.5%	16.0%	12.4%	14.8%	10.6%	10.9%	13.9%	10.6%	12.4%	9.9%	17.2%	9.5%	12.4%

Industry	Massachusetts	Barnstable County	Bristol County	Dukes County	Nantucket County	Plymouth County	Essex County	Rhode Island	Bristol County	Newport County	Providence County	Connecticut	New London County	Virginia	Portsmouth	Newport News
Educational services, and health care and social assistance	25.9%	23.5%	24.8%	22.6%	19.3%	23.3%	23.4%	26.0%	33.7%	24.7%	25.9%	24.3%	21.9%	20.7%	21.9%	21.8%
Arts, entertainment, and recreation, and accommodation and food services	5.7%	8.5%	5.3%	9.4%	7.3%	5.5%	5.7%	6.8%	6.7%	9.2%	6.7%	5.4%	10.9%	5.6%	5.5%	7.7%
Other services, except public administration	3.8%	5.0%	3.6%	4.4%	3.7%	4.1%	4.2%	4.0%	2.6%	4.2%	4.2%	3.8%	3.3%	4.7%	5.1%	3.7%
Public administration	4.8%	6.4%	5.1%	5.7%	7.4%	5.7%	5.1%	5.4%	5.7%	7.5%	4.9%	4.6%	6.5%	11.1%	11.5%	9.3%

Source: U.S. Census Bureau 2022d.

Bristol, Essex, and Plymouth Counties, 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. Manufacturing and wholesale trade jobs account for more than 18 percent of the county's at-place employment, compared to 13 percent statewide (U.S. Census Bureau 2022d). In 2019, living resources accounted for 80 percent of Bristol County's total Ocean Economy value (NOAA 2022). The unemployment rate in Bristol County was 5.4 percent in 2019, similar to the statewide rate (U.S. Census 2022b). The Port of New Bedford, a full-service port with well-established fishing and cargo handling industries, generated 14,429 jobs in 2018 (direct, indirect, and induced), mostly from commercial fishing and seafood processing activity (Martin Associates 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. A total of 571 jobs were generated directly by non-seafood cargo and recreational boating activity (ferries, water taxis, and marinas). 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 2019).

Plymouth County is located in southeastern Massachusetts, just north of the Cape Cod peninsula. Unlike Barnstable, Dukes, and Newport Counties, Plymouth has a relatively small seasonal population, as only 5.1 percent of all housing units are seasonal units. However, tourism and recreation are still significant in the county, likely attributed to its position along the East Coast. In 2019, tourism and recreation accounted for 71 percent of Plymouth County's total Ocean Economy value (NOAA 2022).

Essex County is located in northeast Massachusetts and similar to previously discussed Massachusetts counties, contains a significant ocean-based economy and large coastline. Tourism and recreation accounted for 76 percent of the county's total Ocean Economy value in 2019 (NOAA 2022). However, only 1.7 percent of all housing units are seasonal (U.S. Census Bureau 2022c). From 2010 to 2019, the population of Essex County grew by 6.5 percent, and the median age in the county is 40.9, close to the statewide median age of 39.5. A higher proportion of jobs in Essex County are in the manufacturing sector (10.6 percent) than in Massachusetts as a whole (8.8 percent) (U.S. Census Bureau 2022d).

Newport, Bristol, and Providence Counties, Rhode Island

Similar to the described Massachusetts counties, Newport and Bristol Counties, located in southeast Rhode Island, are notably tied to tourism and recreation, which accounted for 56 and 77 percent of their overall Ocean Economy GDP, respectively (NOAA 2022). Both counties are home to a declining population that is older than that of Rhode Island. The 2019 median age was 45.2 in Newport County and 44.3 in Bristol County, compared to 39.9 across all of Rhode Island (U.S. Census Bureau 2022a). The median owner-occupied home value in both counties is also higher than the statewide average. The median value in Newport County is $387,900 and $358,100 in Bristol County, while the median home value across Rhode Island is $261,900 (U.S. Census Bureau 2022c). A higher proportion of jobs in

Newport County are in arts, entertainment, and recreation and accommodation and food services (9.2 percent) than in Rhode Island as a whole (6.8 percent) (U.S. Census Bureau 2022d).

Providence County is north of Newport and Bristol County. From 2010 to 2019, the population of Providence County grew by 1.2 percent, while the population of Rhode Island grew by only 0.1 percent (U.S. Census Bureau 2022a). The population of the county is younger than that of Rhode Island, with a median age of 37.4 (U.S. Census Bureau 2022a). The per capita income in Providence County is lower than that of the previously described Rhode Island counties at $32,739, while the unemployment rate of 5.9 percent is higher than the rest of the state (U.S. Census Bureau 2022b). A higher proportion of residents in Providence County work in retail trade (12.2 percent) than in Bristol or Newport County (9.7 percent and 9.3 percent, respectively) (U.S. Census Bureau 2022d).

New London, Connecticut

New London County, located in southeast Connecticut, borders the state of Rhode Island, and contains a large coastline situated along Long Island Sound. The city of New London sits directly on the coast and along the Thames River. From 2010 to 2019, the population of New London County decreased by 1.8 percent (U.S. Census Bureau 2022a). The median age in New London County is slightly older than the statewide median, and the proportion of the population that is age 65 or older (17.7 percent) is greater than that of the state (16.8 percent) (U.S. Census Bureau 2022a). A higher proportion of jobs in New London County are in manufacturing and arts, entertainment, and recreation and accommodation and food services, as well as manufacturing (14.3 and 13.9 percent, respectively), than in Connecticut as a whole (8.3 and 10.5 percent, respectively) (U.S. Census Bureau 2022d).

Portsmouth and Newport News, Virginia

The City of Portsmouth is a key contributor to the Port of Virginia and is located across the inlet from Newport News. Both cities are notable for coastal activities such as swimming, fishing, surfing, and sailing along Virginia’s ocean beaches. From 2010 to 2019, the populations of Portsmouth and Newport News decreased by 1.7 percent and 1.2 percent, respectively, while the population of Virginia increased by 7.8 percent (U.S. Census Bureau 2022a). The population in both cities is younger than that of Virginia. The median age in Portsmouth and Newport News is 35.5 and 33.5, respectively, while the median age in Virginia is 38.2 (U.S. Census Bureau 2022a). Additionally, both cities have a significantly lower per capita income ($27,276 in Portsmouth and $33,670 in Newport News) and a higher unemployment rate (6.3 percent in Portsmouth and 5.7 percent in Newport News) than the statewide average, where the median per capita income is $41,225 and the unemployment rates is 4.6 percent (U.S. Census Bureau 2022b). The portion of residents who work in manufacturing in notably higher in Portsmouth (11.5 percent) and Newport News (13.0 percent) than throughout Virginia (7.1 percent) (U.S. Census Bureau 2022d).

3.6.3.2 Impact Level Definitions for Demographics, Employment, and Economics

Definitions of impact levels are provided in Table 3.6.3-6.

Table 3.6.3-6. Impact level definitions for demographics, employment, and economics

Impact Level	Adverse or Beneficial	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	Either no effect or no measurable benefit.
Minor	Adverse	Impacts on the affected activity or geographic place would not disrupt the normal or routine functions of the affected activity or geographic place.
	Beneficial	Small but measurable benefit on demographics, employment, or economic activity.
Moderate	Adverse	The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Project.
	Beneficial	Notable and measurable benefit on demographics, employment, or economic activity.
Major	Adverse	The affected activity or geographic place would experience disruptions to a degree beyond what is normally acceptable.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

3.6.3.3 Impacts of Alternative A - No Action on Demographics, Employment, and Economics

When analyzing the impacts of the No Action Alternative on demographics, employment, and economics, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for demographics, employment, and economics. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for demographics, employment, and economics of the geographic analysis area described in Section 3.4.2.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Tourism, recreation, and marine industries (e.g., fishing) would continue to be important components of the regional economy. Ongoing activities in the geographic analysis area that would contribute to impacts on demographics, employment, and economics include continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; the use of small-scale, onshore renewable energy and climate change. Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increases in precipitation, and warmer ocean temperatures. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increase insurance cost, and reduce the economic viability of coastal communities. Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency would affect industries that rely on these species. The impacts of climate change are likely to, over time, worsen problems that coastal areas already face (Moser et al. 2014). The socioeconomic impact of ongoing activities varies depending on each activity. Activities that generate economic activity, such as port maintenance and channel dredging, would generally benefit the local economy by providing job opportunities and generating indirect economic activity from suppliers and other businesses that support activity along coastal areas. Conversely, ongoing activities that disrupt economic activity, such as climate change, may adversely affect businesses, resulting in impacts on employment and wages.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on demographics, employment, and economics include ongoing construction of the Vineyard Wind 1 project (62 WTGs and 1 OSP) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSP) in OCS-A 0517. Ongoing construction of the Vineyard Wind 1 and South Fork projects would affect demographics, employment, and economics through the IPFs of lighting, cable emplacement and maintenance, noise, port utilization, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same type of impacts that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect demographics, employment, and economics include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise (see Appendix D, Section D.2, for a description of planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in beneficial socioeconomic impacts by generating economic activity that boosts employment, but there is also the potential for some adverse impacts.

Offshore wind could become a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the United States, some studies acknowledge that domestic capacity is poised to increase. This EIS uses available data, analysis, and projections to make informed conclusions on offshore wind's potential economic and employment impacts within the geographic analysis area.

AWEA estimates that the offshore wind industry will invest between $80 and $106 billion in U.S. offshore wind development by 2030, of which $28 to $57 billion will be invested within the United States. This figure depends on installation levels and supply chain growth, as other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects. While most economic and employment impacts would be concentrated in Atlantic coastal states where offshore wind development will occur—there are over $1.3 billion of announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction—there would be nationwide effects as well (AWEA 2020). The AWEA report analyzes base and high scenarios for offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 GW of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030, while the high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. Offshore wind energy development would support $14.2 billion in economic output and $7 billion in value added by 2030 under the base scenario. Offshore wind energy development would support $25.4 billion in economic output and $12.5 billion in value added under the high scenario. It is unclear where in the U.S. supply chain growth would occur.

The University of Delaware projects that offshore wind power will generate 30 GW along the Atlantic coast through 2030. This initiative would require capital expenditures of $100 billion over the next 10 years (University of Delaware 2021). Although the industry supply chain is global and foreign sources would be responsible for some expenditures, more U.S. suppliers are expected to enter the industry.

Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2020 annual GDP for states with offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $60.6 billion in Rhode Island to $1.72 trillion in New York (U.S. Bureau of Economic Analysis 2022) and totaled nearly $4.3 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.6 percent of the combined GDP of these states.

AWEA estimates that in 2030, offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs nationwide, including direct, supply chain, and induced jobs. Most offshore wind jobs (about 60 percent) would be created during the temporary construction phase while the remaining 40 percent would be long-term O&M jobs. RODA estimated in 2020 that offshore wind projects would create 55,989 to 86,138 job years through 2030 in construction and 5,003 to 6,994 long-term jobs in O&M (Georgetown Economic Services 2020). These estimates are generally consistent with the AWEA study in total jobs supported, although the RODA study concludes that a greater proportion of jobs would be in the construction phase. The two studies conclude that states hosting offshore wind projects would have more offshore wind energy jobs, while states with manufacturing and other supply chain activities may generate additional jobs.

In 2020, employment in Massachusetts was 3.6 million (Table 3.6.3-2). While the extent to which there would be impacts in the geographic analysis area is unclear due to the geographic versatility of offshore wind jobs, a substantial portion of the planned offshore wind projects off the coast of Massachusetts and Rhode Island would likely be within commuting distance of ports in New Bedford, Fall River, and Salem, Massachusetts; New London, Connecticut; Providence, Rhode Island; and other ports that would be used for offshore wind staging, construction, and operations.

The sections below summarize the potential impacts of ongoing and planned offshore wind activities on demographics, employment, and economics during construction, O&M, and decommissioning of the projects. Ongoing and planned offshore wind projects in the geographic analysis area that would contribute to impacts on demographics, employment, and economics include those projects within all or portions of OCS-A-0486 (Revolution Wind), OCS-A-0487 (Sunrise Wind), OCS-A-0500 (Bay State Wind), OCS-A 0501 (Vineyard Wind 1), OCS-A 0517 (South Fork Wind), OCS-A-0520 (Beacon Wind), OCS-A 0522 (Vineyard Wind Northeast), and OCS-A 0534 (New England Wind) (Appendix D, Table D2-1). BOEM expects offshore wind development to affect demographics, employment, and economics through the following primary IPFs.

Lighting: Offshore WTGs require aviation warning lighting that could have economic impacts in certain locations. Aviation hazard lighting from up to 901 WTGs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Visitors may make different decisions on coastal locations to visit and potential residents may choose to select different residences because of nighttime views of lights on offshore wind energy structures. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). In a subsequent study, 1,723 beachgoers were surveyed to determine the impact of WTGs, and the conclusion was that the further away the WTGs, the less of an impact. Nearly 70 percent of beachgoers said that WTGs 15 miles offshore would neither worsen nor increase their experience (Parsons et al. 2020). The majority of the WTG positions envisioned offshore of the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs and so impacts are anticipated to be negligible. These lights would be incrementally added over the construction period and would be visible for the operating lives of offshore wind activities. Distance from shore, topography, and atmospheric conditions would affect light visibility.

If implemented, ADLS would reduce the amount of time that WTG lighting is visible. Visibility would depend on distance from shore, topography, and atmospheric conditions. Such systems would likely reduce impacts on demographics, employment, and economics associated with lighting. Lighting for transit or construction could occur during nighttime transit or work activities. Construction of 12 offshore wind projects would occur within the Massachusetts/Rhode Island lease areas between 2023 and 2030, with a maximum of eight projects under construction concurrently (number of projects includes lease remainders; see Appendix D, Table D-2). Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction (COP Volume 2, Section 8.2.2.1; Mayflower Wind 2022).

Cable emplacement and maintenance: Cable installation for each project could temporarily cause commercial fishing vessels, static gear fishing vessels, and recreational vessels to relocate away from work areas and disrupt fish stocks, thereby reducing income and increasing costs during installation. Fishing vessels are not likely to access affected areas during active construction. About 9,832 acres (3,979 hectares) of seafloor disturbance would occur associated with offshore cable and interarray cable installation (Appendix D, Table D2-2). In the long term, concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers and dredgers (COP Volume 2, Section 11.2.3.2; Mayflower Wind 2022). Assuming similar installation procedures as under the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance (COP Volume 2, Section 10.3.2; Mayflower Wind 2022). Impacts of onshore cable installation would depend on the specific location but could temporarily disrupt beaches and other recreational coastal areas. Disruptions may result in conflict over other fishing grounds, increased operating costs for vessels, and lower revenue. Seafood processing and wholesaling businesses could also experience short-term reductions in productivity. Disruptions from new cable emplacement would have localized, short-term and minor impacts on demographics, employment, and economics. Maintenance is anticipated to have long-term intermittent and negligible impacts on demographics, employment, and economics.

Noise: Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in temporary impacts on demographics, employment, and economics due to impacts on commercial/for-hire fishing businesses, recreational businesses, and marine sightseeing activities.

Assuming other offshore wind facilities generate vessel traffic similar to the vessel trips projected for the Proposed Action, construction of each offshore wind project would generate between 15 and 35 vessels operating at any given time (Section 3.6.6, *Navigation and Vessel Traffic*). Noise from vessel traffic during the maintenance and construction phases could affect species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP Volume 2, Section 6.8.2.1.2; Mayflower Wind 2022). This noise may also make these facilities less attractive to fishing operators and recreational boaters (COP Volume 2, Section 11.2.1.1; Mayflower Wind 2022). Similarly, noise from pile driving from offshore wind activities would affect fish populations that are crucial to commercial fishing and marine recreational businesses (COP Volume 2, Section 6.8.2.1.1; Mayflower Wind 2022). These impacts would be greater if multiple construction activities occur in close spatial and temporal proximity. An estimated 920 foundations (WTGs and OSPs) would be installed within the Massachusetts and Rhode Island lease areas between 2023 and 2030.

Onshore construction noise could result in a short-term reduction of economic activity for businesses near installation sites for onshore cables or substations, temporarily inconveniencing workers, residents, and visitors. Noise would have intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Port utilization: Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would bolster port investment and employment, while also supporting jobs and businesses in supporting industries. Offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the ports of New London, Connecticut; Providence, Rhode Island; New Bedford, Salem, and Fall River, Massachusetts; and the Port of Virginia marine terminals in Portsmouth and Newport News, Virginia. While simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity, it would also generate considerable economic activity and benefit the regional economy and infrastructure investment.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. Improvements to existing ports and channels would be beneficial to other port activity. Port utilization in the geographic analysis area would occur primarily during development and construction projects, anticipated to occur primarily between 2023 and 2030. Ongoing O&M activities would sustain port activity and employment at a lower level after construction.

Offshore wind activities and associated port investment and usage would have long-term, moderate beneficial impacts on employment and economic activity by providing employment and industries, such as marine construction, ship construction and servicing, and related manufacturing. The greatest benefits would occur during offshore wind project construction between 2023 and 2030. If offshore wind construction results in competition for scarce berthing space and port service, port usage could have short- to medium-term adverse impacts on commercial shipping.

Presence of structures: The addition of up to 920 offshore wind structures (WTGs and substations) with 1,247 acres (505 hectares) of foundation and scour protection and 414 acres (168 hectares) of offshore export cable hard protection would increase the risk of gear loss connected with cable mattresses and structures along the East Coast (Appendix D, Table D2-2). Fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial/for-hire recreational fishing industries. These offshore facilities would also pose allision and height hazard risks, creating obstructions and navigational complexity for marine vehicles, which would impose fuel costs, time, and risk and require adequate technological aids and trained personnel for safe navigation. In the event of an allision, vessel damage and spills could result in both direct and indirect costs for commercial/for-hire recreational fishing.

Due to the locations of offshore wind lease areas, it is possible that some commercial fishing areas would be displaced. Because of this, fishermen are likely to switch to their next best fishing location. These locations may involve lower catches per unit, catches of alternative species with different prices, or increased congestion, which would have its own effects, such as increased fishing costs among fishing fleets. In a study on the socioeconomic effects of offshore wind off the coast of Rhode Island and Massachusetts, Hoagland et al. (2015) found that losses associated with a reduction in commercial fishing may be distributed in unexpected ways across the coastal economy. Regional coastal economies are linked across onshore industry sectors and offshore activities, and impacts on commercial fishing would not just affect fishing fleets and related coastal businesses. The study's authors found that impacts may be most pronounced in areas that are not located in close proximity to the coastline (Hoagland et al. 2015), highlighting the potential for broad, regional socioeconomic impacts.

The potential for 920 offshore wind energy structures in the geographic analysis area could encourage fish aggregation and generate reef effects that attract recreational fishing vessels (COP Volume 2, Section 11.2.2.2; Mayflower Wind 2022). Fish aggregation could increase human fishing activities, but this attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from the shore as the wind energy facilities. Fish aggregation could result in broad changes in recreational fishing practices if these effects are widespread enough to encourage more participants to travel farther from shore.

The 1,247 acres (505 hectares) of hard coverage for offshore wind foundations could create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase economic activity associated with offshore sightseeing. New structures would be added intermittently between 2023 and 2030 and could benefit structure-oriented species as long as the structures remain (COP Volume 2, Section 6.8.2.4.2; Mayflower Wind 2022).

As a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses, such as seafood processing. The fishing industry is expected to be able to adapt its fishing practices over time in response to these changes. These effects could simultaneously provide new business opportunities, such as fishing and tourism. Overall, the presence of offshore wind structures would have continuous, long-term moderate impacts on demographics, employment, and economics.

Traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses and investment in ports. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate on average between 13 and 35 vessels operating at any given time. As stated previously, construction of 12 offshore wind projects could occur within the Massachusetts and Rhode Island lease areas between 2023 and 2030, with a maximum of eight projects under construction concurrently (Appendix D, Table D2-1). Increased vessel traffic would have continuous, beneficial impacts during all project phases, with moderate impacts during construction and decommissioning.

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

Vessel traffic would occur among ports (outside the geographic analysis area) and offshore wind work areas. Most vessel traffic would travel to the WTG installation area with fewer vessels needed along the cable installation routes (COP Volume 1, Section 3.3.14; Mayflower Wind 2022).

Land disturbance: Land disturbance could result in localized, temporary disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts, such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, temporary, and both beneficial (jobs and revenues to local businesses that participate in onshore construction) and adverse (lost revenue due to construction disturbances). Land disturbance impacts on demographics, employment, and economics would be minor.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends. Ongoing non-offshore wind activities and offshore wind activities would continue to sustain and support economic activity and growth in the geographic analysis area based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas, especially Barnstable, Dukes, and Nantucket Counties. Marine industries, such as commercial fishing and shipping would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies—including maintaining or increasing their year-round population—and protect environmental resources. BOEM anticipates that the No Action Alternative would result in **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, ongoing and planned offshore wind and non-offshore wind activities would affect ocean-based employment and economics, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise. Increased investment in land and marine ports, shipping, and logistics capability is expected to result along with component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. Additional manufacturing and servicing businesses would result either in the geographic analysis area or other locations in the United States if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output in the geographic analysis area specifically, there would be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, because of offshore wind development.

Many of the jobs generated by offshore wind projects are temporary construction jobs. The combination of these jobs over multiple activities and projects will create notable benefits during the construction phases of these projects. This will particularly be the case as the domestic supply chain for offshore wind evolves over time. Offshore wind projects also support long-term O&M jobs (25–35 years); long-term tax revenues; long-term economic benefits of improved ports and other industrial land areas;

diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce.

Offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through cable emplacement, noise and vessel traffic during construction, and the presence of offshore structures during operations. These IPFs would temporarily disturb marine species and displace commercial or for-hire fishing vessels, which could cause conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also lead to increased navigational constraints and risks and potential gear entanglement and loss.

BOEM anticipates that the cumulative impacts of the No Action Alternative would likely have **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics.

3.6.3.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on demographic, employment, or economic characteristics.

- Overall size of project (up to approximately 2,400 MW) and number of WTGs (up to 147).
- The extent to which Mayflower Wind hires local residents and obtains supplies and services from local vendors.
- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M.
- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity.

The size of the Project would affect the overall investment and economic impacts; fewer WTGs would mean less materials purchased, fewer vessels, and less labor and equipment required. Beneficial economic impacts in the geographic analysis area would depend on the proportion of workers, materials, vessels, equipment, and services that can be locally sourced and the specific ports used by the Project.

Mayflower Wind has committed to measures to minimize impacts on demographics, employment, and economics, which include, but are not limited to, maintaining a stakeholder engagement plan and encouraging the hiring of skilled and unskilled labor from the Project region (COP Volume 2, Table 16-1; Mayflower Wind 2022).

3.6.3.5 Impacts of Alternative B - Proposed Action on Demographics, Employment, and Economics

The Proposed Action's beneficial impacts on demographics, employment, and economics depend on what proportion of workers, materials, vessels, equipment, and services can be locally sourced. Mayflower Wind's economic impact study estimates that the Proposed Action would support the following employment in Massachusetts alone in direct, indirect, and induced job-years:[1] an estimated 530 FTE job-years[2] during development, 5,760 FTE job-years during construction, 20,330 FTE job-years during operations, and 310 FTE job-years during decommissioning (COP Volume 2, Section 10.1.2.1, Table 10-8; Mayflower Wind 2022).

The Proposed Action would generate employment during construction, installation, O&M, and decommissioning of the Project. The Proposed Action would support a range of positions such as engineers, environmental scientists, financial analysts, administrative personnel, various trade workers (such as electricians, technicians, steel workers, welders, and ship workers), as well as other construction jobs during construction and installation of the Proposed Action. O&M would create jobs for maintenance crews, substation and turbine technicians, and other support roles. The decommissioning phase would also generate professional and trade jobs and support roles. Therefore, all phases of the Proposed Action would lead to local employment and economic activity.

Assuming that conditions are similar to those of the Vineyard Wind 1 project, job compensation (including benefits) is estimated to average between $88,000 and $96,000 for the construction phase, with occupations including engineers, construction managers, trade workers, and construction technicians. O&M occupations would consist of turbine technicians, plant managers, water transportation workers, and engineers. A study from the New York Workforce Development Institute provided estimates of salaries for jobs in the wind energy industry that concur with the Vineyard Wind 1 project's projections. The expected salary range for trade workers and technicians ranges from $43,000 to $96,000, $65,000 to $73,000 for ships' crew and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

The hiring of local workers would stimulate economic activity through increased demand for housing, food, transportation, entertainment, and other goods and services. A large number of seasonal housing units are available in the vicinity of the Project area. During the summer, competition for temporary accommodations may arise, leading to higher rents (COP Volume 2, Section 10.1.2.4; Mayflower Wind 2022). However, this effect would be temporary during the active construction period and could be reduced if construction is scheduled outside the busy summer season. Permanent workers are expected

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[1] Direct employment refers to jobs created by the direct hiring of workers. Indirect employment refers to jobs created through increased demand for materials, equipment, and services. Induced employment refers to jobs created at businesses where offshore wind industry workers would spend their incomes. Job-years is an economic term that converts dollars spent into job equivalents based upon historical multipliers that consider factors, such as salary, overhead, and hours worked.

[2] A job-year is defined as one job held for 1 year.

to reside locally; there is adequate housing supply to accommodate the increase in the local workforce (Table 3.6.3-3).

Tax revenues for state and local governments would increase as a result of the Project. Equipment, fuel, and some construction materials would likely be purchased from local or regional vendors. These purchases would result in short-term impacts on local businesses by generating additional revenues and contributing to the tax base. Once the Project is operational, property taxes would be assessed on the value of the Mayflower Wind facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the Project area.

Lighting: Both onshore and offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Offshore, aviation hazard lighting on WTGs could affect employment and economics in these areas if the lighting discourages visits or vacation home rentals or purchases in coastal locations where the Proposed Action's WTG lighting is visible. Mayflower Wind proposes to implement an ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm. Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on the local economy. Impacts related to structure lighting would have localized, long-term, and negligible impacts on demographics, employment, and economics.

The anticipated increase in vessel traffic would result in growth in the nighttime traffic of vessels with lighting. Lighting from vessels would occur during nighttime Project construction or maintenance. This lighting would be visible from coastal businesses, especially near the ports used to support Proposed Action construction. Short-term vessel lighting is not anticipated to discourage tourist-related business activities and would not affect other businesses; therefore, the impact of vessel lighting would be short term and negligible.

Cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism, with potential adverse effects on employment and income. Interarray cable installation would require a maximum of three vessels (COP Volume 1, Table 3-21; Mayflower Wind 2022). Offshore export cable installation would require a maximum of five vessels (COP Volume 1, Table 3-21; Mayflower Wind 2022). While it is not specified how long vessels would be present at a given location, there would be at least one location where cable splicing is necessary, which could require a vessel to remain at the same location for several days (COP Volume 1, Section 3.3.7; Mayflower Wind 2022).

The seafloor disturbance (associated with export cable and interarray cable installation), disruption of fish stocks, and concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers/dredgers, potentially reducing income and increasing costs for affected businesses over the long term. Cable installation would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of the Proposed Action and other existing submarine cables would have intermittent, long-term, negligible impacts.

Noise: Noise from vessel traffic would affect commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities as well as noise from maintenance and repair operations that make the wind energy facilities less attractive to fishing operators and recreational boaters (COP Volume 2, Section 11.2.1.2; Mayflower Wind 2022). Noise from O&M activities would have localized, intermittent, long-term, negligible impacts on demographics, employment, and economics.

The estimated maximum of 149 foundations (WTGs and substations) would generate noise from pile driving, one of the most impactful noises on marine species, especially if multiple project construction activities occur in close spatial and temporal proximity. These disturbances would be temporary and localized, and extend only a short distance beyond the work area. Pile driving could harm marine species or cause avoidance by commercial fish populations, which would, in turn, affect commercial and for-hire fishing, as well as recreational vessels that depend on these animals (COP Volume 2, Section 11.2.2.1; Mayflower Wind 2022). Pile driving and associated noise would have localized, short-term, and minor impacts on demographics, employment, and economics.

Infrequent trenching from cable-laying activities emit noise. This noise could temporarily disrupt commercial fishing, marine recreational businesses, and onshore recreational businesses. Noise from trenching and trenchless technology would affect marine life populations, which would in turn affect commercial and recreational fishing businesses. Impacts on marine life would also affect onshore recreational businesses due to noise near public beaches, parks, residences, and offices. The use of trenchless technology at natural and sensitive landfall locations where possible would minimize direct impacts (COP Volume 1, Section 2.2.2; Mayflower Wind 2022). Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Vessel noise could affect marine species relied upon by commercial fishing businesses, marine recreational businesses, recreational boaters, and marine sightseeing activities. Vessel traffic would occur between ports (outside the geographic analysis area) and offshore wind work areas. Most vessel traffic would travel to the WTG installation area, with fewer vessels needed along the cable installation routes (COP Volume 1, Section 3.3.14; Mayflower Wind 2022). Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

Port utilization: Proposed Action activities at ports would support port investment and employment and would also support jobs and businesses in supporting industries and commerce. Several ports are indicated as possibly supporting proposed Project construction: New London, Connecticut; Providence, Rhode Island; New Bedford and Salem, Massachusetts; and Port of Virginia marine terminals in Portsmouth and Newport News, Virginia. These ports would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity.

The economic benefits would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. During operations, activities would be concentrated in Massachusetts, where the Project's onshore O&M facility is anticipated to be located, and in other ports that may support Project-related vessel traffic. The O&M facility would help to diversify the local economy by providing a source of skilled, year-round jobs. Overall, operation of the Proposed Action would generate an estimated 20,330 direct and indirect job-years in Massachusetts while in operation, in addition to 900 job-years created elsewhere in the region, including Rhode Island (COP Volume 2, Section 10.1.2.1.2; Mayflower Wind 2022). The Proposed Action would have a minor beneficial impact on demographics, employment, and economics from port utilization due to greater economic activity and increased employment at ports used by the Proposed Action.

Presence of structures: The Proposed Action would add up to 149 offshore wind structures (up to 147 WTGs and up to 5 OSPs) with foundation scour protection and offshore export cable hard protection, which could affect marine-based businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through entanglement and gear loss/damage, navigational hazard and risk of allisions, fish aggregation, habitat alteration, and space use conflicts. These structures may cause vessel operators to reroute, which would affect their fuel costs, operating time, and revenue. Due to the risk of gear entanglement, fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial and for-hire recreational fishing industries. Marine-based businesses may be adversely affected due to the possible displacement of mobile species and the potential for WTGs to become an exclusion area for fishing. Shoreside support services, such as bait and ice shops, vessels and infrastructure, insurance and maintenance services, processing, markets, and domestic/international shipping services, are anticipated to experience impacts proportional to those felt by the fishing industry itself (BOEM 2017). As described in Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*, considering the small number of vessels and fishing activity that would be affected, the impacts on other fishing industry sectors, including seafood processors and distributers and shoreside support services, would be adverse, with the level of impact depending on the fishery in question. The presence of structures would have continuous, long-term, and negligible to minor impacts on demographics, employment, and economics.

Offshore wind structures could encourage fish aggregation and generate reef effects that attract recreational fishing vessels. These effects would only affect the minority of recreational fishing vessels that reach the wind energy facilities. This would have long-term, negligible benefits on demographics, employment, and economics. Proposed Action structures could increase economic activity associated with offshore sightseeing because these structures create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons. These forms of marine life could attract private or commercial recreational sightseeing vessels (COP Volume 2, Section 10.3.2.2.2; Mayflower Wind 2022). This would have long-term, negligible beneficial impacts on demographics, employment, and economics.

Traffic: The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting project construction, O&M, and decommissioning. Mayflower Wind estimates that construction activity would generate on average between 15 and 35 vessels operating at any given time (refer to Section 3.6.6, *Navigation and Vessel Traffic*, for additional information regarding anticipated vessel traffic). The vessel traffic generated by the Proposed Action could result in temporary, periodic congestion within and near ports, leading to potential delays and increased risk of allision, collision, and spills, which would result in economic costs for vessel owners. As a result of potential delays from increased congestion and increased risk of damage from collisions, the Proposed Action would have continuous, short-term, and minor impacts during construction and negligible impacts during operations.

Land disturbance: Construction of the Proposed Action would require onshore cable installation and new substation/converter station construction. During peak tourist season, construction-related impacts associated with land disturbance, including road construction in Falmouth and Aquidneck Island, could cause traffic delays and inconveniences to local businesses and residents. Temporary blockage of some roads during installation activities may restrict access to some local areas, although it is unlikely that access to specific establishments would be completely inhibited. The impact would be greatest if the Cape Cod Aggregates substation site in the Falmouth Onshore Project area was selected as this would require temporary road closure and disruptions along 8.5 miles of road where the onshore cable would be installed. The disruptions in access would occur for a short period at any given location as installation of equipment progresses along the underground onshore export cables. Impacts would be temporary during construction and Mayflower Wind has committed to implementing a Traffic Management Plan to minimize disruptions to residences and commercial establishments. The employment and economic impact of the Proposed Action caused by disturbance of businesses and potential revenue loss near the onshore cable routes and substation and converter station sites would result in localized, short-term, minor impacts.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities and other planned offshore wind activities. Between 2023 and 2030, WTG lighting from other offshore wind activities would be added to the geographic analysis area, some of which would be visible from the same locations as the Proposed Action's WTGs and could affect demographics, employment, and economics if lighting discourages tourism and recreation-based businesses. The Proposed Action would contribute an undetectable increment to the cumulative lighting impacts from ongoing and planned activities, which would be negligible. Cable emplacement from the Proposed Action and other ongoing and planned activities could hinder commercial fishing operations, potentially reducing income and increasing business costs. Because installation impacts would be short term and most cables would be buried such that they would not interfere with fishing operations, cumulative impacts are anticipated to be negligible. Construction of the Proposed Action would contribute to increased noise impacts during periods of simultaneous construction activity with other offshore wind projects (Appendix D, Table D2-1), potentially affecting commercial fish stock and other marine based businesses. While operational activity would overlap, noise impacts during operations would be far less than during construction. The Proposed Action would contribute an undetectable increment to the cumulative noise impacts on demographics, employment, and economics from ongoing and planned activities, which would be short term and negligible.

Other offshore wind energy activity would provide business activities at the same ports as the Proposed Action, as well as other ports in the geographic analysis area. Port investments are ongoing and planned in response to offshore wind activity. Maintenance and dredging of shipping channels are expected to increase, which would benefit other port users. In context of reasonably foreseeable environmental trends, the cumulative impact of the Proposed Action in combination with other ongoing and planned activities on port utilization would be long-term and moderate beneficial.

Across the Massachusetts and Rhode Island lease areas, up to 1,069 offshore structures, 149 of which would be attributable to the Proposed Action, would affect employment and economics by affecting marine-based businesses. Presence of structures would have both beneficial impacts, such as by providing sightseeing opportunities and fish aggregation that benefit recreational businesses, and adverse effects, such as by causing fishing gear loss, navigational hazards, and viewshed impacts that could affect business operations and income. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the cumulative impacts from other ongoing and planned activities, which would be long-term and moderate due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

Increased vessel traffic from the Proposed Action and other ongoing and planned activities would produce demand for supporting marine services, with beneficial impacts on employment and economics during all Project phases, including minor to moderate beneficial impacts during construction and decommissioning and negligible beneficial impacts during operations. In context of reasonably foreseeable environmental trends, increased vessel traffic congestion and collision risk from the Proposed Action and other ongoing and planned activities would have long-term, continuous impacts on marine businesses during all project phases, with minor impacts during construction and decommissioning and negligible impacts during operations.

The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for offshore wind energy projects. The cumulative impact on land disturbance would be short term and minor due to the short-term and localized disruption of onshore businesses.

Conclusions

Impacts of the Proposed Action: BOEM anticipates that the Proposed Action would have negligible impacts on demographics in the geographic analysis area. While it is likely that some workers would relocate to the area because of the Proposed Action, this volume of workers would not be substantial compared to the current population and housing supply. The Proposed Action alone would affect employment and economics through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development, which would have minor beneficial impacts. Construction would have a minor beneficial impact on employment and economics due to jobs and revenue creation over the short duration of the construction period. The beneficial impact of employment and expenditures during O&M would have a modest magnitude over the 35-year duration of the Project. Although tax revenues and grant funds would be modest in magnitude, they also would provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. If the Proposed Action becomes decommissioned, the impacts on demographics, employment, and economics would be minor and beneficial due to the construction activity necessary to remove wind facility structures and equipment. After decommissioning, the Proposed Action would no longer affect employment or produce other offshore wind-related revenues.

While the Proposed Action's investments in wind energy would largely benefit the local and regional economies through job creation, workforce development, and income and tax revenue, adverse impacts on individual businesses and communities would also occur. Short-term increases in noise during construction, cable emplacement, land disturbance, and the long-term presence of offshore lighting and structures would have negligible to minor adverse impacts on demographics, employment, and economics. The commercial fishing industry and other businesses that depend on local seafood production would experience impacts during construction. Overall, the impacts on commercial fishing and onshore seafood businesses would have minor impacts on demographics, employment, and economics for this component of the geographic analysis area's economy. Although commercial fishing is a small component of the regional economy, it is important to the identity of local communities within the region. The IPFs associated with the Proposed Action alone would also result in impacts on certain recreation and tourism businesses that range from negligible to minor, with an overall minor impact on employment and economic activity for this component of the analysis area's economy.

In summary, the Proposed Action would have **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of the Proposed Action: BOEM anticipates that cumulative impacts on demographics, employment, and economics would be **minor** adverse and **moderate beneficial**. The moderate beneficial impacts primarily would be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the minor adverse effects would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions during construction, and land disturbance. Impacts on commercial and for-hire recreational fishing are anticipated to be moderate but only one component of the overall impacts. Because they are not expected to disrupt normal demographic, employment, and economic trends, the overall impacts in the geographical analysis area likely would be minor.

3.6.3.6 Impacts of Alternative C on Demographics, Employment, and Economics

Impacts of Alternative C: Alternative C would result in similar but slightly greater impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitudes would be the same. To avoid sensitive fish habitat in the Sakonnet River, the export cable route to Brayton Point under Alternative C would be rerouted onshore. The onshore export cable would be installed in trenches within existing road ROWs where feasible, including road shoulders and medians, and could potentially require pathways on private properties. The Alternative C-1 onshore export cable route would be installed primarily along Route 138, on Aquidneck Island, increasing the total length of the onshore cable route by approximately 9 miles (14 kilometers). The Alternative C-2 onshore export cable route would be installed primarily along Routes 77 and 177, in Little Compton and Tiverton, increasing the total length of the onshore cable route by approximately 13 miles (21 kilometers). Similar to the Proposed Action, onshore cable installation activities would result in temporary traffic delays, disruptions to business or residential access, noise, and related construction impacts, which could result in a short-term reduction of economic activity for businesses near installation sites for onshore cables, temporarily inconveniencing workers, residents, and visitors. Construction impacts would have intermittent and short-term impacts on demographics, employment, and economics.

Because the onshore cable routes would be longer than the Proposed Action, the number of businesses and residents affected would be greater and the duration of impacts from construction would be longer, with Alternative C-2 having the greatest impact. Both alternative cable routes would traverse along roadways through mostly rural residential neighborhoods and agricultural land, with some denser residential neighborhoods and local commercial businesses located along the cable routes in Portsmouth at the northern end of Aquidneck Island (Alternative C-1) and in Tiverton (Alternative C-2). The disruptions in access would occur for a short period at any given location as installation of equipment progresses along the onshore export cables. The same avoidance measures that Mayflower Wind has proposed for the Proposed Action would apply for Alternative C, including implementing a Traffic Management Plan to minimize disruptions to local communities and developing a construction schedule to minimize effects to tourism related activities to the extent practicable (COP Volume 2, Table 16-1; Mayflower Wind 2022). Because these impacts would be temporary, lasting only during installation activities, and with implementation of the avoidance measures proposed by Mayflower Wind, impacts under Alternative C are anticipated to be localized, short-term, and minor.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative C: While the onshore cable route to Brayton Point would differ under Alternative C, the overall impact magnitudes are anticipated to be the same as those of the Proposed Action, which is anticipated to be **minor** adverse and **minor** beneficial on demographics, employment, and economics.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternative C would be the same as under the Proposed Action and would be **minor** adverse and **moderate beneficial**.

3.6.3.7 Impacts of Alternative D on Demographics, Employment, and Economics

Impacts of Alternative D: Alternative D would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitudes would be the same. Under Alternative D, up to six fewer WTGs would be constructed than the Proposed Action to reduce impacts on foraging habitat adjacent to Nantucket Shoals. Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. Conversely, the reduced number of WTGs would also mean that the Project would generate less energy and would, therefore, result in slightly lower beneficial impacts associated with delivering a reliable supply of energy. Because Alternative D would produce less energy, it would also offset fewer GHG emissions from fossil-fueled power generation compared to the Proposed Action, further reducing beneficial impacts. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would not change the overall impact rating compared to the Proposed Action.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative D would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative D: Alternative D would result in slightly lower adverse impacts and slightly lower beneficial impacts compared to the Proposed Action, but would not change the overall impact level, which is anticipated to be **minor** adverse and **minor** beneficial on demographics, employment, and economics.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternative D would be the same as under the Proposed Action—**minor** adverse impacts and **moderate beneficial** impacts.

3.6.3.8 Impacts of Alternatives E and F on Demographics, Employment, and Economics

Impacts of Alternatives E and F: Alternative E, which would involve installing a range of foundation types, and Alternative F, which would involve reducing the number of Falmouth offshore export cables from five to three, would not have measurable impacts on demographics, employment, and economics that are materially different from the impacts of the Proposed Action. While Alternative E-2 and Alternative E-3 would avoid foundations requiring pile driving, in contrast to Alternative E-1, which would only install piled foundations, any differences in noise impacts on commercial fisheries would be temporary and localized during foundation installation; therefore, the overall impact magnitude of Alternative E on demographics, employment, and economics would be the same and would not differ from the Proposed Action. Reducing the number of Falmouth offshore cables to minimize seabed impacts under Alternative F would result in no measurable differences in impacts compared to the Proposed Action.

Cumulative Impacts of Alternatives E and F: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives E and F would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternatives E and F: The impacts of Alternative E and Alternative F on demographics, employment, and economics would be about the same as those of the Proposed Action. Impacts would be **minor** adverse impacts and **minor beneficial**.

Cumulative Impacts of Alternatives E and F: In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternative E and Alternative F would be the same as under the Proposed Action—**minor** adverse impacts and **moderate beneficial** impacts.

3.6.3.9 Proposed Mitigation Measures

No measures to mitigate impacts on demographics, employment, and economics have been proposed for analysis.

3.6 Socioeconomic Conditions and Cultural Resources

3.6.4 Environmental Justice

This section discusses environmental justice impacts from the proposed Project, alternatives, and ongoing and planned activities in the environmental justice geographic analysis area. The geographic analysis area for environmental justice, as shown on Figure 3.6.4-1, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties closest to the Wind Farm Area and from which Project components would be visible: Barnstable, Bristol, Dukes, Nantucket, Plymouth, and Essex Counties, Massachusetts; Newport, Bristol, and Providence Counties, Rhode Island; New London County, Connecticut; and Portsmouth and Newport News, Virginia. These counties and municipalities are the most likely to experience beneficial or adverse environmental justice impacts from the proposed Project related to onshore and offshore construction and decommissioning, O&M, and use of port facilities.

3.6.4.1 Description of the Affected Environment and Future Baseline Conditions

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Subsection 1-101). When determining whether environmental effects are disproportionately high and adverse, agencies are to consider whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Indian tribe, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). Beneficial impacts are not typically considered environmental justice impacts; however, this section identifies beneficial effects on environmental justice populations, where appropriate, for completeness.

Executive Order 12898 directs federal agencies to consider the following with respect to environmental justice as part of the NEPA process (CEQ 1997).

- The racial and economic composition of affected communities;
- Health-related issues that may amplify project effects on minority or low-income individuals; and
- Public participation strategies, including community or tribal participation in the NEPA process.

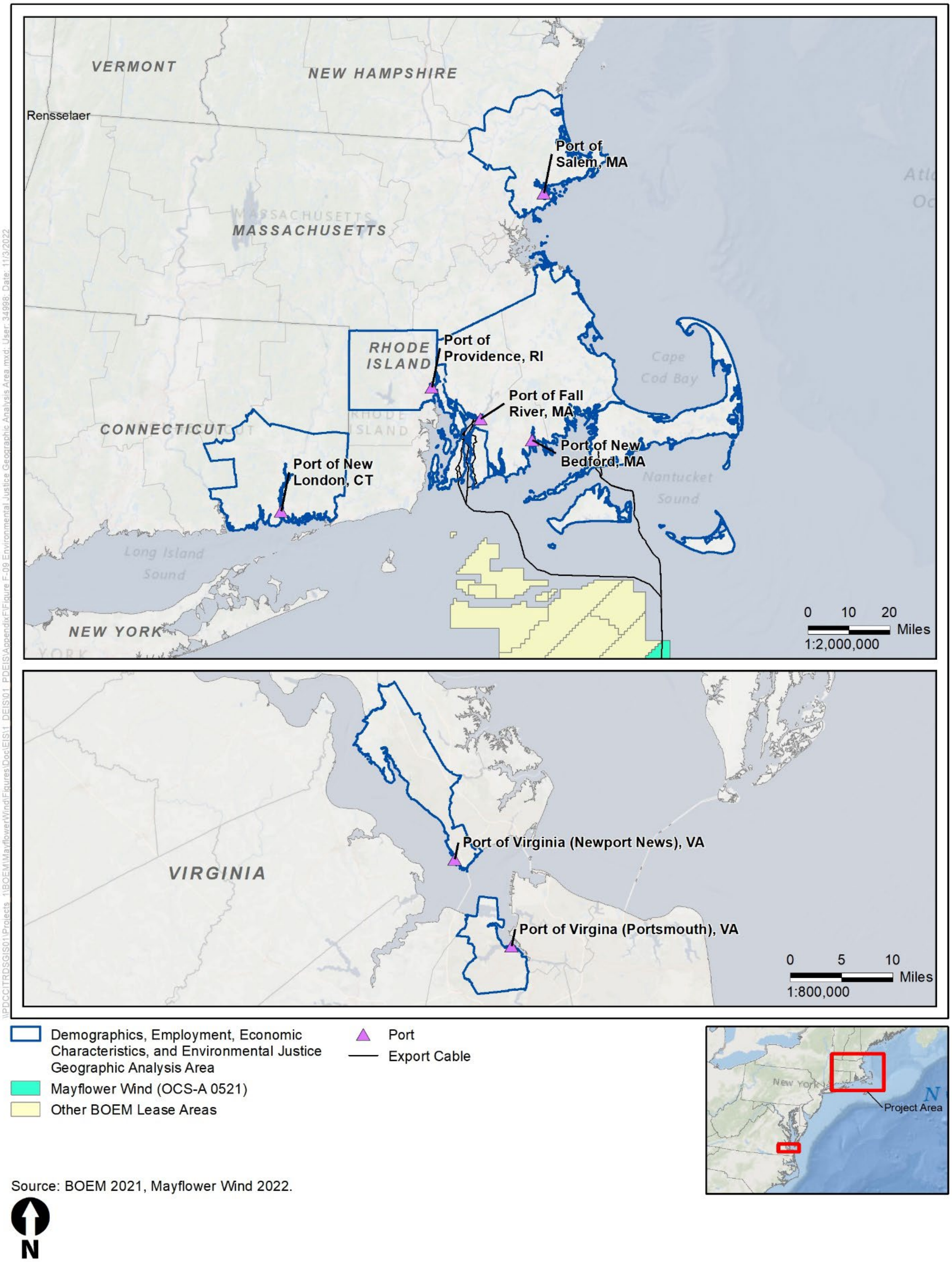

Figure 3.6.4-1. Environmental justice geographic analysis area

USEPA Environmental Justice Community Definition

For the purposes of this analysis, an environmental justice community is defined as the union of federal and, if available, state specific criteria. According to USEPA guidance, environmental justice analyses must address disproportionately high and adverse impacts on minority populations (i.e., who are non-white, or who are white but have Hispanic ethnicity) when minority populations represent over 50 percent of the population of an affected area or when the percentage of minority or low-income populations in the affected area is "meaningfully greater" than the minority percentage in the "reference population"—defined as the population of a larger area in which the affected population resides (i.e., a county, state, or region depending on the geographic extent of the analysis area). Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census, Population Reports, Series P-60 on Income and Poverty (USEPA 2016). CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure.

Commonwealth of Massachusetts Environmental Justice Community Definition

In the Commonwealth of Massachusetts, an environmental justice population, as defined by Chapter 8 of the Massachusetts State Legislature Session Laws Acts of 2021, is any census block group, as determined in accordance with the most recent United States census data, in which (MAEEA 2021):

- The annual median household income is not more than 65 percent of the statewide annual median household income;
- Minorities comprise 40 percent or more of the population;
- 25 percent or more of households lack English language proficiency (defined as 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 [MAEEA 2021]); or
- 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.

Using these definitions and the community demographic data provided by the Massachusetts Executive Office of Energy and Environmental Affairs on its environmental justice web page, environmental justice populations meeting the minority or low-income criteria in the Massachusetts portion of the geographic analysis area are clustered around larger cities and towns near the potential cable landing sites and potential ports (Figure 3.6.4-2, Figure 3.6.4-3, and Figure 3.6.4-4) and are primarily located in and near Falmouth and Hyannis (Barnstable County); Fall River and New Bedford (Bristol County); Aquinnah, Edgartown, and Tisbury (Dukes County); and Brockton and Wareham (Plymouth County). Environmental justice populations meeting both the minority and low-income criteria are present in and near New Bedford, Fall River, Hyannis, Brockton, and Wareham. Environmental justice populations meeting the minority and English isolation or income and English isolation criteria are located in Brockton and New Bedford.

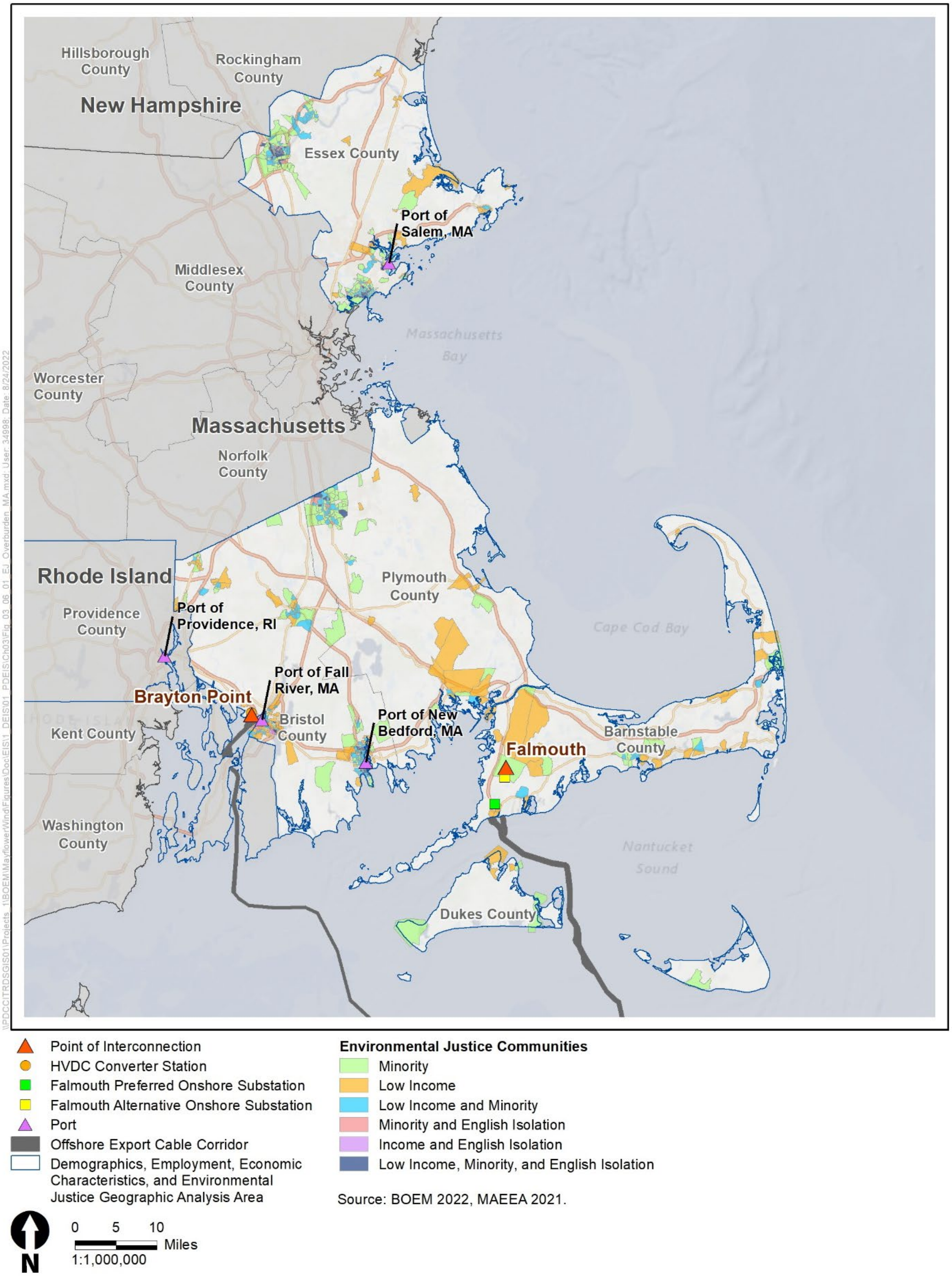

Figure 3.6.4-2. Environmental justice populations in Massachusetts

State of Rhode Island Environmental Justice Community Definition

RIDEM defers to USEPA's environmental justice community thresholds, but in its 2009 *Policy for Considering Environmental Justice in the Review of Investigation and Remediation of Contaminated Properties* defined the minority "reference population" as the entire state (RIDEM 2009). RIDEM 2009 additionally identified as Environmental Justice Focus Areas those in which the percent of the block group that is minority or low-income (under twice the federal poverty level) are high enough to rank in the top 15 percent of block groups statewide. This analysis therefore defines an environmental justice community as a block group that either (1) meets USEPA's "50 percent" criterion for race, or (2) is in the top 15 percent of block groups for minority or low-income status as compared to the state population for Rhode Island. USEPA's Environmental Justice Screening and Mapping Tool's (EJSCREEN) data were used to assess the 50 percent criterion and the top 15 percent criterion for Rhode Island (USEPA 2022a). Based on the top 15 percent criterion, this analysis will consider any block group in Rhode Island above the 85th percentile for low-income population to be an environmental justice community. According to EJSCREEN data, the 85th percentile in Rhode Island equals a block group in which 47 percent of the population qualifies as low-income. Environmental justice communities meeting the minority or income criteria are present within and near Providence (Providence County), and communities meeting the income criterion are present in and near Middletown (Newport County). Figure 3.6.4-5 provides a map of environmental justice community locations in the geographic analysis area in Rhode Island.

State of Connecticut Environmental Justice Community Definition

The state of Connecticut defines environmental justice communities in terms of low-income but not minority populations. Connecticut's House Bill No. 7008 defines an environmental justice community as "a United States census block group, as determined in accordance with the most recent United States 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 per cent of the federal poverty level" or is one of the 25 towns that Connecticut designates as "distressed municipalities" due to their low rankings in income, employment, education, and other areas as compared to the rest of the state (State of Connecticut 2020). This analysis defines environmental justice populations in Connecticut as the union of USEPA's 50 percent criterion for race, the state of Connecticut's 30 percent criterion for low income, and the state of Connecticut's definition of distressed municipality. Based on these criteria, environmental justice communities meeting the low-income or low income and minority criteria in the geographic analysis area for Connecticut are concentrated around the Port of New London (Figure 3.6.4-6). As of 2021, the city of New London is also considered a distressed municipality by the state of Connecticut (DECD 2021).

Commonwealth of Virginia Environmental Justice Community Definition

The Commonwealth of Virginia, following the Virginia Environmental Justice Act of 2020, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (Virginia Code Section 2.2 – 234).

- The population of color, expressed as a percentage of the total population of such area, is higher than the population of color in the Commonwealth expressed as a percentage of the total population of the Commonwealth; or
- Any census block group in which 30 percent or more of the population is composed of people with low income (defined as: "having an annual household income equal to or less than the greater of (i) an amount equal to 80 percent of the median income of the area in which the household is located, as reported by the [U.S.] Department of Housing and Urban Development, and (ii) 200 percent of the Federal Poverty Level").

Environmental justice communities are defined as the union of USEPA's criteria (refer to *USEPA Environmental Justice Community Definition* for more detail) and Virginia's criteria. USEPA's EJSCREEN data were used to assess Virginia's "higher than" criterion for race and the 30 percent criterion for low-income status (USEPA 2022a). According to EJSCREEN data, the mean percentage of minority individuals statewide for Virginia is equivalent to a community in which 38 percent of the population meets the definition of minority. Therefore, any census block group in Virginia that is 38 percent or more minority is considered an environmental justice community. Environmental justice communities meeting the minority or income criteria are present within Newport News and Portsmouth (Figure 3.6.4-7).

Table 3.6.4-1 summarizes trends for non-white populations and the percentage of individuals with incomes below the federally defined poverty line in the counties studied in the geographic analysis area. The percentage of population living under the poverty level generally increased from 2000 to 2010 and declined slightly by 2020. The non-white population percentage generally increased throughout the geographic analysis area between 2000 and 2020. Figure 3.6.4-2 through Figure 3.6.4-7 depict the environmental justice communities within the geographic analysis area. The census tracts represented in these figures are listed in Appendix B, *Supplemental Information and Additional Figures and Tables*.

Table 3.6.4-1. State and county low-income and minority status

Jurisdiction	Percentage of Population below the Federal Poverty Level			Non-White Population Percentage [a]		
	2000	2010	2020	2000	2010	2020
Commonwealth of Massachusetts	**9.3**	**11.4**	**9.8**	**18.1**	**23.9**	**32.4**
Barnstable County	6.9	11.3	6.7	6.6	8.6	15.0
Bristol County	10.0	12.9	10.7	10.6	14.4	23.1
Dukes County	7.3	NA	7.5	10.0	13.7	21.2
Essex County	8.9	10.3	10.1	16.9	24.0	33.8
Nantucket County	7.5	NA	6.3	13.1	19.5	30.6
Plymouth County	6.6	8.0	6.7	12.4	16.1	23.3

Jurisdiction	Percentage of Population below the Federal Poverty Level			Non-White Population Percentage [a]		
	2000	2010	2020	2000	2010	2020
State of Rhode Island	**11.9**	**14.0**	**11.6**	**18.1**	**23.6**	**31.3**
Bristol County	6.3	NA	7.1	3.9	5.7	12.1
Newport County	7.1	5.8	7.7	9.9	12.1	17.2
Providence County	15.5	17.6	14.0	26.2	33.9	42.7
State of Connecticut	**7.9**	**10.1**	**9.8**	**22.5**	**28.8**	**36.8**
New London County	6.4	8.8	8.5	15.3	21.7	27.4
Commonwealth of Virginia	**9.6**	**11.1**	**10.0**	**29.8**	**35.2**	**41.4**
Newport News	13.8	14.6	14.8	48.0	54.0	61.7
Portsmouth	16.2	18.1	15.7	54.9	59.7	64.3

Sources: USCB 2000a, 2000b, 2010, 2020.

[a] Non-White population percentage is 100% minus the not Hispanic or Latino, White alone population percentage.

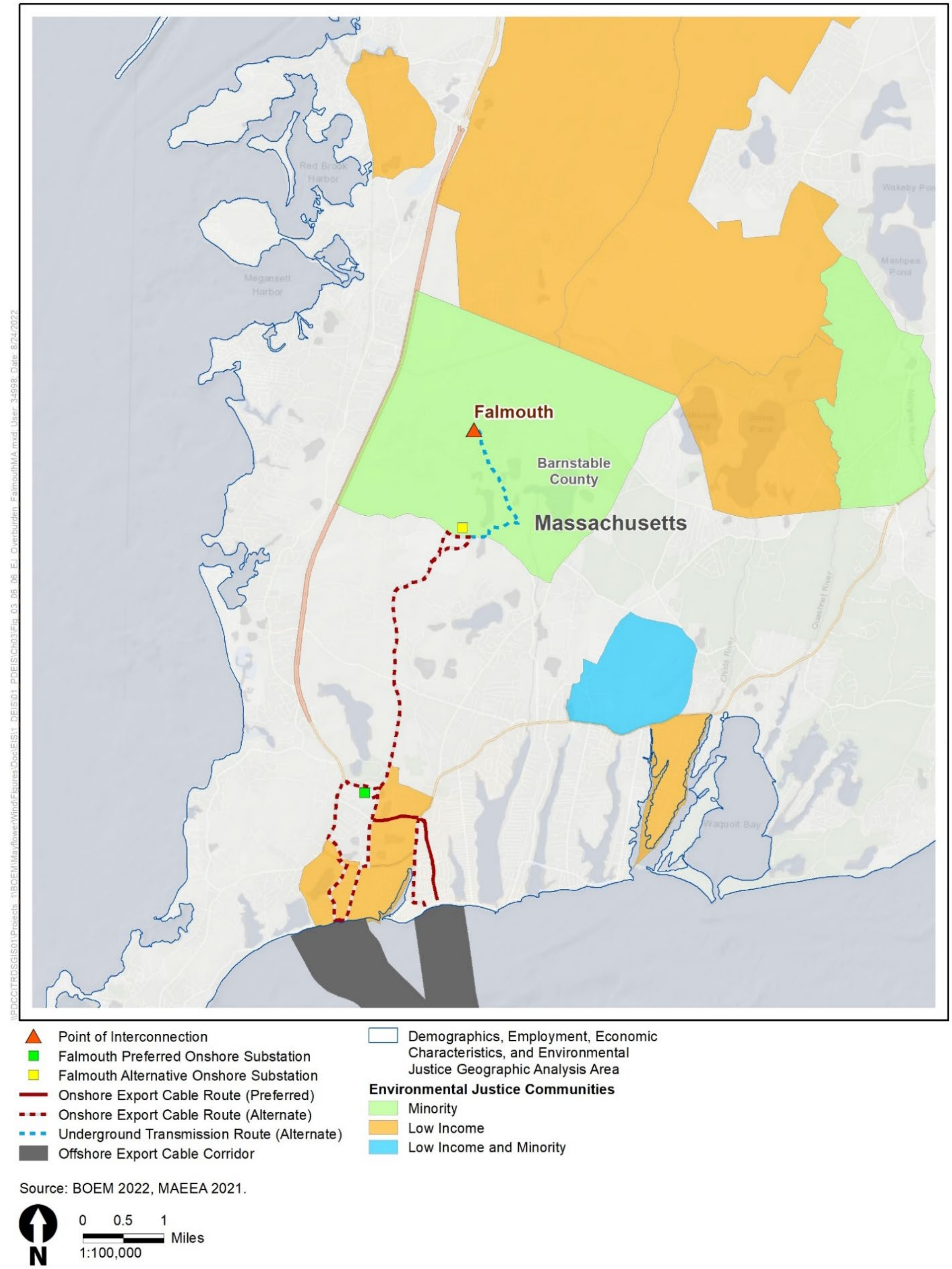

Figure 3.6.4-3. Environmental justice populations around the Falmouth Onshore Project area

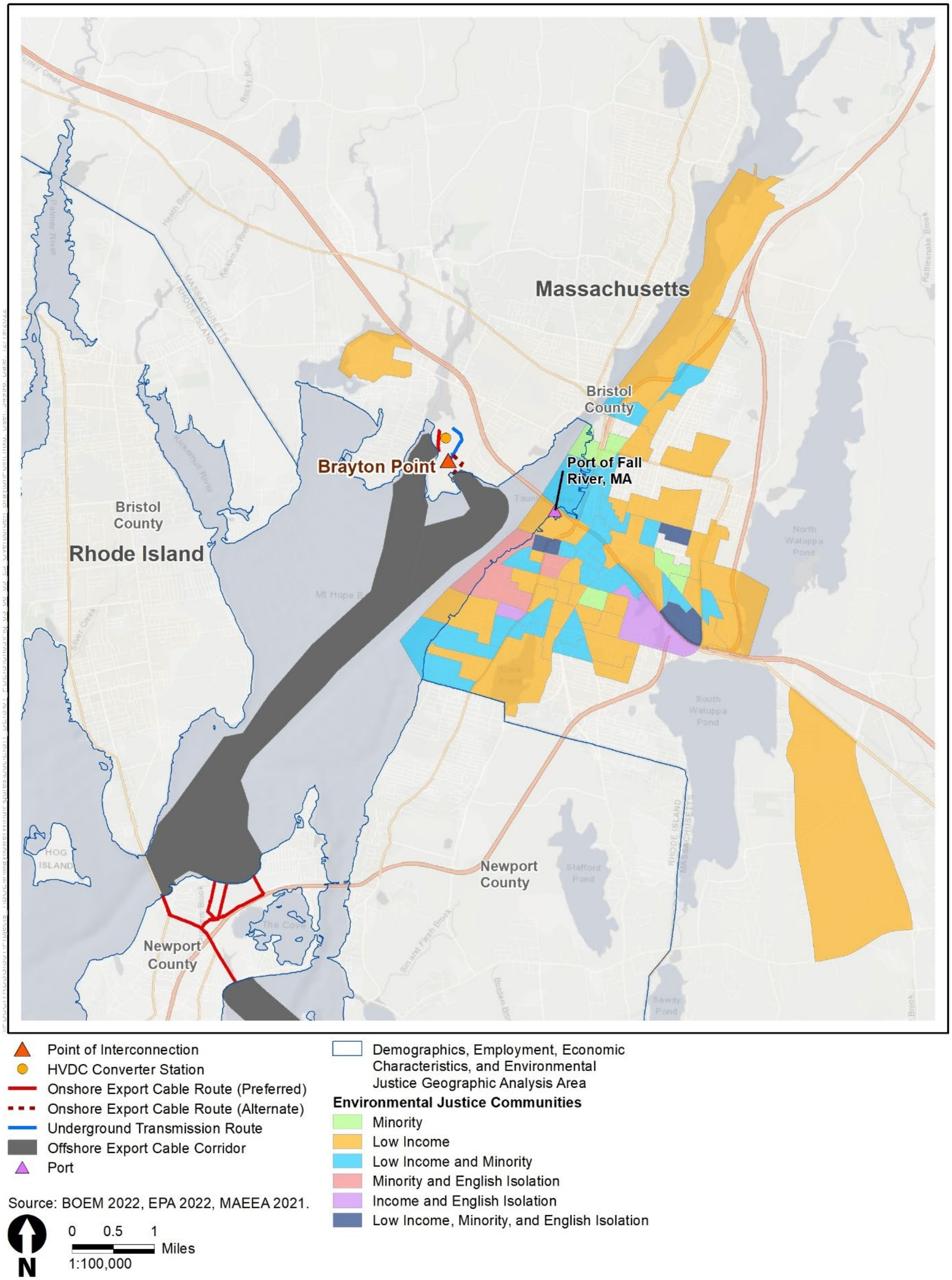

Figure 3.6.4-4. Environmental justice populations around the Brayton Point Onshore Project area

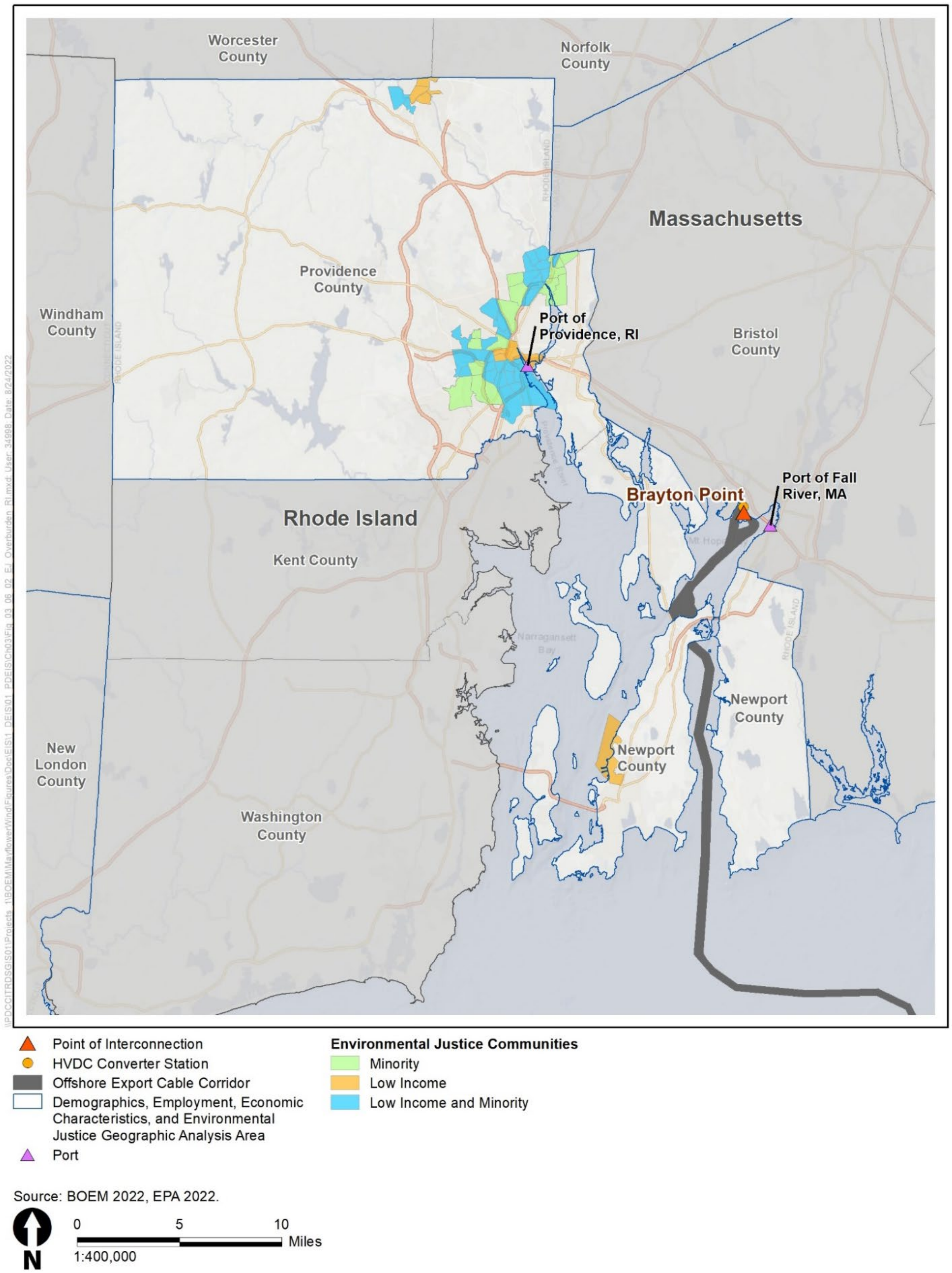

Figure 3.6.4-5. Environmental justice populations in Rhode Island

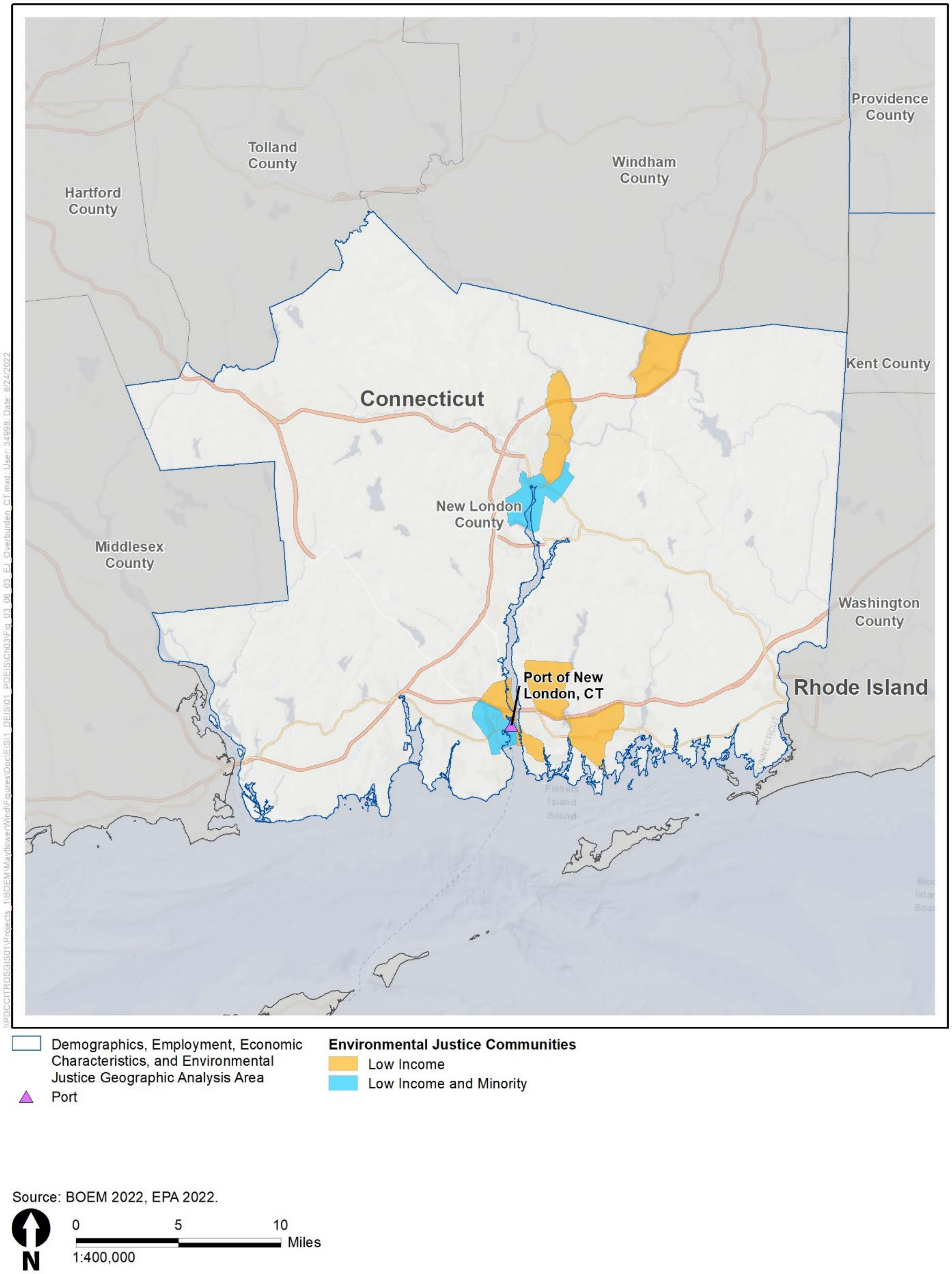

Figure 3.6.4-6. Environmental justice populations in Connecticut

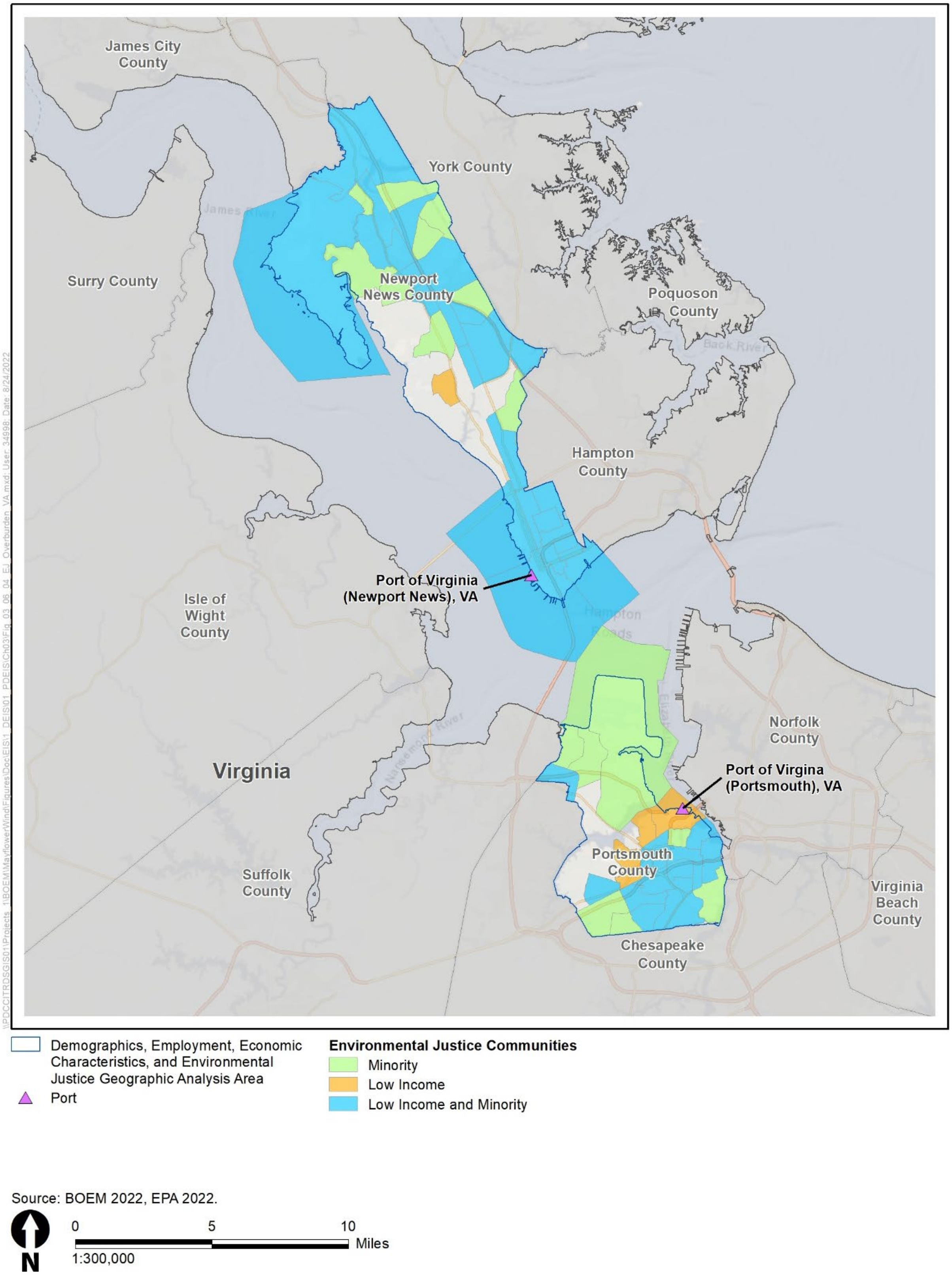

Figure 3.6.4-7. Environmental justice populations in Virginia

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

NOAA's social indicator mapping (NOAA 2022) was used to identify environmental justice populations in the geographic analysis areas that also have a high level of recreational or commercial fishing engagement or fishing reliance. Due to the limited and short-term (during Proposed Action construction) contribution to port use in the Virginia and Connecticut regions of the geographic analysis area, those ports and surrounding communities were not considered in this portion of the analysis.

The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to coastal communities.

- **Commercial fishing engagement measures:** the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement.
- **Commercial fishing reliance measures:** the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates more reliance.
- **Recreational fishing engagement measures:** the presence of recreational fishing through fishing activity estimates. A high rank indicates more engagement.
- **Recreational fishing reliance measures:** the presence of recreational fishing in relation to the population size of a community. A high rank indicates increased reliance.

As shown on Figure 3.6.4-8, the coastal communities of Barnstable, Hyannis, New Bedford, Plymouth, and Chatham, Massachusetts, and Narragansett, Rhode Island, have high levels of commercial fishing engagement. Chatham also has a high level of commercial fishing reliance. Within these communities that have a high level of commercial fishing engagement or reliance, New Bedford and Hyannis are determined to contain environmental justice populations (Figure 3.6.4-2). Barnstable, Hyannis, Narragansett, and a portion of Nantucket Island in Massachusetts have a high level of recreational fishing engagement (Figure 3.6.4-8). Among these communities that have a high level of recreational fishing engagement, only Hyannis is determined to contain environmental justice populations (Figure 3.6.4-2). The coastal community of Bourne, Massachusetts, has a high level of recreational fishing reliance (Figure 3.6.4-8); areas within or near Bourne contain environmental justice populations (Figure 3.6.4-2). One of the two ports in Massachusetts that may be used for the Project, the Port of New Bedford, is located in an area with high levels of commercial fishing engagement (Figure 3.6.4-8). The Port of Providence in Rhode Island, which is an area with environmental justice populations, is not in an area with high levels of commercial or recreational fishing engagement or reliance.

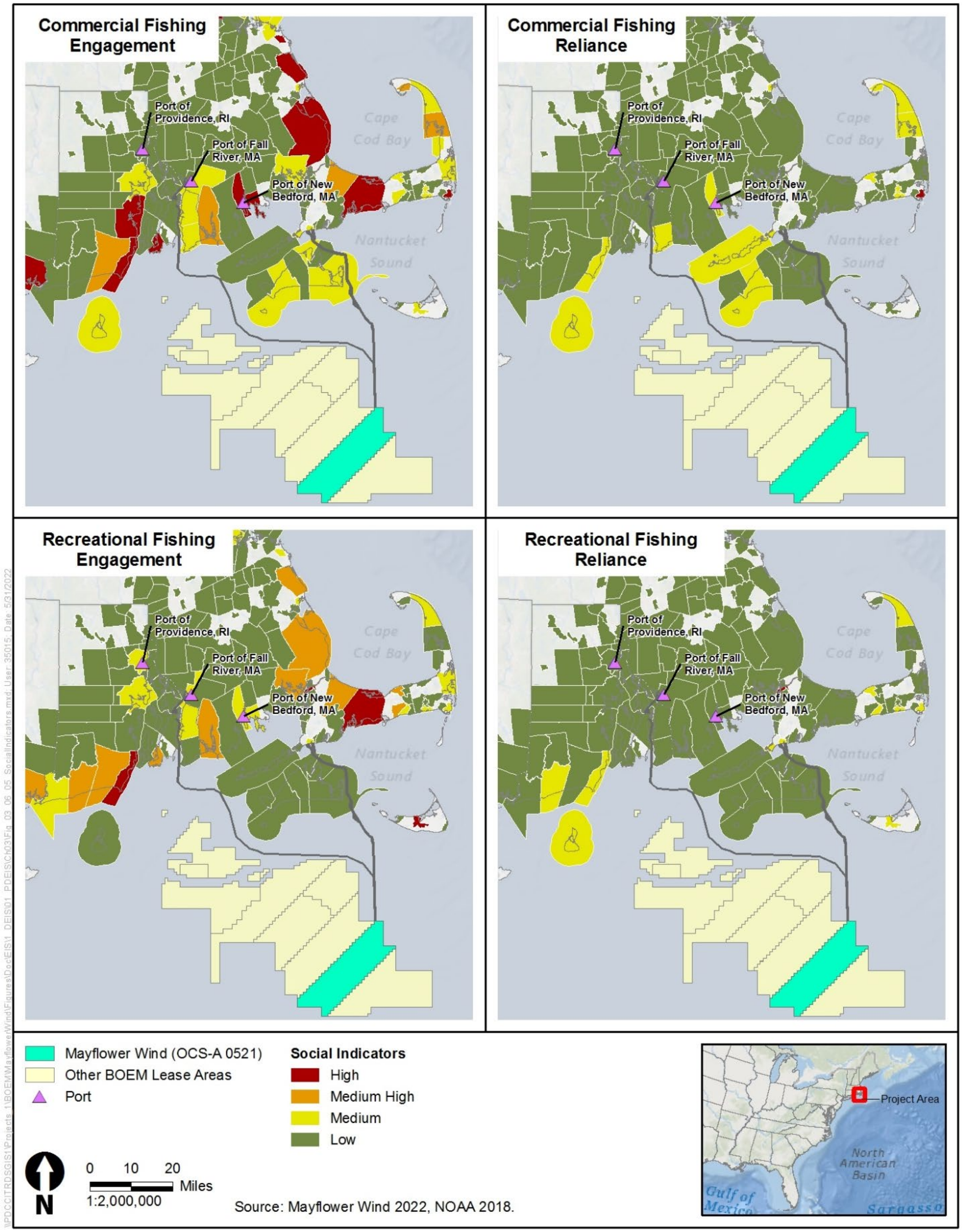

Figure 3.6.4-8. Commercial and recreational fishing engagement or reliance of coastal communities

Within the geographic analysis area, recreational fisheries may be used by low-income and minority residents who rely on subsistence fishing as a food source, as well as tribal members for whom fishing is also a cultural practice. Due to the lack of subsistence fishing reliance indicators, this analysis uses recreation fishing reliance, as defined by the NOAA social indicator, as a proxy for subsistence fishing reliance. Based on the NOAA social indicator mapping (Figure 3.6.4-8), only the community of Bourne, Massachusetts, has high levels of recreational fishing reliance and contains environmental justice populations. Recent BOEM consultation with Native American tribes for the Vineyard Wind 1 project indicate that tribal subsistence fishing and clamming occur off Chappaquiddick Island (BOEM 2020).

NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022). The gentrification pressure indicators measure factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront. Gentrification indicators are related to housing disruption, retiree migration, and urban sprawl.

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including changes in mortgage values. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years, population receiving social security or retirement income, and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

Mapping for gentrification indices shows medium high to high levels of housing disruption in coastal communities in Newport, Rhode Island; Wareham, Tisbury, Nantucket, Plymouth, and most of Cape Cod, with the exception of the town of Truro, Massachusetts. The mapping shows medium high to high retiree migration in and near Chilmark, Siasconset, and Cape Cod, except for Barnstable where there are medium levels of retiree migration. In Little Compton, Rhode Island, the mapping shows medium high levels of retiree migration. Urban sprawl in the geographic analysis area exhibits medium high to high pressure in Fall River, Acushnet, Marion, Woods Hole, Aquinnah, Chilmark, Nantucket, and Provincetown, Massachusetts. Overall, mapping identifies higher gentrification pressure in the environmental justice analysis area compared to other nearby coastal areas due to medium high to high levels of housing disruption and retiree migration, but generally low levels of urban sprawl.

Environmental justice analyses must also address impacts on Native American tribes. Federal agencies should evaluate “interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action,” and “recognize that the impacts within…Indian tribes may be different from impacts on the general population due to a community’s distinct cultural practices” (CEQ 1997). Factors that could lead to disproportionately high and adverse impacts for environmental justice populations include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016).

Massachusetts formally recognizes two federally recognized tribes, the Wampanoag Tribe of Gay Head (Aquinnah) and the Mashpee Wampanoag Tribe, as well as the Nipmuc Nation, which is not federally recognized. The state of Rhode Island recognizes the Narraganset Indian Tribe, which is also federally recognized (NCSL 2019). The Wampanoag Tribe of Gay Head (Aquinnah) and the Mashpee Wampanoag Tribe both reside in the geographic analysis area. Neither the Nipmuc nor the Narraganset peoples reside within the geographic analysis area. The Commonwealth of Virginia recognizes 11 tribes, seven of which are federally recognized. None of the 11 tribes recognized by the Commonwealth of Virginia reside in the geographic analysis area. The Nansemond Indian Nation in Suffolk, Virginia, is the closest tribe to the cities of Newport News and Portsmouth. The Nansemond Indian Nation lived in settlements along the Nansemond River fishing, harvesting oysters, hunting, and farming (Nansemond Indian Nation n.d.). The state of Connecticut recognizes five tribes, two of which are federally recognized: the Mashantucket Pequot Tribe and the Mohegan Tribe of Indians of Connecticut (NCSL 2019). The three non-federally recognized tribes in Connecticut do not reside in the geographic analysis area.

BOEM has invited the following federally recognized tribes with ancestral associations to lands within the Project area to participate in government-to-government consultations: Delaware Indian Tribe, Mashantucket Pequot Tribal Nation, Mashpee Wampanoag Tribe, Mohegan Tribe of Connecticut, Narragansett Indian Tribe, Shinnecock Indian Nation, and Wampanoag Tribe of Gay Head (Aquinnah). BOEM is also consulting with these federally recognized tribes, and the Chappaquiddick Wampanoag Tribe, a historical Massachusetts tribe, as part of the NHPA Section 106 consultation process.

3.6.4.2 Scope of the Environmental Justice Analysis

To define the scope of the environmental justice analysis, BOEM reviewed the impact conclusions for each resource analyzed in the EIS to assess whether the Proposed Action and action alternatives would result in major impacts that would be considered "high and adverse" and whether major impacts had the potential to affect environmental justice populations given the geographic extent of the impact relative to the locations of environmental justice populations. Major impacts that had the potential to affect environmental justice populations were further analyzed to determine if the impact would be disproportionately high and adverse. Although the environmental justice analysis considers impacts of other ongoing and planned activities, including other future offshore wind projects, determinations as to whether impacts on environmental justice populations would be disproportionately high and adverse are made for the Proposed Action and action alternatives alone.

As shown on Figure 3.6.4-2 and Figure 3.6.4-5, onshore Project infrastructure including cable landfalls, onshore substations, and points of interconnection are in areas where environmental justice populations have been identified. IPFs from onshore construction, including air emissions, cable emplacement, and noise, may all affect environmental justice communities near ports and cable routes. Because onshore construction would affect environmental justice populations identified in the geographic analysis area, impacts associated with construction, O&M, and decommissioning of onshore

Project components are carried forward for further analysis of disproportionately high and adverse effects within the environmental justice analysis. Mayflower Wind is considering multiple ports for marshalling during construction including New London, Connecticut; Providence, Rhode Island; New Bedford and Salem, Massachusetts; the Port of Virginia marine terminals in Newport News and Portsmouth, Virginia; as well as ports in Canada. The Ports of New Bedford and Fall River, Massachusetts, would be the most likely ports for O&M activity. As shown on Figure 3.6.4-2 through Figure 3.6.4-7, all of the domestic ports being considered for the Proposed Action are in areas where environmental justice populations have been identified. Therefore, port utilization is carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis under the port utilization and air emission IPFs.

Construction, O&M, and decommissioning of offshore structures (WTGs and OSPs) could have major impacts on some commercial fishing operations that use the Lease Area, with potential for indirect impacts on employment in related industries that could affect environmental justice populations. Cable emplacement and maintenance and construction noise would also contribute to impacts on commercial fishing. The long-term presence of offshore structures (WTGs and OSPs) would also have major impacts on scenic and visual resources and viewer experience from some onshore viewpoints that could affect environmental justice populations. Therefore, impacts of construction, O&M, and decommissioning of offshore Project components are carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis.

Section 3.6.2, *Cultural Resources,* determined that construction of offshore wind structures and cables could result in major impacts on marine cultural, terrestrial archaeological, or architectural resources if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction. BOEM has committed to working with the lessee, consulting parties, Native American tribes, and the SHPOs to develop specific treatment plans to address impacts on cultural resources that cannot be avoided and are also historic properties listed or eligible for listing in the NRHP. Development and implementation of Project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of otherwise unmitigated impacts on cultural resources; however, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these resources can be avoided.

The tribal significance of cultural resources identified in the cultural resources geographic analysis area has not yet been fully determined, and consultation with Native American tribes via NHPA Section 106 consultation and government-to-government consultation is ongoing. As discussed in Section 3.6.2, Mayflower Wind's cultural resource background research identified three TCPs in the cultural resources geographic analysis area, two of which may be subject to impacts from the Project (COP Appendices Q and R; Mayflower Wind 2022): Chappaquiddick Island and Nantucket Sound. Both TCPs have been previously determined to bear significance to state and federally recognized tribes and are eligible for listing in the NRHP. ASLFs within or in proximity to the Nantucket Sound TCP may be elements contributing to the TCP's eligibility for the NRHP and in the Project's marine area of potential effects would be subject to physical impacts by the Project. Both TCPs are subject to visual impacts from the visibility of Project components. Additionally, Mayflower Wind's archaeological investigations identified terrestrial archaeological resources with pre-contact Native American components in the geographic analysis area; these resources may bear significance to Native American consulting parties. No other tribal resources, such as cultural landscapes, burial sites, treaty-reserved rights to usual and accustomed fishing or hunting grounds, or other potentially affected tribal resources have been identified to date. BOEM will continue to consult with Native American tribes throughout development of the EIS and will consider impacts on tribal resources identified through consultation in the environmental justice analysis if they are discovered. For more information on cultural resources and historic properties, see Section 3.6.2, *Cultural Resources*, and Appendix I, *Determination of Effect for NHPA Section 106 Consultation*.

Other resource impacts that concluded less-than-major impacts for the Proposed Action and action alternatives or were unlikely to affect environmental justice populations were excluded from further analysis of environmental justice impacts. This includes impacts related to bats; benthic resources; birds; coastal habitat and fauna; finfish, invertebrates, and EFH; land use and coastal infrastructure; marine mammals; navigation and vessel traffic; sea turtles; water quality; and wetlands.

3.6.4.3 Impact Level Definitions for Environmental Justice

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Table 3.6.4-2. A determination of whether impacts are "disproportionately high and adverse" in accordance with Executive Order 12898 is provided in the conclusion sections for the Proposed Action and action alternatives.

Definitions of impact levels are provided in Table 3.6.4-2. Determination of a "major" impact corresponds to a "high and adverse" impact for the environmental justice analysis. Major (or high and adverse) impacts have been further analyzed to determine if those impacts would be disproportionately high and adverse for low-income or minority populations.

Table 3.6.4-2. Impact level definitions for environmental justice

Impact Level	Type of Impact	Definition
Negligible	Adverse	Adverse impacts on environmental justice populations would be small and unmeasurable.
	Beneficial	Beneficial impacts on environmental justice populations would be small and unmeasurable.
Minor	Adverse	Adverse impacts on environmental justice populations would be small and measurable but would not disrupt the normal or routine functions of the affected population.
	Beneficial	Environmental justice populations would experience a small and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.

Impact Level	Type of Impact	Definition
Moderate	Adverse	Environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts.
	Beneficial	Environmental justice populations would experience a notable and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Major	Adverse	Environmental justice populations would have to adjust to significant disruptions due to notable and measurable adverse impacts. The affected population may experience measurable long-term effects.
	Beneficial	Environmental justice populations would experience a substantial long-term improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.

3.6.4.4 Impacts of the No Action Alternative on Environmental Justice

When analyzing the impacts of the No Action Alternative on environmental justice, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for environmental justice. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for environmental justice (3.6.4.1, *Description of the Affected Environment and Future Baseline Conditions*) 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 activities that affect environmental justice populations include onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; and commercial fishing operations. Ongoing activities support beneficial employment and also generate sources of air emissions, noise, lighting, and vehicle and vessel traffic that can adversely affect the quality of life in affected communities.

Coastal development that leads to gentrification of coastal communities may create space-use conflicts and reduce access to coastal areas and working waterfronts that communities rely on for recreation, employment, and commercial fishing. Gentrification can also lead to increased tourism and recreational boating and fishing that provide employment opportunities in recreation and tourism (refer to Section 3.6.4.1 for a description of gentrification in the geographic analysis area). Housing disruption caused by rising home values and rents can displace affordable housing, with disproportionate effects for low-income and minority populations.

Ongoing offshore wind activities in the geographic analysis area for environmental justice include OCS-A 0517 (South Fork Wind) and OCS-A 0501 (Vineyard Wind 1). Ongoing construction of these projects would affect environmental justice through the primary IPFs of air emissions, cable emplacement and maintenance, noise, port utilization, presence of structures, and land disturbance. Ongoing construction of the Vineyard Wind 1 and South Fork projects would have the same type of impacts on environmental justice that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned non-offshore wind activities that may affect environmental justice populations include dredging and port improvement, construction and maintenance of coastal infrastructure (marinas, docks, and bulkheads), and onshore coastal development that can lead to gentrification of coastal communities and working waterfronts (see Appendix D, *Planned Activities Scenario,* for a description of planned activities). Planned non-offshore wind activities would have impacts similar to those of ongoing non-offshore wind activities.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on environmental justice during construction, O&M, and decommissioning of the projects. Future offshore wind projects in the geographic analysis area are planned within lease areas OCS-A 0487 (Sunrise Wind), OCS-A 0486 (Revolution Wind), OCS-A 0534 (New England Wind, which also spans a portion of Lease Area OCS-A 0501), OCS-A 0520 (Beacon Wind), OCS-A 0500 (Bay State Wind), and OCS-A 0522 (Vineyard Wind Northeast). BOEM has approved COPs for two offshore wind projects that overlap the geographic analysis area: OCS-A 0517 (South Fork Wind) and OCS-A 0501 (Vineyard Wind). These projects are estimated to collectively install 920 structures (WTGs and OSPs) and 3,520 statute miles (5,665 kilometers) of submarine export cables and interarray cables in the geographic analysis area between 2023 and 2030 (Appendix D, Table D2-1).

Offshore wind projects other than the Proposed Action both within and outside of the environmental justice analysis area have prompted several studies of the impacts of such projects on local communities and environmental justice communities particularly. A 2019 report on the future of clean energy in the United States by the Brookings Institute found that clean energy jobs, including those for offshore wind, on average offer higher wages than the national all-industry average wage. The report further found that jobs in the burgeoning clean energy industry often do not require formal education for employment, which may be a barrier to employment for individuals from environmental justice communities (Muro et al. 2019). Other studies have examined the potential adverse effects of future offshore wind projects on environmental justice areas. One 2022 study specifically criticized the exclusion of indigenous peoples from discussions of offshore wind development (Bacchiocchi et al. 2022).

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

Air emissions: Increased port activity would generate short-term, variable increases in air emissions. Emissions for regulated air pollutants would occur during construction from equipment such as onshore construction equipment, helicopters, drones, vessels, and generators (COP Volume 2, Table 5-4; Mayflower Wind 2022). Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts depending upon the ports that are used, ambient air quality, and the increase in emissions at any given port. Onshore, some industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it.

Other future offshore wind projects constructed in the geographic analysis area would contribute to regional air quality impacts. As stated in Section 3.4.1, *Air Quality*, during the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Mayflower Wind proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 34,496 tons of CO, 165,807 tons of NO_X, 8,808 tons of PM_{10}, 5,589 tons of $PM_{2.5}$, 4,441 tons of SO_2, 5,732 tons of VOCs, and 11,228,498 tons of CO_2 (Appendix D, Table D2-4). This area is larger than the environmental justice geographic analysis area; therefore, a large portion of the emissions would be generated along the vessel transit routes and at the offshore work areas. Emissions of NO_X and CO are primarily due to diesel construction equipment, vessels, and commercial vehicles.

Emissions would vary spatially and temporally during construction phases even for overlapping projects. Offshore wind projects other than the Proposed Action that would be constructed in the Massachusetts/Rhode Island, New York/New Jersey, Delaware/Maryland, and Virginia/North Carolina lease areas may utilize the same ports during construction as the Proposed Action, with periods of overlapping construction between 2023 and 2030. Emissions from vessels, vehicles, and equipment operating in ports could affect environmental justice communities adjacent or close to those ports. All of the proposed ports that could support Mayflower Wind construction are either located within or are in proximity to environmental justice communities: Ports of New London, Providence, New Bedford, and Salem, as well as the Newport News and Portsmouth terminals at the Port of Virginia. The port locations are in attainment of the NAAQS, except for the Port of New London, Connecticut, which is in a nonattainment area for ozone (Section 3.4.1). Emissions at the Port of New London would therefore contribute to air quality impacts that are already exceeding federal air quality standards. Emissions from other offshore wind projects affecting specific neighborhoods have not been quantified; however, it is assumed that offshore wind project emissions at ports would contribute a small proportion of total emissions from those facilities. Therefore, air emissions during construction would have small, short-term, variable impacts on environmental justice communities due to temporary increases in air emissions. The air emissions impacts would be greater if multiple offshore wind projects simultaneously use the same port for construction staging. If construction staging is distributed among several ports, the air emissions would not be concentrated near certain ports, and impacts on proximal environmental justice communities would be lower.

As explained in Section 3.4.1, operational activities from other offshore wind projects within the air quality geographic analysis area would generate 1,297 tons per year of CO, 5,073 tons per year of NO_X, 152 tons per year of PM_{10}, 137 tons per year of $PM_{2.5}$, 75 tons per year of SO_2, 100 tons per year of VOCs, and 412,263 tons per year of CO_2. Operational emissions would overall be intermittent and widely dispersed throughout the vessel routes from the onshore O&M facility, and would generally contribute to small and localized air quality impacts. Emissions would largely be due to vessel traffic related to O&M and operation of emergency diesel generators. These emissions would be intermittent and widely dispersed, with small and localized air quality impacts. Only the portion of those emissions resulting from ship engines and port-based equipment operating within and near the ports proposed for O&M activity (Fall River and New Bedford, Massachusetts) would affect environmental justice communities. Therefore, during operations of offshore wind projects, the air emissions volumes resulting from port activities are not anticipated to be large enough to have impacts on environmental justice communities.

The power generation capacity of offshore wind development could potentially lead to lower regional air emissions by displacing fossil fuel plants for power generation, resulting in a potential reduction in regional GHG emissions, as analyzed in further detail in Section 3.4.1. A 2019 study found that nationally, exposure to fine particulate matter from fossil fuel electricity generation in the United States varied by income and by race, with average exposures highest for Black individuals, followed by non-Hispanic white individuals. Exposures for other groups (i.e., Asian, Native American, and Hispanic) were somewhat lower. Exposures were higher for lower-income populations than for higher-income populations, but disparities were larger by race than by income (Thind et al. 2019). A 2019 study of the Northeastern and Mid-Atlantic states found greater mortality rates associated with $PM_{2.5}$ exposure among Black participants and participants who were eligible for Medicaid (Yitshak-Sade et al. 2019).

Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. A 2016 study for the Mid-Atlantic region found that offshore wind could produce measurable benefits related to health costs and reduction in loss of life due to displacement of fossil fuel power generation (Buonocore et al. 2016). Environmental justice populations tend to have disproportionately high exposure to air pollutants, likely leading to disproportionately high adverse health consequences. Accordingly, offshore wind generation would have potential benefits for environmental justice populations through reduction or avoidance of air emissions and concomitant reduction or avoidance of adverse health impacts.

Cable emplacement and maintenance: Cable emplacement for offshore wind projects in the Massachusetts and Rhode Island lease areas would result in seafloor disturbance and temporary increases in turbidity. Cable emplacement could displace other marine activities temporarily within cable installation areas. As described in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, cable installation and maintenance would have localized, temporary, short-term impacts on the revenue and operating costs of commercial and for-hire fishing businesses. Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income and also leading to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend upon the commercial fishing industry. Business impacts could affect environmental justice populations due to the potential loss of income or jobs by low-income and minority workers in the commercial fishing industry. In addition, cable installation and maintenance could temporarily disrupt recreational fisheries used by low-income and minority residents who rely on subsistence fishing as a food source, as well as tribal members for whom fishing is also a cultural practice. As noted in Section 3.6.8, *Recreation and Tourism*, most recreational fishing in the analysis area occurs close to shore. Additionally, recent BOEM consultation with Native American tribes for the Vineyard Wind 1 project indicates that tribal subsistence fisheries occur predominately in inshore areas (BOEM 2020). Therefore, while temporary impacts on recreational subsistence fishing may occur near cable landfall sites, future development of offshore cables occurring further offshore, are expected to result in short-term, negligible to minor, localized impacts on the recreational and subsistence fishing activities of environmental justice populations.

Noise: As described in greater detail in Section 3.6.3, *Demographics, Employment, and Economics* and Section 3.6.8, *Recreation and Tourism*, noise from site assessment G&G survey activities, pile driving, trenching, and vessels is likely to result in a revenue reduction of economic activity for commercial fishing and marine recreational businesses that operate in the areas offshore from the geographic analysis area for environmental justice. 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 localized impacts of offshore noise on fishing could also affect subsistence fishing. 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. The impacts of offshore noise on marine businesses and subsistence fishing would have short-term, localized impacts on low-income and minority workers in marine-dependent businesses as well as residents who practice subsistence fishing and clamming, resulting in impacts on environmental justice populations.

Noise generated by offshore wind staging operations at ports would potentially have impacts on environmental justice communities if the port is near such communities. Within the geographic analysis area for environmental justice populations, the ports of New Bedford and Salem, Massachusetts; Providence, Rhode Island; New London, Connecticut; and Newport News and Portsmouth, Virginia are within or near environmental justice communities. The noise impacts from increased port utilization would be short term and variable, limited to the construction period, and would increase if a port is used for multiple offshore wind projects during the same time period.

Port utilization: Offshore wind project installation would require port facilities for berthing, staging, and loadout. Future offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area. Offshore wind projects that utilize ports in or near environmental justice communities, such as the port cities of Fall River, New Bedford, and Salem, Massachusetts; Providence, Rhode Island; New London, Connecticut; and Newport News and Portsmouth, Virginia (Figure 3.6.4-2, Figure 3.6.4-5, Figure 3.6.4-6, Figure 3.6.4-7) may contribute to adverse impacts on these communities from increased air emissions, lighting, vessel traffic, and noise generated by port utilization or expansion (see discussions under *Air emissions, Noise*, and *Presence of Structures* IPFs). Ongoing and planned offshore wind development may contribute to vessel congestion in ports within the geographic analysis area, creating a short-term disruption of normal vessel traffic conditions for environmental justice communities that utilize ports for commercial or recreational vessel trips. Port use and expansion would also have beneficial impacts on employment at ports. Port utilization for offshore wind would have short-term, beneficial impacts for environmental justice populations during construction and decommissioning, resulting from employment opportunities, support for other local businesses by 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: Construction, decommissioning, and, to a lesser extent, O&M of future offshore wind projects could affect employment and economic activity generated by commercial fishing and marine-based businesses. Commercial fishing businesses would need to adjust routes and fishing grounds to avoid offshore work areas during construction and to avoid WTGs and OSPs during operations. Concrete cable covers and scour protection could result in gear loss and would make some fishing techniques unavailable in locations where the cable coverage exists. For-hire recreational fishing businesses would also need to avoid construction areas and offshore structures. A decrease in revenue, employment, and income within commercial fishing and marine industries could affect low-income and minority workers in communities with a high level of commercial fishing engagement or reliance (Figure 3.6.4-8). The impacts during construction would be short term and would increase in magnitude when multiple offshore construction areas exist at the same time. 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 required.

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

The long-term presence of WTGs associated with future offshore wind may also cause major adverse impacts on scenic and visual resources in coastal communities that are within the viewshed of future offshore wind projects. The level of impact on onshore viewers would depend on the distance to the WTGs offshore, the number and height of the WTGs associated with each future offshore wind project, and the design of the aviation warning lighting system, which could introduce continuous nighttime lighting.

The presence of structures could also have physical or visual impacts on tribally important cultural resources in the geographic analysis area as discussed in Section 3.6.4.2, *Scope of the Environmental Justice Analysis*. The construction of these structures for other offshore wind projects in this area, including offshore export cables from Vineyard Wind 1 and New England Wind, could contribute to impacts on TCPs and other tribally sensitive marine cultural resources. As described in Section 3.6.2, all projects would be required to adhere to the NHPA and would be required to avoid, minimize, or mitigate impacts on marine cultural resources if they are identified. If marine cultural resources cannot be avoided, the magnitude of impacts would be moderate to major, due to the permanent, irreversible nature of the impacts.

Land disturbance: Offshore wind development would require onshore cable installation, and substation construction or expansion. Based upon information in published COPs, export cables and related onshore project components for the approved Vineyard Wind 1 project and for the planned New England Wind project would be installed in the environmental justice analysis area between 2023 and 2026 in Barnstable, Massachusetts. Depending on siting, land disturbance could result in temporary, localized, variable disturbances of neighborhoods and businesses near cable routes and construction sites due to typical construction impacts such as increased noise, dust, traffic, and road disturbances. Potential short-term, variable impacts on environmental justice communities could result from land disturbance, depending upon the particular location of onshore construction for each offshore wind project.

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

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, environmental justice populations within the geographic analysis area would continue to be influenced by regional environmental, demographic, and economic trends and ongoing activities. BOEM expects ongoing activities to have continuing impacts on environmental justice populations through the following trends: ongoing population growth and new development; resulting traffic increases and industrial development, possibly increasing emissions near environmental justice communities; ongoing gentrification of coastal communities; ongoing commercial fishing, seafood processing, and tourism industries that provide job opportunities for low-income residents; and construction-related air pollutant emissions and noise when these occur near environmental justice communities. BOEM anticipates that the environmental justice impacts as a result of ongoing activities associated with the No Action Alternative would be **minor**.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and environmental justice would continue to be affected by the primary IPFs of air emissions, cable emplacement and maintenance, presence of structures, and port utilization. Planned non-offshore wind activities, including dredging and port improvement, construction and maintenance of coastal infrastructure (marinas, docks, and bulkheads), and onshore coastal development, would also contribute to impacts on environmental justice communities.

Ongoing and planned offshore wind activities would contribute to environmental justice impacts through increased vehicle and vessel traffic, which could lead to an increase in air emissions; additional offshore structures posing navigational hazards for recreational and commercial fishing; impacts on tribally important cultural resources; and the possible need for port upgrades beyond those currently envisioned due to increased port activity.

BOEM anticipates that the cumulative impact of the No Action Alternative would be **minor** because environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts. However, BOEM recognizes that impacts could increase to **moderate** to **major** if tribally important cultural resources in the geographic analysis area cannot be avoided.

BOEM also anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in **minor beneficial** effects on minority and low-income populations through economic activity and job opportunities in marine trades and the offshore wind industry. Additional beneficial effects may result from reductions in air emissions if offshore wind projects displace energy generation using fossil fuels.

3.6.4.5 Relevant Design Parameters and Potential Variances in Impacts

Effects on environmental justice communities would occur when the Proposed Action's adverse effects 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 Action or to their higher vulnerability to impacts.

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of environmental justice impacts.

- Overall size of the Project and number of WTGs.
- The Project layout including the number, type, height, and placement of the WTGs and OSPs, and the design and visibility of lighting on the structures.
- The extent to which Mayflower Wind hires local residents and obtains supplies and services from local vendors.
- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M.
- The PDE parameters that could affect commercial fishing because impacts on these activities affect employment and economic activity.
- Arrangement of WTGs and accessibility of the Wind Farm Area to recreational boaters.
- The time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix C. Below is a summary of potential variances in impacts on members of environmental justice communities who depend on subsistence fishing or jobs in commercial/for-hire fishing or marine recreation.

- WTG number, size, location, and lighting: More WTGs and closer spacing could increase space-use conflicts with commercial and for-hire recreational fishing vessels. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- Utilization of ports that are near or within low-income and minority populations would have greater impacts.

Mayflower Wind has committed to measures to minimize impacts on environmental justice communities, which include, but are not limited to, maintaining a stakeholder engagement plan, encouraging the hiring of skilled and unskilled labor in the Project region, and developing a Traffic Management Plan to minimize disruptions to the communities in the vicinity of construction, as well as committing to making at least 75 percent of the O&M workforce, procurement, and services local (COP Volume 2; Table 16-1 Mayflower Wind 2022).

3.6.4.6 Impacts of the Proposed Action on Environmental Justice

Impacts on environmental justice communities from the Proposed Action from the IPFs below would result from views of WTGs and impacts on shellfish, fish, and marine mammal populations. The Proposed Action would also include effects on low-income and minority workers in the commercial/for-hire fishing, marine recreation, and supporting industries. The most impactful IPFs would likely include cable emplacement and presence of offshore structures because of the potential impacts of these IPFs on marine businesses (fishing and recreational), as well as views of WTGs.

The most impactful IPFs would also include higher levels of air emissions and noise at port facilities and visual impacts near environmental justice communities, as well as the presence of offshore structures that would affect navigation and commercial fishing. Beneficial economic effects would result from port utilization and reduction in air emissions, due to the displacement of fossil fuel electricity generation. Impacts are characterized by onshore and offshore activities during each period of the Project (construction, O&M, and decommissioning).

Air emissions: Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts, depending upon the ports that are used. As identified in Appendix D, offshore wind projects along the East Coast may utilize the proposed ports of the Proposed Action during periods of overlapping construction between 2023 and 2030. The Proposed Action would contribute to increased air emissions at the ports of Fall River, New Bedford, and Salem, Massachusetts; Providence, Rhode Island; New London, Connecticut; and Newport News and Portsmouth, Virginia (Figure 3.6.4-2 through Figure 3.6.4-7), which are predominantly, or are adjacent to, environmental justice communities. Greater air quality impacts may occur at ports where existing air quality is lower, including at the Port of New London, Connecticut, which is in a nonattainment area for ozone; all other ports are in attainment. Emissions at port locations are not quantitatively evaluated;

however, as stated in Section 3.4.1, overall air emissions impacts would be minor during Proposed Action construction, O&M, and decommissioning, with the greatest quantity of emissions produced in the Wind Farm Area and by vessels transiting from ports to the Wind Farm Area. Increased short-term and variable emissions from Proposed Action construction and operations would have negligible to minor disproportionate, adverse impacts on the communities near these ports.

Net reductions in air pollutant emissions resulting from the Proposed Action alone would result in long-term benefits to communities (regardless of environmental justice status) by displacing emissions from fossil-fuel-generated power plants. As explained in Section 3.4.1, by displacing fossil fuel power generation, once operational, the Proposed Action would result in annual avoided emissions of 692 tons of NO_X, 313 tons of SO_2, and 4,038,482 tons of CO_2 (COP Volume 2, Table 5-5; Mayflower Wind 2022). Estimates of annual avoided health effects would range from 13.6 to 35.1 million dollars in health benefits and 1.4 to 3.2 avoided mortality cases (Section 3.4.1). Minority and low-income populations are disproportionately affected by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants (USEPA 2022b). Therefore, the Proposed Action alone could benefit environmental justice communities by displacing fossil fuel power–generating capacity within or near the geographic analysis area.

Cable emplacement and maintenance: Offshore cable emplacement for the Proposed Action would temporarily affect commercial/for-hire fishing businesses, marine recreation, and subsistence fishing during cable installation and infrequent maintenance. As noted in Sections 3.6.1 and 3.6.3, installation of the Proposed Action's cables would have short-term, localized, minor impacts on marine businesses (commercial fishing or recreation businesses) and subsistence fishing. Cable installation could affect fish and mammals of interest for fishing and sightseeing through dredging and turbulence, although species would recover upon completion of installation activities (Sections 3.5.6, *Marine Mammals,* and 3.5.7, *Sea Turtles*). Installation and construction of offshore components for the Proposed Action could therefore have a short-term, minor impact on low-income and minority workers in marine businesses.

Noise: Noise from Proposed Action construction (primarily pile driving) could temporarily affect fish and marine mammal populations, hindering fishing and sightseeing near construction activity within the Wind Farm Area, which could discourage some businesses from operating in these areas during pile driving (Sections 3.6.1 and 3.6.8). This would result in a localized, short-term, negligible impact on low-income jobs supported by these businesses, as well as on subsistence fishing. Noise generated by the Proposed Action's staging operations at ports could also potentially affect environmental justice communities, where the ports are near such communities. The ports proposed for use by Mayflower Wind have other industrial and commercial sites, as well as major roads, which generate ongoing noise, and therefore any additional noise from Proposed Action activity would be consistent with existing uses, and impacts would be short term and negligible.

Port utilization: The Proposed Action would require port facilities for berthing, staging, and loadout. Air emissions and noise generated by the Proposed Action's activities would potentially affect environmental justice communities at ports in or near these communities, including New Bedford and Salem, Massachusetts; Providence, Rhode Island; New London, Connecticut; and Newport News and

Portsmouth, Virginia (see discussions under the *Air emissions* and *Noise* IPFs), although these effects are anticipated to be negligible. Increased vessel activity at ports due to the Proposed Action could have a minor adverse effect on environmental justice communities that utilize ports for commercial or recreational vessel trips, due to a short-term, measurable disruption of normal vessel traffic conditions. The Proposed Action would have a beneficial impact on environmental justice from port utilization due to greater economic activity and increased employment at the ports in the geographic analysis area, primarily during construction and decommissioning and to a lesser extent during operations. There is no port expansion included as part of the Proposed Action. The Proposed Action would have minor beneficial impacts on environmental justice through increased job availability.

Presence of structures: The Proposed Action's establishment of offshore structures, including up to 147 WTGs, 5 OSPs, and hardcover for cables, would result in both adverse and beneficial impacts on marine businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) and subsistence fishing. Adverse impacts would result from navigational complexity within the Wind Farm Area, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hardcover, leading to possible equipment loss and limiting certain commercial fishing methods. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for tour boats and for-hire recreational fishing businesses. As discussed in Section 3.6.1, BOEM anticipates that the adverse impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing would vary by fishery and fishing operation due to differences in target species abundance in the Project area, gear type, and predominant location of fishing activity. BOEM expects that impacts of the Proposed Action on commercial fishing and for-hire recreational fishing would range from negligible to major, depending on the fishery and fishing operation.

Impacts of the Proposed Action on commercial fishing and for-hire recreational fishing would have a greater impact on communities that have a high level of commercial or recreational fishing engagement or reliance. As shown on Figure 3.6.4-8, Barnstable, Hyannis, New Bedford, Plymouth, and Chatham, Massachusetts, and Narragansett, Rhode Island, have high levels of commercial fishing engagement, while Chatham also has a high level of commercial fishing reliance. Of these communities, only Hyannis and New Bedford are determined to also have environmental justice populations (Figure 3.6.4-2). The other communities do not contain environmental justice populations, and maintain the same or higher levels of commercial fishing engagement and reliance than Hyannis and New Bedford. Therefore, BOEM has determined that commercial fishing impacts on environmental justice populations in Hyannis and New Bedford would not be disproportionate. Impacts of the Proposed Action on commercial fishing landings and secondary impacts for employment at onshore seafood processors and distributors would vary depending on the specific fisheries and fishing operations affected by the presence of structures in the Offshore Project area. Because onshore seafood processors and distributors process catch from a broad geographic area and because the impact on specific fishing operations would vary and would not be industry-wide, BOEM expects that secondary impacts for employment on fishing vessels and at onshore seafood processing and distribution facilities would be moderate overall. Because these secondary impacts would not be major or specific to environmental justice workers in these industries, BOEM has determined these impacts would not be disproportionately high and adverse.

Many coastal communities along the Massachusetts and Rhode Island shores have a high level of recreational fishing engagement (Figure 3.6.4-8), and most of these communities do not contain an environmental justice population, with the exception of Hyannis, Massachusetts (Figure 3.6.4-2). Impacts on for-hire recreational fishing are also not high and adverse, as impacts of the Proposed Action could include long-term, minor adverse and minor beneficial impacts for some for-hire recreational fishing operations due to space-use conflicts and the artificial reef effect, respectively. Therefore, BOEM has determined that impacts of the Proposed Action on for-hire recreational fishing would not be disproportionately high and adverse for environmental justice populations.

Overall, the offshore structures for the Proposed Action alone would have minor to major impacts on marine businesses (Sections 3.6.1, 3.6.3, and 3.6.8), resulting in long-term, continuous impacts on environmental justice populations due to the impact on low-income and minority workers in marine industries and low-income and minority residents who rely on subsistence fishing. As noted previously, because most recreational and subsistence fishing occurs near shore, development of the offshore structures in the Wind Farm Area would have negligible to minor impacts on environmental justice populations. Mayflower Wind has committed to hire at least 75 percent of O&M workers from the local workforce and encourage the hiring of personnel from the proposed Project region for any construction positions created (COP Volume 2, Section 10.1.2.1; Mayflower Wind 2022). The plan to hire locally could reduce the impact on environmental justice populations if it results in job opportunities for low-income or minority populations, but it is not anticipated to reduce the overall impact level.

Based on analysis in Section 3.6.9, *Scenic and Visual Resources,* Proposed Action WTGs would have negligible to major impacts on viewer experience within the geographic analysis area. As discussed in greater detail in Section 3.6.8, the impact of visible WTGs on recreation and tourism activities would be long term, continuous, and minor. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole. The impact of visible WTGs on tourism businesses that employ environmental justice populations are therefore expected to be minor, while views of WTGs would be sustained from many coastal communities along the shore and would not disproportionately affect environmental justice populations. Therefore, BOEM has determined that impacts of the Proposed Action on viewer experience would not be disproportionately high and adverse for environmental justice populations.

As noted in Section 3.6.2, the Proposed Action's construction and presence of structures could have impacts on cultural resources of tribal significance. Three TCPs have been identified in the cultural resources geographic analysis area, two of which may be subject to impacts from the Project (COP Appendices Q and R; Mayflower Wind 2022): Chappaquiddick Island and Nantucket Sound. Both TCPs have been previously determined to bear significance to state and federally recognized tribes and are eligible for listing in the NRHP. ASLFs within or in proximity to the Nantucket Sound TCP may be elements contributing to the TCP's eligibility for the NRHP and in the Project's marine area of potential effects would be subject to physical impacts by the Project from installation of the Falmouth offshore export cables. The construction and presence of structures could contribute to impacts on the Nantucket Sound TCP, which would be disproportionately felt by environmental justice populations due to the unique cultural importance of the landforms to the tribes residing within or maintaining cultural associations to the geographic analysis area, resulting in major impacts. Both the Chappaquiddick Island and Nantucket Sound TCPs are also subject to visual impacts from the visibility of Project components. Because visual impacts from the Project's offshore components are widespread across the geographic analysis area, impacts would not be disproportionately felt by tribal nations.

Land disturbance: As shown on Figure 3.6.4-3, both the preferred and alternative locations for the Falmouth onshore substation and their landfalls are adjacent to neighborhoods that meet environmental justice criteria. Land use around the Falmouth Onshore Project area, includes residential, recreational, and commercial uses. For Brayton Point, the intermediate landfall on Aquidneck Island and the site of the converter station are not located in areas with environmental justice populations (Figure 3.6.4-4). The current land use around the Brayton Point cable corridor is primarily a mixture of industrial, parks and open space, and urban uses.

As discussed in Section 3.6.5, *Land Use and Coastal Infrastructure*, construction of the onshore export cables, onshore substations, and other onshore Project components would temporarily disturb neighboring land uses through construction noise, vibration, and dust and other air emissions, and cause delays in travel along the affected roads. Noise from temporary HDD activities at the Falmouth landfalls during construction and long-term operational noise at the substation sites could disproportionately affect environmental justice populations near these sites. However, the noise levels would be reduced below applicable regulatory and Project-specific thresholds with implementation of applicant-proposed mitigation measures, such as installation of noise barriers, and noise impacts on environmental justice populations would be minor. Mayflower Wind has committed to a construction schedule that avoids the height of summer tourism seasons (COP Volume 2, Section 12.2.2.1; Mayflower Wind 2022), which would avoid impacts on tourism business that may employ environmental justice populations. Land disturbance during construction would have short-term, variable, minor impacts on environmental justice communities. During operation, the Falmouth onshore export cable infrastructure, including cable landfall sites and onshore cables, would be underground and primarily within roads and utility ROWs, while the substations would operate in industrial areas. As a result, operations and occasional maintenance or repair operations from the Proposed Action alone would have negligible impacts and would not result in disproportionately high and adverse impacts on environmental justice communities.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities and other planned offshore wind activities. Ongoing and planned non-offshore wind activities that affect environmental justice in the geographic analysis area include onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; and continued commercial fishing operations.

Other offshore wind projects using ports within the geographic analysis area for environmental justice populations would overlap with the Project's operations phase, and short-term air quality impacts during the construction phase would be likely to vary from minor to moderate significance levels. Cumulative impacts on environmental justice populations from air emissions would likely be negligible to minor, due to short-term emissions near ports, of which the Proposed Action would contribute a noticeable increment. The combined reduction in air emissions from all ongoing and planned offshore wind projects that displace fossil fuel power generation would have a long-term beneficial impact on environmental justice populations.

Ongoing and planned cable emplacement and maintenance for other offshore wind activities would generate comparable types of impacts to those of the Proposed Action, including impacts on subsistence fishing and reduced employment and income of workers employed in industries supporting commercial fishing. The incremental impacts contributed by the Proposed Action to the combined offshore cable emplacement impacts on environmental justice populations from ongoing and planned activities including future offshore wind would likely be noticeable, resulting in overall short term and minor cumulative impacts. Cable emplacement and the presence of structures from the Proposed Action and other offshore wind projects, including Vineyard Wind 1 and New England Wind, could contribute to impacts on tribally important TCPs, which would be disproportionately felt by environmental justice populations. Impacts on these tribal resources are anticipated to be localized and permanent, and range from negligible to major depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts on TCPs and any contributing ASLFs.

Reasonably foreseeable activities would occasionally generate additional pile-driving noise or other construction noise near ports and marinas, some of which may be near environmental justice communities. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area and longer time period. The increased impacts would affect the fishing and sightseeing businesses that rely on these species, resulting in impacts on employment, income, and subsistence fishing (Sections 3.6.1, 3.6.3, and 3.6.8). Cumulative impacts on environmental justice populations from noise would likely be negligible to minor, of which the Proposed Action would contribute a noticeable increment, based on the potential impacts of pile driving noise on boating, fisheries, and marine mammals.

Ports to be utilized for the Proposed Action may also be used for other ongoing and planned activities. Combined port utilization impacts on environmental justice populations from ongoing and planned activities, including the Proposed Action, would likely be minor due to air emissions and noise. Port activity would also have minor beneficial impacts on environmental justice communities, due to increased employment opportunities and business activity.

The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas. The presence of structures for the Proposed Action in combination with other planned offshore wind would result in adverse cumulative impacts on marine businesses supporting commercial fishing, adverse and beneficial cumulative impacts on marine businesses supporting for-hire recreational fishing, and adverse cumulative impacts on scenic and visual resources, similar to impacts of the Proposed Action but more notable due to the greater number of cumulative structures.

Other offshore wind projects may install onshore project components in the geographic analysis area. Onshore export cables and substations for other offshore wind development are anticipated to use cable routes and substation locations that comply with local land use regulations, and these improvements are not likely to be close enough to the Proposed Action to affect the same neighboring land uses. Therefore, the cumulative impacts from the Proposed Action in combination with other ongoing and planned activities would likely be negligible.

Conclusions

Impacts of the Proposed Action: During both construction and operations of the Proposed Action, the impacts on low-income and minority employees of marine industries and supporting businesses (commercial fishing, support industries, marine recreation, and tourism) from most IPFs would range from negligible to minor with minor beneficial impacts. The Proposed Action would result in negligible to minor impacts on environmental justice communities due to air emissions, noise at ports, land disturbance at onshore construction sites, and 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 ASLFs in or near the defined Nantucket Sound TCP resulting from offshore construction would result in major disproportionate impacts on Native American tribal nations that trace their ancestry to the TCP. Visual impacts on both the Nantucket Sound TCP and Chappaquiddick Island TCP would also contribute to impacts on tribal nations, but, because views of WTGs would be sustained from many coastal communities along the shore, these impacts would not disproportionately affect tribal nations. Potentially beneficial impacts on environmental justice populations would result from port utilization and the resulting employment and economic activity. Beneficial impacts could also result if the Proposed Action displaces fossil fuel energy generation in locations that improve air quality and health outcomes for environmental justice populations.

In summary, BOEM anticipates that the Proposed Action would have overall **negligible** to **minor** impacts, with the exception of **major** impacts related to tribally important TCPs, and **minor beneficial** impacts on all environmental justice populations. Except for the TCP impacts, BOEM determined that impacts of the Proposed Action on low-income and minority populations would not be disproportionately high and adverse. The installation of cables intersecting the Nantucket Sound TCP would result in disproportionally high and adverse impacts on environmental justice populations due to the unique cultural importance of the landforms to the tribes residing within, or maintaining cultural associations to, the analysis area.

Cumulative Impacts of the Proposed Action: The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas, and additional onshore construction and port utilization within the geographic analysis area. In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with impacts from ongoing and planned activities including future offshore wind would be **moderate**.

3.6.4.7 Impacts of Alternatives C and F on Environmental Justice

Impacts of Alternatives C and F: The impacts of Alternatives C-1, C-2, and F on environmental justice communities would be the same as those of the Proposed Action except for impacts of land disturbance and cable emplacement and maintenance. To avoid sensitive fish habitat in the Sakonnet River, the export cable route to Brayton Point under Alternatives C-1 and C-2 would be re-routed onshore. The longer onshore cable routes under Alternatives C-1 and C-2 would result in increased air emissions, traffic, and noise associated with onshore construction. However, the location of the onshore cables would not occur in areas with environmental justice populations (Figure 3.6.4-9); therefore, there would be no additional impacts on environmental justice communities compared to the Proposed Action. Limiting the number of Falmouth offshore export cables to three under Alternative F and adding one more HVDC converter OSP would not meaningfully change the impacts on recreational and commercial fishing businesses that are a source of employment for low-income and minority populations. The impacts of Alternatives C and F would be the same as those of the Proposed Action for environmental justice populations.

Cumulative Impacts of Alternatives C and F: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives C and F would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternatives C and F: Impacts of Alternatives C-1, C-2, and F would be the same as those of the Proposed Action for environmental justice populations and would range from **negligible** to **major** adverse and **minor beneficial**.

Cumulative Impacts of Alternatives C and F: In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternatives C -1, C-2, and F would be the same as the Proposed Action, which are anticipated to be **moderate**.

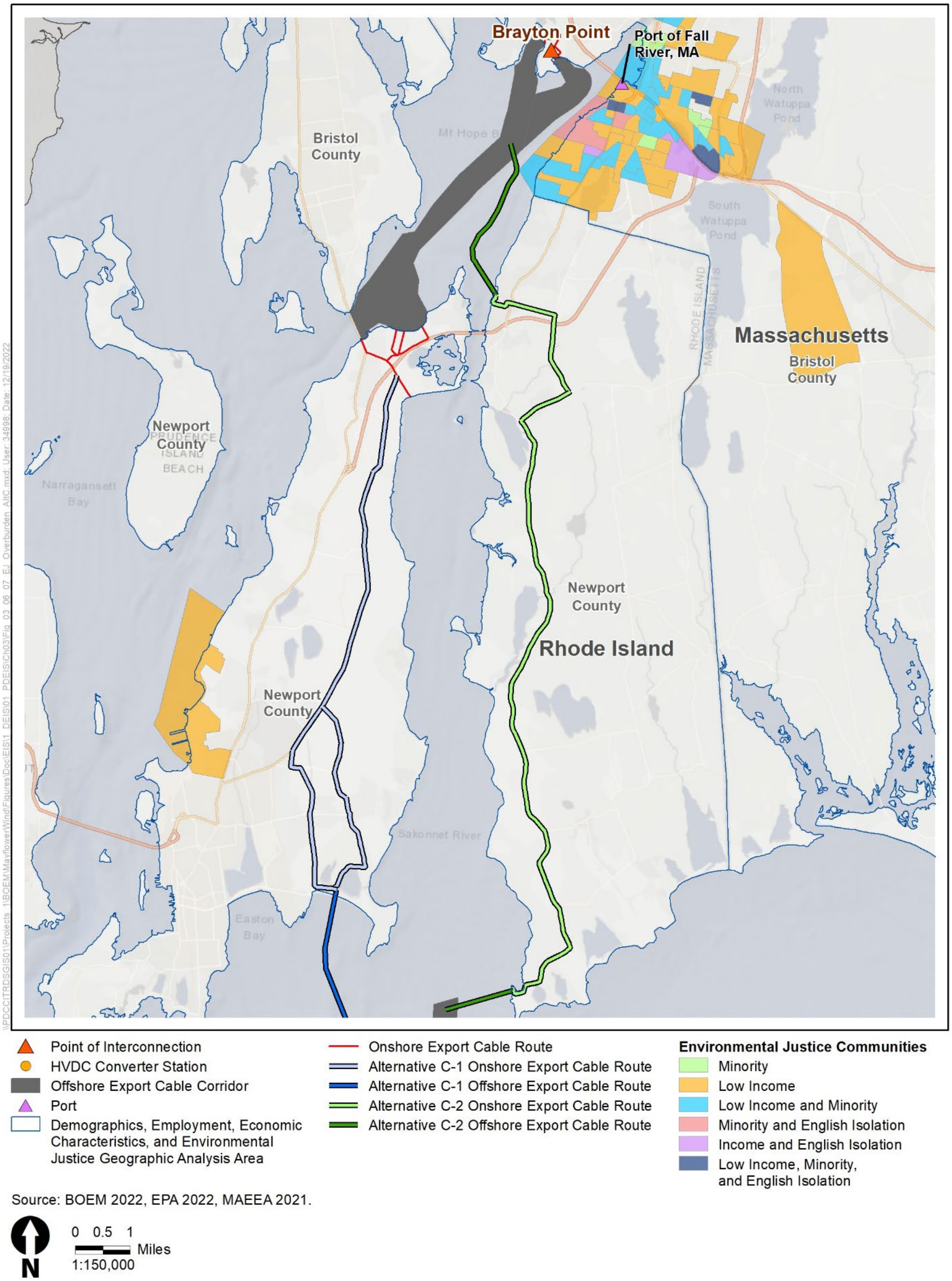

Figure 3.6.4-9. Environmental justice communities near Alternative C cable corridors

3.6.4.8 Impacts of Alternatives D and E on Environmental Justice

Impacts of Alternatives D and E: The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternative D and Alternative E would be similar to those described under the Proposed Action. Under Alternative D, the removal of up to six WTGs near Nantucket Shoals would slightly reduce vessel activity at port locations with environmental justice communities and reduce impacts on commercial and for-hire fishing operations by providing more structure-free areas compared to the Proposed Action. Under Alternative E, use of all piled foundations (Alternative E-1) would have the same impacts as the Proposed Action by affecting fishing and other marine-based businesses from operating during pile-driving activity. Use of gravity-based (Alternative E-2) or suction-bucket foundations (Alternative E-3) for WTGs and OSPs would slightly reduce impacts on businesses in environmental justice communities that rely on fishing or tourism by reducing the noise associated with foundation installation, which may be a deterrent to these operations, as compared to pile driving.

Under both Alternatives D and E, localized long-term, negligible to minor impacts are still anticipated and would not change the impacts on business that are the source of employment for low-income populations significantly from the Proposed Action. Alternative D would not meaningfully change onshore visual resource impacts or adverse impacts from the presence of WTGs on the local coastal economy compared to the Proposed Action. The impacts resulting from individual IPFs under both Alternatives D and E would be similar to the impacts described for the Proposed Action.

Cumulative Impacts of Alternatives D and E: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives D and E would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternatives D and E: Impacts of Alternative D and Alternative E would be similar as those of the Proposed Action for environmental justice populations and would range from **negligible** to **major** adverse and **minor beneficial**. While impacts from individual IPFs may be slightly reduced due to the reduction in the number of WTGs (Alternative D) or avoidance of pile driving (Alternatives E-2 and E-3), there would not be a meaningful difference in impacts on fishing and marine businesses that may employ low-income and minority workers or to the overall coastal economy.

Cumulative Impacts of Alternatives D and E: In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternatives D and E would be the same as the Proposed Action, which are anticipated to be **moderate**.

3.6.4.9 Proposed Mitigation Measures

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

3.6 Socioeconomic Conditions and Cultural Resources

3.6.5 Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.6.5-1, includes Barnstable and Bristol Counties in Massachusetts, Newport County in Rhode Island, Falmouth and Somerset in Massachusetts, and Portsmouth in Rhode Island, as well as municipal boundaries surrounding the ports that may be used for the Project. Mayflower Wind proposes the use of ports in New London, Connecticut; Providence, Rhode Island; New Bedford, Salem, and Fall River, Massachusetts; the Port of Virginia marine terminals in Portsmouth and Newport News, Virginia; and ports in Canada.

3.6.5.1 Description of the Affected Environment and Future Baseline Conditions

Within the geographic analysis area, land use is diverse, including water, marine, open land, conservation land, forest, parks, recreational, residential, business, industrial, urban, and agricultural land uses. The dominant land uses along the onshore cable corridors are commercial, residential, and public use. There are two proposed onshore export cable routes, Falmouth and Brayton Point. The Falmouth onshore export cable routes are in Falmouth, Massachusetts. Based on ArcGIS and MassGIS land use cover data, land uses in the vicinity of the Falmouth cable route are classified as agriculture, commercial, forest, industrial, mixed use, recreation, residential, right-of-way, and tax exempt (COP Volume 2, Figure 12-20; Mayflower Wind 2022). Some recreational areas are located in proximity to the onshore export cable routes, including Falmouth Heights Beach, Surf Drive Beach, Worcester Avenue Park, Central Park, and Crescent Parks; and the area includes a variety of residential development types (single family, multi-family, other) (COP Volume 2, Section 12.1.4.1 and Figure 12-20; Mayflower Wind 2022). In Falmouth, Massachusetts, the dominant land uses are residential and open space (COP Volume 2, Figure 12-20; Mayflower Wind 2022).

The Brayton Point onshore export cable corridors are in Somerset, Massachusetts, and on Aquidneck Island in Portsmouth, Rhode Island. Land uses in the vicinity of the Brayton Point route are urban development, non-urban developed, reserve, Narragansett Indian Lands, farmland, parks and open space, water bodies commercial, industrial, mixed use, residential, right-of-way, and tax exempt. The primary uses along the corridor are a combination of industrial, parks and open space, and urban (COP Volume 2, Figures 12-21 and 12-22; Mayflower Wind 2022).

Important landscape features near Falmouth and Brayton Point include a combination of natural views such as beaches, shorelines, inlets, and scenic vistas, and human-made views such as historic districts, parks, and other cultural features. Portions of the Onshore Project area are part of the Cape Cod/Long Island EcoRegion, which features a unique variety of landscapes and habitat regions such as inlets, ocean bays and sounds, and historic districts (COP Appendix T, Section 6.2; Mayflower Wind 2022).

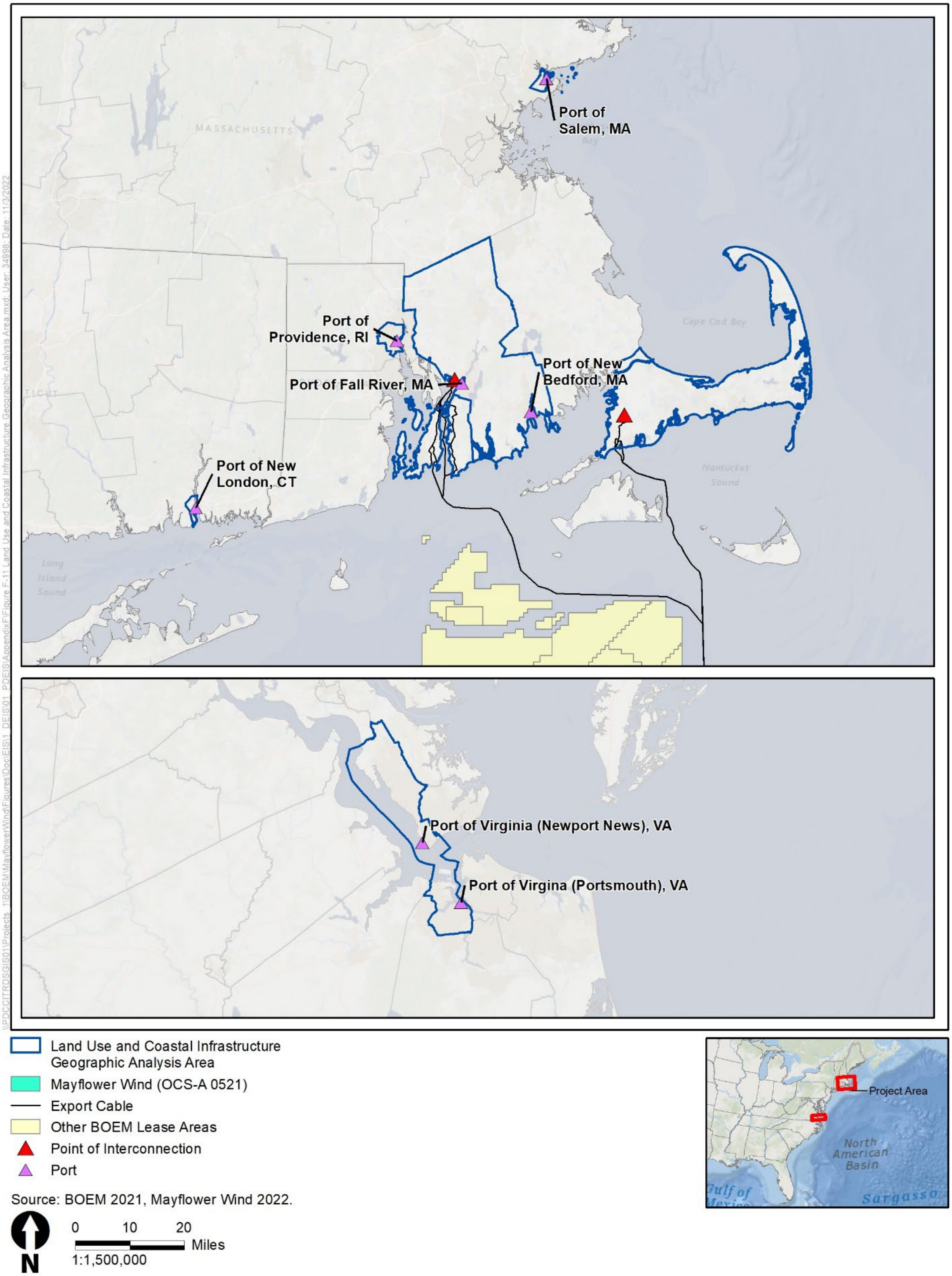

Figure 3.6.5-1. Land Use and Coastal Infrastructure geographic analysis area

The Project would use various ports for marshalling during construction, O&M, and decommissioning. The marshalling ports under consideration include New London, Connecticut; Providence, Rhode Island; New Bedford and Salem, Massachusetts; the Port of Virginia marine terminals in Portsmouth and Newport News, Virginia; and ports in Canada. The Ports of New Bedford and Fall River, Massachusetts would be the most likely ports for O&M activity. Mayflower Wind expects the ports used for construction and O&M would also be used for decommissioning. The Port of New London is surrounded by land zoned as Open Space (OS), Maritime District (MD), Two Family Residential (R-2), and General Business (C-1) (City of New London 2020). The Port of New Bedford is surrounded by land zoned as Industrial A and Mixed Use Business (City of New Bedford 2015). The Port of Salem is surrounded by land zoned as industrial (City of Salem 2012). The Port of Providence is surrounded by land zoned as waterfront and industrial (City of Providence 2021). The port in Portsmouth, Virginia is characterized by land zoned as industrial and is surrounded by land zoned as light industrial and urban residential (City of Portsmouth 2021). The port in Newport News, Virginia is within land zoned as Heavy Industrial (M2) (Newport News 2016). The Port of Fall River is within land zoned as Waterfront and Transit-Oriented Development District (City of Fall River 2022).

3.6.5.2 Impact Level Definitions for Land Use and Coastal Infrastructure

Definitions of impact levels are provided in Table 3.6.5-1.

Table 3.6.5-1. Impact level definitions for land use and coastal infrastructure

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on area land use would not be detectable.
	Beneficial	Beneficial impacts on area land use would not be detectable.
Minor	Adverse	Adverse impacts would be detectable but would be short term and localized.
	Beneficial	Beneficial impacts would be detectable but would be short term and localized.
Moderate	Adverse	Adverse impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
	Beneficial	Beneficial impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
Major	Adverse	Adverse impacts would be detectable, long term, and extensive, and result in permanent land use change.
	Beneficial	Beneficial impacts would be detectable, long term, and extensive, and result in permanent land use change.

3.6.5.3 Impacts of the No Action Alternative on Land Use and Coastal Infrastructure

When analyzing the impacts of the No Action Alternative on land use and coastal infrastructure, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for land use and coastal infrastructure. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for land use and coastal infrastructure in the geographic analysis area as described in Section 3.6.5.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to be affected by ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities that affect land use and coastal infrastructure include ongoing port maintenance and upgrades and onshore development. Ongoing offshore wind activities that may contribute to impacts on land use and coastal infrastructure include construction of the Vineyard Wind 1 (OCS-A 0501) and South Fork projects (OCS-A 0517). The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and regulations. The geographic analysis area is highly developed, and most construction projects would likely affect land that has already been disturbed from past development, although some development on undeveloped land may also occur. Ports in the geographic analysis area would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that affect land use and coastal infrastructure in the geographic analysis area include dredging and port improvement projects, military use, onshore development, port expansion and offshore cable emplacement and maintenance (see Appendix D for a description of planned activities). Planned activities would contribute to impacts on land use and coastal infrastructure through the primary IPFs of accidental releases, light, port utilization, presence of structures, land disturbance, noise, traffic, and EMF.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on land use during construction, O&M, and decommissioning of the projects. Ongoing and planned offshore wind projects in the geographic analysis area that would contribute to impacts on land use include those projects within all or portions of OCS-A-0486 (Revolution Wind), OCS-A-0487 (Sunrise Wind), OCS-A-0500 (Bay State Wind), OCS-A 0501 (Vineyard Wind 1), OCS-A 0517 (South Fork Wind), OCS-A-0520 (Beacon Wind), OCS-A 0522 (Vineyard Wind Northeast), and OCS-A 0534 (New England Wind) (Appendix D, Table D2-1). BOEM expects other offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazardous materials may increase because of offshore wind activities. Accidental release risks would be highest during construction, but still pose a risk during operation and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. The overall impact of accidental releases on land use and coastal infrastructure is anticipated to be localized, short term, and negligible and could result in temporary restrictions on use of adjacent properties and coastal infrastructure during the cleanup process.

Light: As described in Section 3.6.9, *Scenic and Visual Resources,* aviation hazard lighting on offshore wind projects (encompassing 901 WTGs) could potentially be visible from beaches and coastal areas in and near the geographic analysis area. Visibility would depend on distance from shore, topography, atmospheric conditions, and whether ADLS technology is implemented, but would be long term. Nighttime lighting for construction and decommissioning of landfalls, onshore export cables, and interconnection cables could disrupt existing uses on adjacent properties. These impacts would be localized and short term. Nighttime lighting from operation of onshore substations, O&M facilities, and port facilities could disrupt existing or planned uses on adjacent properties in the long term, depending on the specific location of these facilities, the land use and zoning of adjacent properties, and the extent of visual screening incorporated into the design of planned offshore wind facilities. Given the existing level of development in the geographic analysis area and that facilities would be sited consistent with local zoning regulations, BOEM anticipates the impact of facility lighting would be minor.

Port utilization: Offshore wind energy projects would make productive use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts such as greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind.

Offshore wind activity would support planned dredging and improvement projects at ports in the geographic analysis area. For example, the New Bedford Port Authority is conducting a $17 million expansion project to add 150,000 square feet of terminal space beginning in 2022 (Port of New Bedford 2022; Standard Times 2022). The Connecticut Port Authority is redeveloping the Port of New London State Pier as a heavy-lift capable port facility that would support wind turbine construction staging and pre-assembly, which is expected to be completed in 2023 (Connecticut Port Authority 2021a; 2021b; CT Examiner 2022). The Port of Virginia is conducting a ship-channel deepening-and-widening project to dredge the shipping channels to be completed in 2024 (Port of Virginia 2021). If multiple offshore wind energy projects rely on the same ports, this simultaneous use could stress port resources and could increase the marine and road traffic, noise, and air pollution in the area. Overall, other offshore wind projects would have constant, long-term, minor beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity, as well as localized, short-term, minor adverse impacts in cases where individual ports are stressed due to simultaneous project activity.

Presence of structures: As described in Section 3.6.9, 901 WTGs associated with offshore wind projects other than the Proposed Action could be visible from some shorelines (depending on vegetation, topography, and atmospheric conditions). Visibility would vary with distance from shore, topography, and atmospheric conditions, and impacts would generally be localized, constant, and long term. The presence of WTGs would have negligible impacts on land use because, while WTGs could be visible from some shoreline locations in the geographic analysis area, WTGs would not result in changes to land use.

The presence of onshore transmission cable infrastructure is anticipated to have minimal long-term impacts on land use. BOEM anticipates that new substations for offshore wind projects would be within or near existing substations, or in locations designated for such uses. Consistent with the Proposed Action, BOEM also assumes that cable conduits would primarily be underground and co-located with roads or other utilities (COP Volume 1, Sections 3.3.7; Mayflower Wind 2022). As a result, operation of substations and cable conduits would not affect the established and planned land uses for a local area and would have negligible impacts on land use.

Land disturbance: Offshore wind installation would require installation of onshore transmission cable infrastructure and substations, which would cause temporary traffic delays and could temporarily affect access to adjacent properties. These impacts would only last through construction and occasionally during maintenance events. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for offshore wind energy projects; however, other offshore wind projects would generally have localized, negligible, and short-term impacts during construction or maintenance and no long-term impacts on land use.

Noise: Offshore wind projects would generate noise, primarily associated with onshore cable trenching and substation construction and operation. Noise from offshore wind construction activities is not expected to reach the geographic analysis area. This IPF may affect land use if noise levels influence business activity or residents' and visitors' decisions on where to visit or live. Noise from onshore construction and substation operations is anticipated to be similar to noise from other ongoing construction projects and substation operation in the geographic analysis area and therefore would have a minor, short- to long-term impact on land use.

Traffic: Offshore wind projects could result in increased road traffic and congestion that may affect land use and coastal infrastructure because traffic volumes may dictate where residents and businesses choose to locate. Onshore construction of cables for offshore wind projects will likely disrupt road traffic for a short period. Occasional, temporary traffic delays would result from repairs and maintenance. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for offshore wind energy projects and traffic management plans developed with local governments. Traffic impacts on land use and coastal infrastructure are anticipated to be minor.

EMF: Onshore export cables in the geographic analysis area would generate EMF during operation of wind farms. Residents and visitors may be exposed to EMF where cables are installed near businesses, residences, or in public areas. Common household items including television sets, hair dryers, and electric drills can emit magnetic fields similar to or higher in intensity than those emitted by power cables (CSA Ocean Sciences, Inc. and Exponent 2019). Assuming other offshore wind export cables produce similar EMF levels as the Proposed Action, at a burial depth of 3 feet (1 meter), maximum emissions directly above the onshore export cables would be 403 milliGauss, based on a cable operating voltage of 275-kV (COP Appendix P1; Mayflower Wind 2022). This value is well below the reported human health reference levels of 2,000 milliGauss for the general population (International Commission on Non-ionizing Radiation Protection 2010). Even if other offshore wind export cables were of higher voltage or buried closer to the surface, EMF levels are still anticipated to be well below the human health reference levels; therefore, EMF impacts on land use would be long-term but negligible.

Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts on land use and coastal infrastructure, primarily through the IPFs of accidental releases, light, port utilization, presence of structures, land disturbance, noise, traffic, and EMF. BOEM anticipates that the impacts of ongoing activities would have both **minor beneficial** and **minor** adverse impacts in the geographic analysis area.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue to be affected by the primary IPFs of accidental releases, light, port utilization, presence of structures, land disturbance, noise, traffic, and EMF. Planned non-offshore wind activities, primarily increased port maintenance and expansion and construction activity, would have impacts similar to those of ongoing activities. Planned offshore wind activities would contribute to effects on land use through land disturbance (during installation of onshore cable and substations) and accidental releases during onshore construction, as well as through the presence of offshore lighting on wind energy structures and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind would support the productive use of ports and related infrastructure designed or appropriate for offshore wind activity (including construction and installation, O&M, and decommissioning). BOEM anticipates that the cumulative impact of the No Action Alternative would be **minor** adverse and **minor beneficial**.

3.6.5.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on land use and coastal infrastructure.

- Export cable route locations and onshore substation site variants within the Onshore Project area.
- The time of year during which construction occurs. Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). If Project construction were to occur during this season, impacts on roads and land uses during the busy tourist season would be exacerbated.

Mayflower Wind has committed to measures to minimize impacts on land use and coastal infrastructure by developing crossing and proximity agreements with utility owners prior to utility crossings and developing a construction schedule to minimize effects to tourism related activities, including scheduling construction outside of major events and avoiding construction during the summer tourist season (COP Volume 2, Section 14.2.2.1.2 and Table 16-1; Mayflower Wind 2022).

3.6.5.5 Impacts of Alternative B – Proposed Action on Land Use and Coastal Infrastructure

The Proposed Action would likely result in localized impacts that would not alter the overall character of land use and coastal infrastructure in the geographic analysis area. The most impactful IPFs would likely be land disturbance during cable installation, the visual impact of offshore WTGs, and the utilization of ports.[1] Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction, but may also occur during operations and decommissioning.

Accidental releases: Accidental releases from the Proposed Action could include release of fuel/fluids/hazardous materials as a result of port usage, installation of the onshore cables and substation, and substation operation (COP Volume 2, Section 12.2.5; Mayflower Wind 2022). Potential contamination may occur from unforeseen spills or accidents, and any such occurrence would be reported and addressed in accordance with the local authority. The impact of accidental releases on land use and coastal infrastructure could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, short-term, negligible to minor impacts on land use.

Light: The Proposed Action would include the installation and continuous use of aviation hazard avoidance lighting on WTGs and OSPs during low-light and nighttime conditions. During operations, lighting from all the Proposed Action's 147 WTGs could potentially be visible from certain coastal or elevated locations in the geographic analysis area. Mayflower Wind proposes to implement an ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity of the wind farm. Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on land use (COP Volume 1, Section 3.3.12; Mayflower Wind 2022). During construction, lighting technology would be used to minimize impacts on avian and bat species, which would also help reduce impacts on land use (COP Volume 2, Table 16-1; Mayflower Wind 2022). At onshore facilities, security lighting installed along onshore substation and converter station perimeter fencing and at building entrances would be down shielded to mitigate light pollution and would be designed to comply with night sky lighting standards (COP Volume 2, Section 8.2.2.2; Mayflower Wind 2022). Mayflower Wind has also committed to working with Falmouth and Somerset, Massachusetts to ensure the lighting scheme for the onshore substation and converter station complies with Town requirements. As a result, WTG lighting of the onshore substation and converter station would have a long-term, continuous, negligible impact on land use in the geographic analysis area, due to potential effects on property use and value.

Port utilization: The Proposed Action includes no port expansion activities but would use ports that have expanded or would expand to support the wind energy industry generally. For instance, the New Bedford MCT, which would be one of the primary ports used by Mayflower Wind during O&M, has been expanded specifically to support the construction of offshore wind facilities (COP Volume 2, Section 12.1.5; Mayflower Wind 2022). In addition, Mayflower Wind has made financial commitments for port

[1] The Proposed Action would not directly require any upgrades to port infrastructure but would make productive use of existing ports.

upgrades that are intended to enhance the capabilities of the existing port facility in Fall River, Massachusetts.

Land uses and coastal infrastructure affected by construction of offshore components would include temporary construction ports including New London, Connecticut; Providence, Rhode Island; New Bedford and Salem, Massachusetts; and the Port of Virginia marine terminals in Portsmouth and Newport News, Virginia. Mayflower Wind anticipates using the ports of New Bedford and Fall River, Massachusetts for O&M activities. These ports are expected to be used during construction and O&M but have independent utility and would not be dedicated to the Project. Proposed uses at existing port facilities would be consistent with the current land uses occurring at these locations and are not expected to result in changes to land use or zoning. The increased activity at these ports would provide a source of investment in the coastal infrastructure.

Activities associated with Proposed Action construction would generate noise, vibration, and vehicular traffic at port locations. These impacts are typical for industrial ports and would not hinder other nearby land uses or use of coastal infrastructure. Overall, the construction and installation of offshore components, O&M, and decommissioning for the Proposed Action alone would have negligible adverse and minor beneficial impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

Presence of structures: The WTGs could be visible from certain coastal and elevated mainland areas, depending upon vegetation, topography, and atmospheric conditions, which could have long-term impacts on land use if the views influence visitor decisions on locations or properties to visit or purchase. The WTGs would be installed over 20 nautical miles (32.2 kilometers) from the closest point to the Massachusetts shore. The WTGs would not dominate offshore views as a result of their proposed distance from shore, even under ideal weather and atmospheric conditions for viewing. The Proposed Action alone would have a long-term, continuous, minor impact on land use and coastal infrastructure in the geographic analysis area due to views of WTGs and the potential effects on property use and value.

In general, impacts on land use and zoning from onshore construction and operations would be minimized as the Project would use existing roads, ROWs, and industrial areas to the extent practicable. The three proposed Falmouth landfalls are in locations zoned as Public Use by the Town of Falmouth, including Worcester Park, Central Park, and the Surf Drive Beach public parking area. This zoning designation does not allow the installation of electrical transmission infrastructure, and any landfall option would likely require obtaining an easement from the Town of Falmouth and a zoning exemption from the state of Massachusetts (COP Volume 2, Section 12.2.1.1; Mayflower Wind 2022). Because the overall size of the area affected would be small (less than 1 acre for the transition joint bays) and the permanent electrical infrastructure would be buried, the long-term use of the public sites (i.e., parks and parking area) would not be adversely affected. From the landfall locations, the Falmouth onshore cable route would travel north within existing roadways to the onshore substation, and would be in proximity to primarily residential, commercial, and Public Use-zoned land. Impacts on land use and zoning would be minimized because the onshore cables would use existing roads and ROWs to the extent practicable.

Mayflower Wind would construct the Falmouth substation at one of two sites: Lawrence Lynch or Cape Cod Aggregates. The site of the preferred Lawrence Lynch substation is 27.3 acres (11.01 hectares) zoned as Light Industrial A, and is a former quarry that is currently used as an asphalt plant. The site of the Cape Cod Aggregates substation is 33.6 acres (13.6 hectares) located on private parcels zoned as Agricultural AA in a Water Resource Overlay District that is presently used as a sand and gravel quarry. Similar to the landfall locations, zoning relief would likely be required from the Town of Falmouth zoning bylaws for the two substation sites. As both substation sites are located on current and former quarries and are on or nearby industrially zoned areas, it is not anticipated that the substations would conflict with existing or future land uses.

On November 17, 2021, Mayflower Wind filed a zoning petition (D.P.U 21-142) with the Massachusetts Department of Public Utilities seeking comprehensive exemption from the operation of the zoning bylaws of the Town of Falmouth, including “exemptions from the use provisions of the Falmouth Zoning Bylaw, as well as certain provisions regarding dimensional requirements, signage, height, site plan review, parking, nuisances, noise, and interference, and other local permitting provisions.” The Massachusetts Department of Public Utilities may grant a zoning exemption only if it determines the proposed use of the land is “reasonably necessary for the public interest or convenience” (see Massachusetts General Laws Chapter 40A§3). Due to the need for broad-scale zoning relief, impacts on land use would be moderate. However, because the proposed uses must be in the public interest for zoning relief to be granted, the onshore facilities would use existing ROWs to the extent practicable, and because the Project would not require a change to an underlying zoning designation, impacts would be minimized and there would be no long-term changes to surrounding land uses.

For Brayton Point, the intermediate landfall locations and cable routes on Aquidneck Island would be located within road or utility ROWs or privately owned land, and no impacts on local zoning laws are anticipated (COP Volume 2, Section 12.2.1.1; Mayflower Wind 2022). Because all Project components in Somerset (converter station, landfalls, cable routes, transmission line) are sited within “Industrial District” zoning, and development of a converter station and associated equipment is consistent with this use, no long-term effects on land use or zoning are anticipated.

Onshore construction is expected to result in temporary or permanent impacts on local residents, businesses, and the community along the proposed onshore export cable routes during the construction and decommissioning period. Landfall construction methods would minimize land use impacts, and areas would be restored to their previous condition after construction (COP Volume 2, Section 12.2.2.1; Mayflower Wind 2022). Temporarily increased noise levels, lighting, and traffic during construction may affect local sensitive receptors (e.g., schools, medical facilities), but would be minimized through best management practices and would not change existing land uses. Mayflower Wind has committed to implementing a construction schedule that would minimize effects to tourism related activities, such as scheduling construction activities to avoid the height of the summer tourist season and coordinating with stakeholders/visitors’ bureaus to schedule outside of major events, to the extent feasible (COP Volume 2, Section 12.2.2.1; Mayflower Wind 2022).

Land disturbance: The Proposed Action's onshore export cable infrastructure would be installed underground in a duct bank, generally along, under, or adjacent to existing roads or utility ROW. HDD would be used to minimize impacts on land disturbance at the Falmouth and Brayton Point landfalls and at the intermediate landfall entering and exiting Aquidneck Island. Installation of the cable landfall sites and underground cable routes would temporarily disturb neighboring land uses through construction noise, vibration, dust, and travel delays along the affected roads. These impacts are anticipated to last for the duration of construction; following construction, the cable route corridors would be returned to their previous condition and use. Cables would be installed in trenches with a maximum disturbance width of 35 feet (11 meters). The Falmouth export cables and transmission line could require up to 23.3 acres (9.4 hectares) of disturbance, and the Brayton Point onshore export cables and transmission line could require up to 6.1 acres (2.5 hectares) of disturbance. O&M would not result in land disturbance except in the event that cable maintenance or replacement is required. During decommissioning, the onshore cables may be left in place for possible future reuse or removed, with impacts similar to those from construction. Land use impacts would be minimized by using existing ROWs, co-locating project components and restoring areas to pre-disturbed conditions following construction, resulting in minor land use impacts.

The construction of the onshore substation and the onshore converter station would result in temporary and permanent impacts due to construction and the use of temporary construction workspace. Construction of these facilities would require a permanent site, including area for equipment and buildings, equipment yards, energy storage, stormwater management, and landscaping. The maximum disturbance footprint for the Falmouth substation would be 26 acres (10.5 hectares), and the maximum disturbance footprint for the Brayton point converter station would be 10 acres (4 hectares). The facilities are not anticipated to conflict with surrounding land uses, as described under *Presence of Structures*.

Noise: The Proposed Action would comply with local regulatory authority requirements to minimize impacts on nearby communities (COP Volume 2, Section 12.2.3.1; Mayflower Wind 2022). Typical construction equipment ranges from a generator or refrigerator unit at 73 dBA at 50 feet (15 meters) to an impact pile driver at 101 dBA at 50 feet (15 meters). As the Proposed Action would be built 20 nautical miles (48 kilometers) offshore, noise effects from offshore construction and decommissioning would be temporary and negligible. Onshore, temporarily increased noise levels during construction may affect local sensitive receptors (such as religious locations, recreational areas, schools, and other places that are particularly sensitive to construction) but would be minimized through best management practices. Because there are no relevant regulatory limits for construction noise, the Project would follow a guideline limit of 65 dBA during the daytime. The greatest impacts would be from HDD activity at the landfall sites in Falmouth, which would require applicant-proposed mitigation measures, such as temporary construction noise barriers and equipment silencers, to achieve the 65 dBA guideline at the closest sensitive receptors (COP Volume 2, Sections 9.1.3.2.2 and 9.1.5; Mayflower Wind 2022). With implementation of these applicant-proposed mitigation measures (refer to Table G-1 in Appendix G, *Mitigation and Monitoring*), impacts from construction noise would be short-term and minor and are not anticipated to change existing land uses.

During operations of the Proposed Action, the converter station and substation sites would generate increased noise levels in the immediate vicinity of these sites. Based on noise modeling conducted at the two Falmouth substation sites, mitigation may be required at both sites in order to meet the MassDEP limit of 10 dBA above the measured minimum background sound levels at the closest noise-sensitive locations (COP Volume 2, Section 9.1.4.1; Mayflower Wind 2022). The greatest potential for impacts would be at the Lawrence Lynch substation site, which is located near low-density residential housing. Applicant-proposed mitigation measures include installing noise barriers to reduce sounds levels to comply with the Massachusetts regulatory requirements. Because the proposed onshore substation sites and converter station would be located on gravel quarries and a former power plant, and Mayflower Wind would implement applicant-proposed measures to reduce noise levels (Appendix G, Table G-1), there would be no changes in land use. Impacts would be long-term but minor.

Traffic: Cable installation within roadways would result in temporary traffic impacts due to closed roads and detours. The onshore cable route for Falmouth is expected to cover 8.5 miles (13.7 kilometers) and would be 2.6 miles (4.1 kilometers) for Brayton Point. Best management practices and maintenance of traffic plans would be coordinated with stakeholders, Falmouth and Somerset, Massachusetts, and Portsmouth, Rhode Island, and would adhere to a construction schedule that avoids the height of summer tourism seasons (COP Volume 2, Section 12.2.2.1). Construction staging in parking lots adjacent to or near the landfall locations at Falmouth and Aquidneck Island may temporarily reduce available parking; however, impacts would be limited because construction would be outside of the peak tourism seasons. Traffic impacts would be limited to the immediate construction area and would be minor and short-term. Roadways would be returned to preconstruction conditions, and changes to the existing land use would not result.

EMF: Once installed, onshore export cables would generate EMF during operations of the Project. The cables would be installed largely in public road ROWs where visitors may be exposed to EMF generated by the cables. Buried power cables produce weak field strengths well below the recommended threshold values for human exposure (CSA Ocean Sciences, Inc. and Exponent 2019). Based on EMF modeling of 275-kV HVAC export cables buried at a depth of 3 feet, maximum emissions directly above the onshore export cables would be 403 milliGauss (COP Appendix P1; Mayflower Wind 2022). From 10 to 25 feet from the cable centerline, emissions values drop to between 32 and 157 milliGauss. These values are well below the reported human health reference levels of 2,000 milliGauss for the general population (International Commission on Non-ionizing Radiation Protection 2010). The Project may also use HVDC cables, and while Mayflower Wind did not conduct modeling for HVDC cables, typical EMF levels in the immediate vicinity of HVDC cables (less than 1,000 milliGauss) are not known to cause health risks (COP Appendix P2; Mayflower Wind 2022). EMF from onshore cable routes is not anticipated to adversely affect human health nor require a change in land use to reduce exposure to human populations. Therefore, impacts on land use would be long-term but negligible.

3.6.5.6 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities and other ongoing and planned offshore wind activities. Ongoing and planned non-offshore wind activities that affect land use and coastal infrastructure in the geographic analysis area include ongoing dredging and port maintenance, military use, and offshore cable emplacement and maintenance.

The incremental impacts contributed by the Proposed Action to the accidental release impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind would increase the risk of (and thus the potential impacts from) accidental releases of fuel/fluids/hazardous materials in the geographic analysis area. The visual impacts associated with lighting and presence of structures of 1,048 WTGs from the Proposed Action and other offshore wind projects, portions of which would be visible from coastlines and elevated inland locations, could have long-term impacts on land use if the views and nighttime lighting influence visitor decisions on locations or properties to visit or purchase. Due to the distances of the WTGs from shore, impacts would be similar to the Proposed Action alone. Cumulative impacts would be long term and negligible from lighting and long-term and minor from lighting and presence of structures.

Cumulative impacts related to port utilization would be minor if increased activity levels stress port resources. Minor beneficial impacts would also result due to increased port utilization and resulting economic activity.

Impacts on land use and coastal infrastructure would be additive only if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity. Assuming that new substations for offshore wind projects would be in locations designated for industrial or utility uses, and underground cable conduits would primarily be co-located with roads or other utilities, operation of substations and cable conduits would not affect the established and planned land uses for a local area. Therefore, cumulative impacts would be minor and short term due to the potential for construction-related disturbance and access limitations along the export cable routes.

Ongoing and planned offshore wind activities would generate comparable types of impacts to those of the Proposed Action from noise, traffic, and EMF impacts. Other projects would be required to comply with the same or similar noise regulations as the Proposed Action, which would minimize potential noise impacts. Cumulative impacts on traffic would only occur if construction associated with other projects generates traffic in close spatial and temporal proximity as the Proposed Action. Other offshore wind projects are anticipated to result in similar, insignificant EMF levels as the Proposed Action. BOEM expects the cumulative impacts of noise, traffic, and EMF on land use and coastal infrastructure to be localized and minor.

Conclusions

Impacts of the Proposed Action: BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action alone would range from **negligible** to **moderate** with **minor beneficial** impacts. The Proposed Action would have negligible impacts resulting from port utilization, minor impacts resulting from land disturbance during onshore installation of the cable route and substation, negligible to minor impacts resulting from accidental spills, and localized minor impacts from noise and traffic. There would be moderate impacts associated with the Falmouth landfall sites and substations, which would require zoning relief from the Town of Falmouth zoning bylaws. Overall, BOEM anticipates there would be **moderate** impacts with **minor beneficial** impacts on land use and coastal infrastructure.

Cumulative Impacts of the Proposed Action: BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would result in **moderate** adverse impacts and **minor beneficial** impacts on land use and coastal infrastructure in the geographic analysis area.

3.6.5.7 Impacts of Alternative C on Land Use and Coastal Infrastructure

Impacts of Alternative C: The impacts of Alternative C on land use and coastal infrastructure would be similar to those of the Proposed Action except for land disturbance, traffic, and noise associated with the onshore export cable corridor route. Under both Alternative C-1 and Alternative C-2, the export cable route to Brayton Point would be rerouted onshore to avoid sensitive fish habitat in the Sakonnet River. The onshore export cables would be installed in trenches within the existing roadways where feasible, but may require pathways on road shoulders, medians, and private property.

Land disturbance: Alternative C-1 and Alternative C-2 would increase the total length of the Brayton Point onshore cable route by approximately 9 miles and 13 miles (14 and 21 kilometers), respectively. Similar to the Proposed Action, temporary impacts on land disturbance would occur largely within the existing roadways or along the immediate edge of the road ROW. The roadbed would be restored immediately following construction. There is some potential for the onshore export cables to require pathways on private property, transmission ROWs, and railroad ROWs, which may require Mayflower Wind to obtain easements. Impacts would be most pronounced along the southern portions of both alternatives where the roads are 20 feet (6.1 meters) wide with no shoulder and lined with historic stonewalls, hedges, old growth trees and historic structures, which may be disturbed during construction. The Alternative C-1 landfall location would be sited in the parking lot of Second Beach in an Open Space zoning district in Middletown (Town of Middletown 2022). The Alternative C-2 landfall locations would be in the parking lot of the Sakonnet Point Marina in Little Compton and on a private parcel zoned as Waterfront off Schooner Drive in Tiverton (Town of Little Compton 2022; Town of Tiverton 2022). While local zoning laws generally allow for electrical infrastructure in these areas, further coordination would be required with affected municipalities to facilitate authorization of the land use. Impacts on surrounding land uses are anticipated to be moderate because Alternative C would affect a larger area than the Proposed Action, but impacts would be short-term and underground installation of utility infrastructure in public ROWs would not result in long-term land use changes.

Traffic: Due to the increase in the total length of the onshore export cable corridor route under Alternative C, construction associated with the cable installation within or adjacent to the roadway would result in an increase in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways and parking areas compared to the Proposed Action. Because the onshore cable routes would be longer than under the Proposed Action, the amount of roadway and the duration of impacts from construction would be longer, with Alternative C-2 having the greater impact. From the landfall, the Alternative C-1 onshore route would head north from Middletown, Rhode Island along one of two variations and then follow Route 138 through mostly rural residential and agricultural land into the town of Portsmouth, before following the same route as the Proposed Action into Mount Hope Bay. Alternative C-2 would follow mostly Routes 77 and Route 177 through Little Compton and Tiverton along rural residential communities and agricultural land. The southern portions of the roadways that would be used for both alternatives are narrow two-lane roads with no shoulder, and construction would cause the greatest traffic delays in these areas. Road closures during construction of the onshore export cable route would temporarily restrict access to certain portions of the surrounding areas. Roadways would be returned to pre-construction conditions and permanent changes to traffic and traffic patterns would not occur.

Noise: Alternative C would involve more onshore construction activities and related noise impacts as a result of the increased length of the onshore export cable route. Impacts from noise under Alternative C would be minimized through the use of existing ROWs and complying with best management practices to minimize noise impacts during construction (COP Volume 2, Table 16-1; Mayflower Wind 2022). While the increased export cable route would likely result in extended construction with potentially increased impacts on surrounding land uses from noise, the overall impacts of construction under Alternative C would be of the same magnitude as those of the Proposed Action.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative C: Alternative C would increase the length of onshore cable route, resulting in increased impacts on temporary and permanent land disturbance compared to the Proposed Action, with Alternative C-2 resulting in the most impacts. The overall impact magnitudes would be the same as the Proposed Action because the cable corridors are anticipated to be largely installed in existing roadways, and the primary impacts would be limited to the duration of construction. Overall, impacts on land use and coastal infrastructure would be **moderate** and **minor beneficial** impacts.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternative C on land use and coastal infrastructure would be similar to those of the Proposed Action: **moderate** adverse and **minor beneficial** on land use and coastal infrastructure.

3.6.5.8 Impacts of Alternatives D, E, and F on Land Use and Coastal Infrastructure

Impacts of Alternatives D, E, and F: The impacts of Alternatives D, E, and F on land use and coastal infrastructure would be similar to those of the Proposed Action because these alternatives differ only with respect to offshore components, which would have minimal effects on land use. The impacts on land use resulting from land disturbance and maintenance associated with onshore construction under Alternatives D, E, and F are expected to be the same as those of the Proposed Action.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives D, E, and F would be the same as described under the Proposed Action.

Conclusions

Impacts of Alternatives D, E, and F: The impacts associated with the Proposed Action alone would not change under Alternatives D, E, and F because the alternatives only differ in offshore components, and offshore components would not substantially contribute to impacts on land use and coastal infrastructure; the same construction and installation, O&M, and conceptual decommissioning activities would still occur. Overall, impacts on land use and coastal infrastructure would be **moderate** with **minor beneficial** impacts.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives D, E, and F would be the same as the Proposed Action: **moderate** and **minor beneficial**.

3.6.5.1 Proposed Mitigation Measures

No measures to mitigate impacts on land use and coastal infrastructure have been proposed for analysis.

3.6 Socioeconomic Conditions and Cultural Resources

3.6.6 Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on waterways and water approaches from the proposed Project, alternatives, and ongoing and planned activities in the navigation and vessel traffic geographic analysis area. The navigation and vessel traffic geographic analysis area, as shown on Figure 3.6.6-1 includes coastal and marine waters within a 10-mile (16.1-kilometer) buffer of the Offshore Project area and adjacent lease areas off Massachusetts and Rhode Island, as well as waterways leading to ports that may be used by the Project. Information presented in this section draws primarily upon the NSRA[1] (COP Appendix X; Mayflower Wind 2022), which was conducted per the guidance in USCG *Navigation and Vessel Inspection Circular 01-19* (USCG 2019).

3.6.6.1 Description of the Affected Environment and Future Baseline Conditions

Regional Setting

Proposed Project facilities would be approximately 26 nm (48 kilometers) south of Martha's Vineyard and 20 nm (37 kilometers) south of Nantucket, Massachusetts under a Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0521). Figure 3.6.6-1 shows vessel traffic in the vicinity of the Lease Area based on Automatic Identification System (AIS) data and nearby routing measures (traffic separation zones, precautionary areas). There are several routing measures[2] that regulate vessel traffic to help ships avoid navigational hazards in the vicinity of the Lease Area. Two Traffic Separation Systems[3] influence deep-draft vessel routes in the geographic analysis area: the Nantucket/Ambrose Shipping Safety Fairway (referred to hereafter as Nantucket Ambrose Fairway) and the Narragansett Bay Traffic Separation System in Rhode Island Sound (Figure 3.6.6-2).

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[1] The "Study Area" used in the NSRA (COP Volume 2, Figure 13-1; Mayflower Wind 2022) is inclusive of the Project area and offshore waters extending at least 20 nm (37 kilometers) on all sides of the Project area and offshore ECCs. The navigation and vessel traffic geographic analysis area is generally consistent with the NSRA Study Area but also includes more distant ports that may be used by the Project. Where this EIS references risk analysis from the NSRA, it is specific to the geographic scope of the NSRA Study Area.

[2] The term *routing* measure originates from the International Maritime Organization. USCG submits and obtains approval for routing measures within U.S. navigable waters to the International Maritime Organization. Areas to Be Avoided, Inshore Traffic Zones, No Anchoring Areas, Precautionary Areas, Roundabouts, and Traffic Separation Schemes are all routing measures (USCG 2020: Appendix B).

[3] A Traffic Separation System, is an internationally recognized measure that minimizes the risk of collision by separating vessels into opposing streams of traffic through establishment of traffic lanes. Vessel use of Traffic Separation System is voluntary.

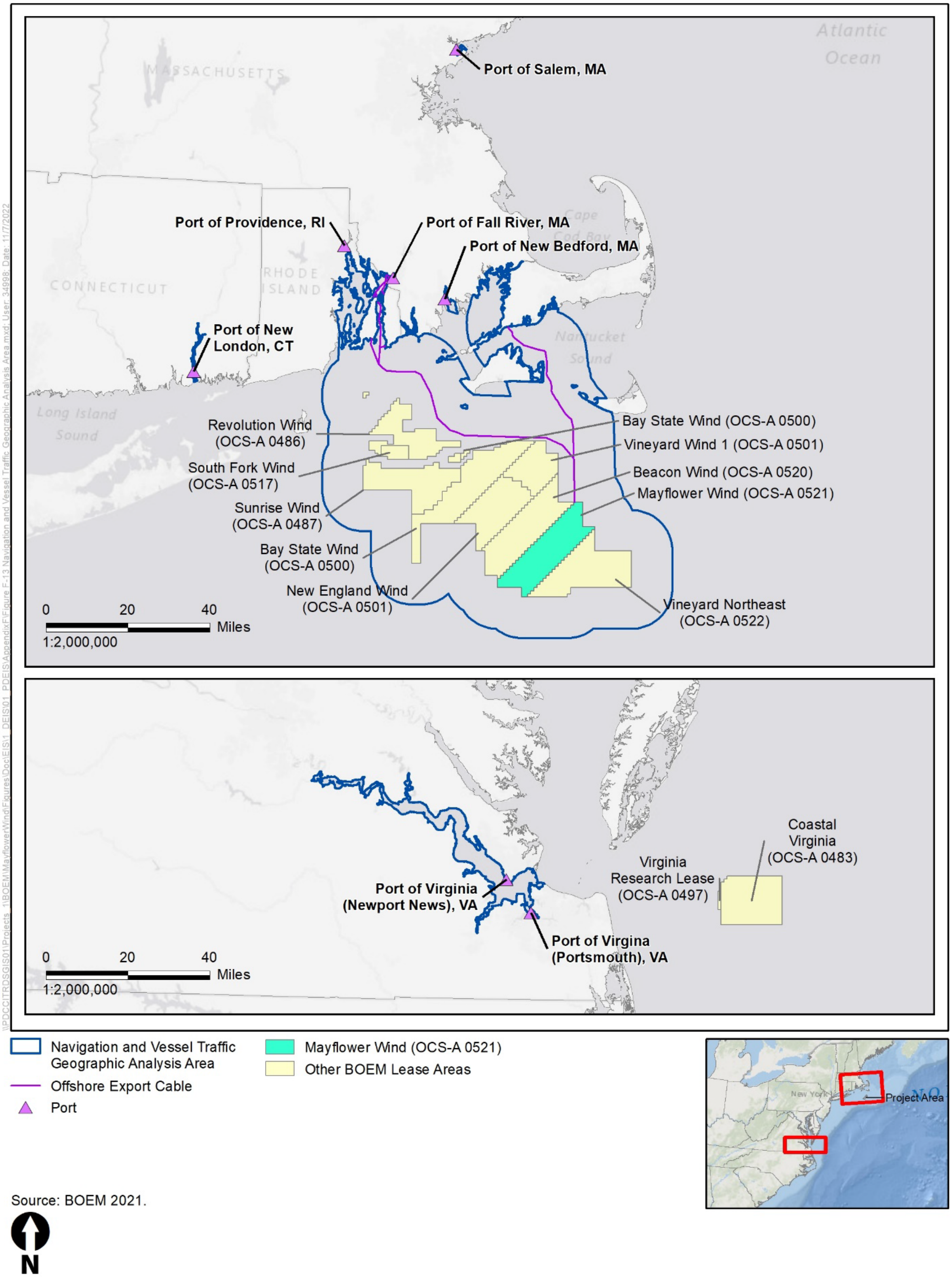

Figure 3.6.6-1. Navigation and vessel traffic geographic analysis area

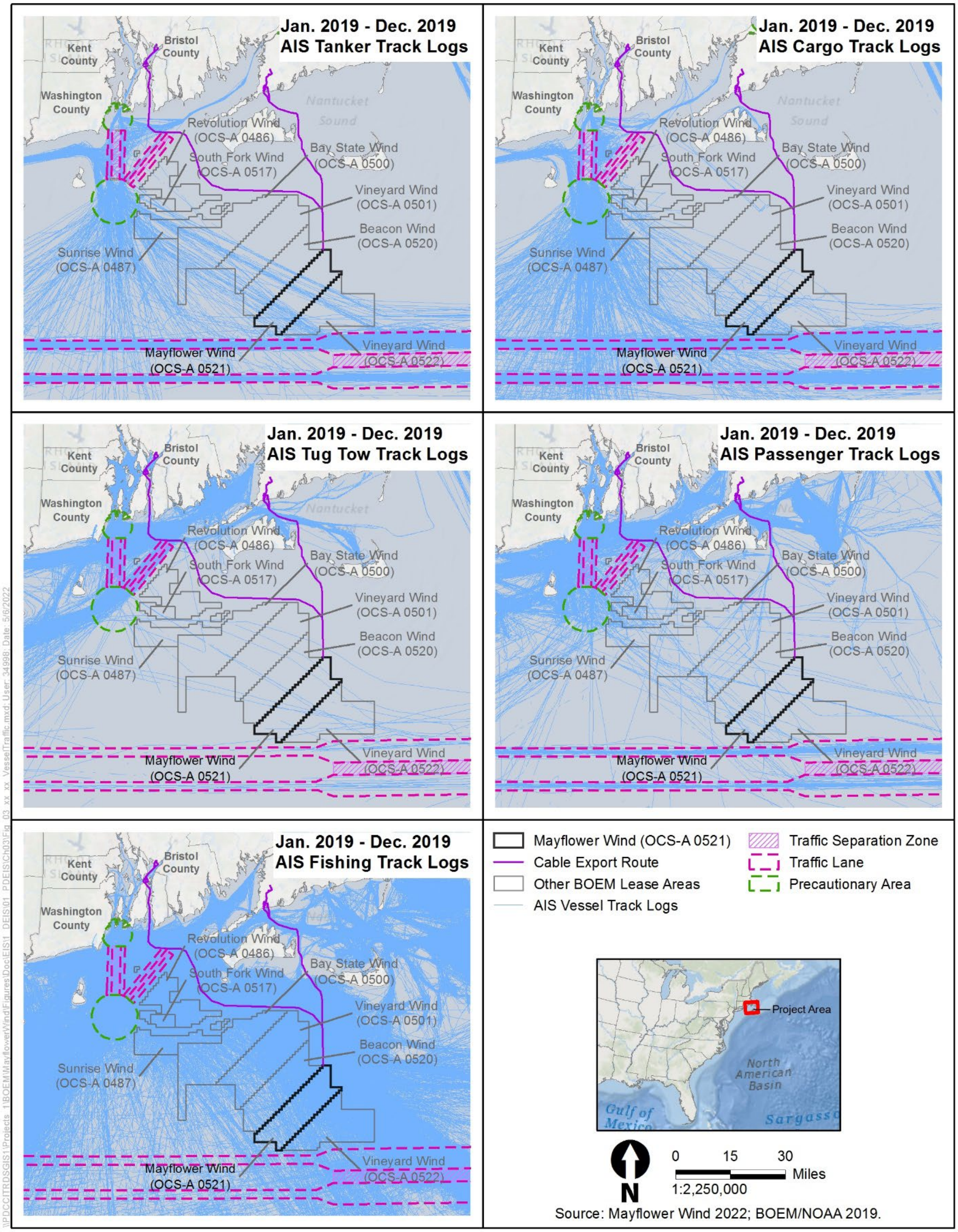

Figure 3.6.6-2. Vessel traffic in the vicinity of the Lease Area

Cargo vessels, carriers, and tankers make use of the two Traffic Separation Systems on approach to and departure from ports. The majority of deep-draft vessel transits occur in the traffic lanes along the southern edge of the geographic analysis area within the Nantucket Ambrose Fairway (Figure 3.6.6-2) (COP Appendix X, Section 2.1.1.1; Mayflower Wind 2022). The closest anchorage to the Lease Area is Anchorage G, located 13 nm (24 kilometers) north (COP Appendix X, Figure 2-35; Mayflower Wind 2022). The Falmouth offshore export cable route would cross Anchorages G, H, and I, and the Brayton Point offshore export cable route would be installed adjacent to Anchorages E and F. To the northeast and east of the Project area, the International Maritime Organization has designated Nantucket Shoals, a shallow area that presents hazards for deep-draft vessels, as an Area to be Avoided.

The USCG prepares port access route studies to review potential traffic density and the need for safe access routes for vessels. MARIPARS is the primary study relevant to the geographic analysis area, which provides recommendations regarding offshore wind energy development in the Rhode Island and Massachusetts Wind Energy Areas (USCG 2020). The recommendations include development of WTGs along a standard and uniform grid pattern with standard spacing to accommodate vessel transits, fishing operations, and SAR operations. In December 2021, USCG released the Northern New York Bight port access route study, which recommends combining the two separate Nantucket-Ambrose lanes south of the Lease Area into a single fairway (USCG 2021a).

Vessel Traffic

There is wide variance in traffic density, vessel types, and vessel sizes in the geographic analysis area. The sources employed to identify vessel traffic patterns in the NSRA include Nationwide AIS data for 2019, 2016 vessel monitoring system data from NMFS, vessel trip report data from 2011 to 2015, the MARIPARS (USCG 2020), and interactions with recreational boating, fishing, and towing industry organizations, agencies, and other stakeholders. Based on the information in the NSRA, vessel traffic in the northern portion of the geographic analysis area (within Nantucket Sound, the Sakonnet River, and Mount Hope Bay) comprises smaller vessels with a high seasonal influence. The vessel traffic in the southern portion of the analysis area, which encompasses the Lease Area, is more varied, with a mixture of deep-draft vessels and commercial fishing vessels engaged in fishing or transiting to fishing grounds outside the Project area.

Table 3.6.6-1 shows the number of vessel tracks that intersected the Lease Area and offshore export cable routes based on AIS data from NOAA Office for Coastal Management from January 1, 2019 to December 31, 2019. AIS is only required on commercial vessels with a length of 65 feet (19.8 meters) or longer. While some smaller recreational and fishing vessels carry AIS, the data in the table most likely underrepresents vessels less than 65 feet (19.8 meters) long that traverse the Project area. Nonetheless, over 75 percent of AIS tracks in the Project area were from fishing and pleasure vessels.

Table 3.6.6-1. Vessel tracks in the Offshore Project area (January 1–December 31, 2019)

Vessel Type	Vessel Tracks	Percent of Total
Cargo	163	1%
Fishing [a]	11,303	38%
Passenger	2,803	9%
Pleasure Craft/Sailing [b]	11,251	38%
Tanker	180	1%
Tug/Tow	1,708	6%
Other/Not Available [b]	2,326	8%
Total	**29,734**	**100%**

Source: Office for Coastal Management 2022.
[a] AIS track counts for fishing and pleasure vessels underrepresent these vessel types, as not all of these vessel types are required to have AIS on board per USCG regulations.
[b] Other/Not Available vessel types include research, military, law enforcement, and unspecified vessels.

Most cargo, carrier, and tanker vessel traffic in the geographic analysis area use the Nantucket Ambrose Fairway and Narragansett Bay Traffic Separation System. The densest vessel tracks are within the Nantucket Ambrose Fairway, located between the approaches to New York and waters south of Nantucket. Some deep-draft vessels cross the Lease Area when transiting between the Nantucket Ambrose Fairway and the Narragansett Bay Traffic Separation System. Minimal cargo and tanker activity occurs in the Sakonnet River and Rhode Island Sound, with slightly higher activity in Mount Hope Bay (COP Volume 2, Section 13.1.1; Mayflower Wind 2022).

In the geographic analysis area, the area with the most commercial fishing vessel traffic is in the northwest-southeast corridor from Martha's Vineyard and along Nantucket Shoals intersecting the Falmouth ECC. Near the Brayton Point ECC, the most commercial fishing activity occurs in Rhode Island Sound with limited activity in Mount Hope Bay and the Sakonnet River, with the exception of high levels of monkfish fishing and limited gillnet fishing (COP Volume 2, Section 13.1.1; Mayflower Wind 2022).

Most passenger vessels present in the geographic analysis area occur between Cape Cod, Martha's Vineyard, and Nantucket. There are also cruise ships that transit the Nantucket Ambrose Fairway and some pleasure vessel transits in Nantucket Sound and Rhode Island Sound, the Sakonnet River, and Mount Hope Bay (COP Volume 2, Section 13.1.1; Mayflower Wind 2022).

Vessel Incidents

The NSRA modeled baseline vessel incidents based on vessel traffic patterns without the Proposed Action. Expected and modeled accident frequencies in the Lease Area for allision are zero, as there are currently no wind turbines in the Lease Area that present a risk for allision. The accident frequency for collisions is 0.005 accident per year, or 5 accidents in 1,000 years. The greatest collision risk is from groundings, with an accident frequency of 0.058 accident per year. Most of the overall accident frequency (90 percent) is from fishing vessels, which transit close to the shoreline (COP Appendix X, Section E.3.1; Mayflower Wind 2022).

Mission data taken from the USCG MARIPARS report indicate that an average of 9.5 SAR cases per year occurred in an area approximately equivalent to the Massachusetts and Rhode Island lease areas, of which 0.14 cases occurred in the Project area (USCG 2020; Mayflower Wind 2022). The largest percentage of incidents were disabled vessels, distress/medivac, and other incidents; there were no recorded allisions, collisions, or groundings in the Project area (COP Appendix X, Figure 12-3; Mayflower Wind 2022).

Aids to Navigation

The closest federal aid to navigation to the Lease Area is the Muskeget Channel "MC" buoy, which is approximately 21 nm (39 kilometers) from the Lease Area and marks the southern entrance to the channel (COP Appendix X; Mayflower Wind 2022). Additional federal and private aids to navigation are located in proximity to the Falmouth offshore ECC in Nantucket Sound and the Brayton Point offshore ECC in the Sakonnet River and Mount Hope Bay. Aids to navigation are developed by the USCG to assist mariners in determining their position and identifying safe courses and to warn of dangers and obstructions.

Ports, Harbors, and Navigation Channels

The major ports in the vicinity of the Project area include the ports of Providence and Davisville in Rhode Island, and the ports of Fall River and New Bedford in Massachusetts. These ports serve the commercial fishing industry, passenger cruise lines, cargo and other maritime activities. Of these, the largest deep-draft port by volume is Providence Port. The primary vessel traffic and commercial shipping lanes to these ports are outside the Lease Area. Other ports in the geographic analysis area include the Port of Salem, Massachusetts; Port of New London, Connecticut; and Port of Virginia, Virginia.

3.6.6.2 Impact Level Definitions for Navigation and Vessel Traffic

Definitions of impact levels are provided in Table 3.6.6-2. There would be no beneficial impacts on navigation and vessel traffic.

Table 3.6.6-2. Impact level definitions for navigation and vessel traffic

Impact Level	Impact Type	Definition
Negligible	Adverse	No measurable impacts would occur.
Minor	Adverse	Impacts would be small, localized, and temporary. Normal or routine functions associated with vessel navigation would not be disrupted.
Moderate	Adverse	Impacts would be unavoidable. Vessel traffic would have to adjust somewhat to account for disruptions due to impacts of the Project.
Major	Adverse	Vessel traffic would experience unavoidable disruptions to a degree beyond what is normally acceptable, including potential loss of vessels and life.

3.6.6.3 Impacts of Alternative A – No Action on Navigation and Vessel Traffic

When analyzing the impacts of the No Action Alternative on navigation and vessel traffic, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for navigation and vessel traffic. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for navigation and vessel traffic described in Section 3.6.6.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities that affect navigation and vessel traffic in the geographic analysis area include marine transportation, military use, NMFS activities and scientific research, and fisheries use and management. Impacts from these activities would increase vessel traffic in the area, adding to congestion in waterways and increasing the potential for maritime accidents.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic include ongoing construction of the Vineyard Wind 1 project (62 WTGs and 1 OSP) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSP) in OCS-A 0517. Ongoing construction of the Vineyard Wind 1 and South Fork projects would have the same type of impacts on navigation and vessel traffic that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect navigation and vessel traffic in the geographic analysis area include port improvement projects, dredging projects, and installation of new structures on the OCS. These activities may result in a moderate increase in port maintenance activities, port upgrades to accommodate larger deep-draft vessels, and temporary increases in vessel traffic for offshore cable emplacement and maintenance. See Appendix D, *Planned Activities Scenario*, for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for navigation and vessel traffic.

The sections below summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on navigation and vessel traffic during construction, O&M, and decommissioning of the projects. Ongoing and planned offshore wind projects in the geographic analysis area that would contribute to impacts on navigation and vessel traffic include those projects in all or portions of OCS-A-0486 (Revolution Wind), OCS-A-0487 (Sunrise Wind), OCS-A-0500 (Bay State Wind), OCS-A 0501 (Vineyard Wind 1), OCS-A 0517 (South Fork Wind), OCS-A-0520 (Beacon Wind), OCS-A 0522 (Vineyard Wind Northeast), and OCS-A 0534 (New England Wind) (Table D2-1, Appendix D). BOEM expects other offshore wind development in the geographic analysis area to affect navigation and vessel traffic through the following IPFs.

Anchoring: Offshore wind developers are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk for deep-draft vessels would come from anchoring in an emergency scenario. In addition, cables would be identified on nautical charts, which vessel operators would be expected to consult prior to dropping anchor. 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, damage to the vessel anchor and/or anchor chain, and risks associated with an anchor contacting an electrified cable.

Smaller commercial or recreational vessels anchoring in the offshore wind lease areas may have issues with anchors failing to hold near foundations and any scour protection. Considering the small size of the geographic analysis area compared to the remaining area of open ocean near the Project area, as well as the low likelihood that any anchoring risk would occur in an emergency scenario, it is unlikely that offshore wind activities would affect vessel-anchoring activities, and impacts would likely be negligible.

Port utilization: Other offshore wind development would support planned expansions and modifications at ports in the geographic analysis area for navigation and vessel traffic, including Port of Virginia and Port of New Bedford. Simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity and resources and could concentrate vessel traffic in port areas. Such concentrated activities could lead to increased risk of allision, collision, and vessel delay.

The increase in port utilization due to offshore wind activity would vary across ports and would depend on the specific port or ports supporting each offshore wind project. It is unlikely that all projects would use the same ports; therefore, the total increase in vessel traffic would be distributed across multiple ports in the region. Port utilization in the geographic analysis area would occur primarily during construction. Offshore wind construction activities may result in competition for scarce berthing space and port services potentially causing short- to medium-term adverse impacts on commercial shipping. During peak activity, impacts on port utilization would be moderate, short term, and continuous at the ports and their maritime approaches.

After offshore wind projects are constructed, related port utilization would decrease. During operations, project-related port utilization would have minor, long-term, intermittent, localized impacts on overall vessel traffic and navigation. Port utilization would increase again during decommissioning at the end of the operating period of each project, which BOEM anticipates to be approximately 35 years, with magnitudes and impacts similar to those described for construction.

Presence of structures: Approximately 920 WTGs and OSPs would be constructed in the geographic analysis area that would pose navigational hazards to vessels transiting in 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 OSP structures in areas where no such structures currently exist, potential compression of vessel traffic both outside and within offshore wind lease areas, and potential difficulty seeing other vessels due to a cluttered view field. All offshore wind projects would be required to light and mark their projects in compliance with the guidelines in BOEM's *Lighting and Marking Guidelines* (BOEM 2021), in addition to procuring valid PATON from the appropriate USCG District. The increasing presence of structures as new offshore wind farm areas are developed could lead to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, engagement of USCG SAR, and vessel fuel spills.

Another potential impact of offshore wind structures is interference with marine vessel radars. The MARIPARS report notes (USCG 2020) that various factors play a role in potential marine radar interference by offshore wind infrastructure, stating that "the potential for interference with marine radar is site specific and depends on many factors including, but not limited to, turbine size, array layouts, number of turbines, construction material(s), and the vessel types." In the event of radar interference, other navigational tools are available to ship captains.

The fish aggregation and reef effects of offshore wind structures would also provide new opportunities for recreational fishing. The additional recreational vessel activity focused on aggregation and reef effects would incrementally increase vessel congestion and the risk of allision, collision, and spills near WTGs. Overall, the impacts of this IPF on navigation and vessel traffic would be moderate, long term (as long as structures remain, approximately 35 years), regional (throughout the entire geographic analysis area for navigation and vessel traffic), and constant.

Cable emplacement and maintenance: Other offshore wind projects in the geographic analysis area would require installation of 3,520 miles (5,665 kilometers) of offshore export and interarray cables. Emplacement and maintenance of cables for these offshore wind projects would generate vessel traffic and would specifically add slower-moving vessel traffic above cable routes. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes during installation and maintenance activities. BOEM anticipates that there would likely be simultaneous cable-laying activities from multiple projects based on the estimated construction timeline. While simultaneous cable-laying activities may disrupt vessel traffic over a larger area than if activities occurred sequentially, the total time of disruption would be less than if each project were to conduct cable-laying activities sequentially. The impacts of this IPF on vessel traffic and navigation would be minor to moderate because impacts would be short term, localized, and most disruptive during peak construction activity of the offshore wind projects in 2024 and 2025.

Traffic: Offshore wind projects would generate vessel traffic during construction, operation, and decommissioning in the geographic analysis area. Other vessel traffic in the region (e.g., from commercial fishing, for-hire and individual recreational use, shipping activities, military uses) would overlap with offshore wind-related vessel activity in the open ocean and near ports supporting the offshore wind projects. BOEM anticipates that the total increase in vessel traffic would be distributed across multiple ports in the region.

Up to 12 offshore wind projects (number of projects includes lease remainders; see Appendix D, Table D-2) would be constructed in the geographic analysis area between 2023 and 2030. Based on the estimated construction schedules for these projects, vessel traffic would likely be highest between 2024 and 2025 when up to 10 projects could be under construction at the same time. For purposes of estimating total vessel traffic, BOEM assumed that construction vessel traffic for these projects would be similar to the Proposed Action of between 15 to 35 vessels operating at any given time (the Proposed Action proposes the most WTGs of any of the 12 other offshore wind projects in the geographic analysis area so this is a conservative assumption). At peak construction between 2024 and 2025, other offshore wind projects could generate between 150 and 350 vessels operating in and near the geographic analysis area. The presence of offshore wind project vessels would add to the overall Atlantic Coast vessel traffic levels as new offshore wind farm areas are developed, leading to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, engagement of USCG SAR, and vessel fuel spills. Increased offshore wind-related vessel traffic during construction would have moderate, short-term, constant, localized impacts on overall (wind and non-wind) vessel traffic and navigation.

After offshore wind projects are constructed, related vessel activity would decrease. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. For purposes of estimating total operational vessel traffic in the geographic analysis area, BOEM assumed that vessel traffic for these projects would be similar to the Proposed Action estimates of one to three vessels per day. Combined, the 12 offshore wind projects in the geographic analysis area would generate approximately 36 vessels per day during normal O&M beginning in 2030. During operations, project-related vessel traffic would have minor, long-term, intermittent, localized impacts on overall vessel traffic and navigation. Vessel activity would increase again during decommissioning at the end of the assumed 35-year operating period of each project, with magnitudes and impacts similar to those described for construction.

Conclusions

Impacts of the No Action Alternative: BOEM expects ongoing activities, including non-offshore wind and offshore wind activities to have continuing short- and long-term impacts on navigation and vessel traffic, primarily through the presence of structures, port utilization, and vessel traffic. BOEM anticipates that the impacts of ongoing activities, especially port utilization, presence of structures, and vessel traffic, would be **negligible** to **moderate**.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and navigation and vessel traffic would continue to be affected by the primary IPFs of port utilization, presence of structures, cable emplacement, and vessel traffic. Planned non-offshore wind activities, including port improvement projects, dredging projects, and offshore cable emplacement and maintenance, would contribute to impacts on navigation and vessel traffic.

Planned offshore wind activities would increase vessel activity, which could lead to congestion at affected ports, the possible need for port upgrades beyond those currently envisioned, and an increased likelihood of collisions and allisions, with resultant increased risk of accidental releases. The planned construction of offshore wind projects would add new structures in areas where no such structures currently exist, increasing the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety. BOEM anticipates that the cumulative impacts of the No Action Alternative would result in **negligible** to **moderate** impacts primarily due to the presence of structures.

3.6.6.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on navigation and vessel traffic.

- The Project layout including the number, type, and placement of the WTGs and OSPs including the location, width, and orientation of the Wind Farm Area rows and columns.
- The number of vessels used for construction and installation.
- The offshore electric cable corridor routes/locations.
- Time of year of construction.
- Ports selected to support construction and installation and O&M.

Mayflower Wind has committed to measures to minimize impacts on navigation and vessel traffic, which include, but are not limited to, implementing construction safety zones in consultation with USCG, using on-scene safety vessel(s) and/or personnel to advise mariners of construction activity, as necessary, and marking of structures to align with letter and number marking of all offshore structures within the Massachusetts and Rhode Island wind energy area, improving SAR and general navigation (COP Volume 2, Table 16-1; Mayflower Wind 2022).

3.6.6.5 Impacts of Alternative B – Proposed Action on Navigation and Vessel Traffic

Impacts from the Proposed Action alone would include increased vessel traffic in and near the Wind Farm Area and on the approach to ports used by the Proposed Action, as well as obstructions to navigation caused by Proposed Action activity. COP Volume 1, Table 3-21 and Table 3-23 (Mayflower Wind 2022) summarize the anticipated Project-related vessel traffic during construction and O&M, respectively.

Changes in traffic from the Project are anticipated to include the following.

- Project-related vessel traffic related to construction, O&M, and decommissioning activities.
- Additional non-Project traffic that might be generated by the presence of the Wind Farm Area, for example, pleasure vessel trips for sight-seeing or recreational fishing.
- The modification of usual traffic routes for some ship types due to the presence of wind farm structures.

The NSRA risk analysis modeled the frequency of non-Project vessel accidents that could result from installation of the Proposed Action wind farm structures. The model estimates frequencies for marine accidents accounting for Project- and location-specific environmental, traffic, and operational parameters. Baseline vessel traffic data used in the model are described in Section 3.6.6.1, *Description of the Affected Environment and Future Baseline Conditions*. Detailed information about the risk analysis is included in COP Appendix X (Mayflower Wind 2022). The risk analysis calculated the frequency of hazards due to drift allision, powered allision, drift grounding, powered grounding, and collision. Results of the NSRA risk modeling are described below under the IPF headings for *Presence of Structures* and *Traffic*.

Anchoring: The nearest established anchorage to the Lease Area is Anchorage G located 13 nm (24 kilometers) to the north. As indicated by AIS data, there is no significant anchorage activity in the vicinity of the Lease Area. Therefore, construction and operation of the Wind Farm Area is not anticipated to have a measurable effect on navigation and safety related to anchorages (COP Appendix X, Section 2.2.3.1; Mayflower Wind 2022). Smaller vessels anchoring in the Wind Farm Area may have issues with anchors failing to hold near foundations and any associated scour protection, or, alternately, where the anchors may become snagged and potentially lost. During construction, installation, and decommissioning operations, smaller recreational and fishing vessels would most likely not transit the Wind Farm Area and, therefore, not anchor in the geographic analysis area. Consequently, any potential impacts from smaller vessels anchoring in the Wind Farm Area would primarily occur during the O&M phase.

There are several anchorage areas in proximity to and overlapping the proposed offshore export cable routes (COP Appendix X, Figure 2-35; Mayflower Wind 2022). The Falmouth offshore export cable route would cross Anchorages G, H, and I (in and around Nantucket Sound), and the Brayton Point offshore export cable route would pass in proximity to Anchorages E and F (in and around Vineyard Sound). Based on AIS data, these anchorages would likely be used mostly by smaller vessels such as passenger and pleasure crafts (COP Appendix X, Figure 2-25; Mayflower Wind 2022). Anchors for these vessels are unlikely to penetrate to the depth that would make contact with the buried cable. Additionally, cables would be chartered and Mayflower Wind would take into consideration anchoring impacts in cable design in areas where anchoring may occur, reducing the potential for anchoring impacts (COP, Section 3.4.1.1.1; Mayflower Wind 2022).

Deviations from “normal” anchorage activities, such as vessels anchoring in an emergency scenario, pose a potential hazard to subsea cables. Depending upon the anchor weight, vessels with a tonnage greater than 10,000 deadweight tonnage (DWT) would be the most likely to carry anchors that could penetrate to the Project cable burial depth if anchoring in an emergency scenario in the vicinity of the ECC (Sharples 2011). For comparison, 2019 AIS data indicates the average passenger or pleasure vessel in the geographic analysis area is less than 1,000 DWT (COP Appendix X, Figure 2-28; Mayflower Wind 2022). However, anchor penetration is dependent upon factors other than ship size and anchor weight, such as the type of soil on the seabed and whether the anchor is dragged after the initial drop (Sharples 2011). Mayflower Wind has conducted a Cable Burial Risk Assessment to calculate the target cable lowering depth to minimize risks to the offshore export cables from damage, and to mitigate potential conflicts between commercial or recreational fishermen and the new structure (COP Volume 2, Section 11.2.3.2; Mayflower Wind 2022). To minimize conflicts between fishing gear and the proposed Project's interarray and offshore export cables, the interarray cables would be buried at a target depth of 3.2 to 8.2 feet (1.0 to 2.5 meters), and the offshore export cables would be buried at a target depth of 3.2 to 13.1 feet (1.0 to 4.0 meters). A cable burial depth targeted at 5 to 6 feet (1.5 to 1.8 meters) has resulted in cable interactions approaching zero incidents, based on observations in the U.S. telecommunications industry since 2000 (North American Submarine Cable Association 2019).

If sufficient burial depth cannot be achieved, armoring or other cable protection would be used to protect cables from external damage. Cable protection methods may include rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers (COP Volume 1, Section 3.3.5.3; Mayflower Wind 2022). In the event an anchor does make contact with a buried export cable, impacts could include damage to the export cable and potential damage to the vessel anchor and/or anchor chain. Depending on the extent of the damage to the export cable the risks associated with an anchor contacting an electrified cable can pose issues to Project equipment (an overload and shut-down of converter or transformer stations) but is not going to cause electrical shock to the ship involved since seawater is a good conductor of electricity (Sharples 2011). If the export cable is damaged to the point of requiring repair, there could be impacts associated with additional vessel activity to conduct damage assessment and repair. Secondary impacts are repercussions on the vessel operator's liability and insurance. Combined with the low likelihood that any anchoring would occur in an emergency scenario, impacts on navigation and vessel traffic would be negligible.

Port utilization: The Proposed Action is considering multiple ports for marshalling during construction including New London, Connecticut; Providence, Rhode Island; New Bedford and Salem, Massachusetts; Port of Virginia, Virginia; and ports in Canada. The Ports of New Bedford and Fall River, Massachusetts would be the most likely ports for O&M activity. The Proposed Action would generate trips by support vessels, such as crew transports vessels, hotel vessels, tugs, and miscellaneous vessels, which would increase congestion at ports, especially during construction and decommissioning. Construction of the Proposed Action would generate on average 15 to 35 vessels (with a maximum peak of 50 vessels) operating in the Wind Farm Area or over the offshore ECC route at any given time (COP Volume 1, Table 3-21; Mayflower Wind 2022). On average, the Proposed Action would generate approximately one to three vessel trips per day between the Lease Area and ports during regular operations. The presence of these vessels could cause delays for non-Proposed Action vessels and could cause some fishing or recreational vessel operators to change routes or use an alternative port. The Proposed Action's impacts on vessel traffic due to port utilization would be moderate, short term, and continuous through construction and installation. During O&M, impacts would be minor, long-term, and intermittent. Impacts would increase to moderate for decommissioning comparable to construction and installation impacts.

Presence of structures: The Proposed Action would include up to 147 WTGs and 5 OSPs, for up to 149 structure positions, operating for approximately 35 years in the Wind Farm Area where no such structures currently exist. The 149 positions would conform to a 1-nautical-mile-by-1-nautical-mile (1.9-kilometers-by-1.9-kilometers) grid layout with an east–west and north–south orientation across the entire Massachusetts and Rhode Island lease areas, as agreed upon by Mayflower Wind and other leaseholders. This uniform grid pattern and spacing is consistent with recommendations in the MARIPARS final report concerning WTG layout (USCG 2020) and minimizes the risks of vessel accidents and space use conflicts in the Wind Farm Area.

Proposed Action structures would increase the risk of allision, as well as collision with other vessels navigating through WTGs and could interfere with marine radars (although other navigation tools are available to ship captains). Nearly all vessels that travel through the Wind Farm Area would need to navigate with greater caution under the Proposed Action to avoid WTGs and OSPs; however, there would be no restrictions on use or navigation in the geographic analysis area. WTGs with lighting and marking could serve as additional aids to navigation. Mayflower Wind intends to submit requests to USCG for up to 149 PATONs, one for each of the WTG or OSP positions. Many vessels that currently navigate that area would continue to be able to navigate through the geographic analysis area safely. Vessels that exceed a height of 53.8 feet (16.4 meters) would be at risk of alliding with WTG blades at mean high water, and would need to navigate around the Wind Farm Area or navigate with caution through the Wind Farm Area to avoid the WTGs. Cargo/carrier, tanker, cruise ships, and tug vessels are anticipated to choose routes around the turbine array (COP Appendix X, Section 2.3; Mayflower Wind 2022).

While some non-Project vessel traffic may navigate through the Project area, many vessels would most likely choose not to pass through the area during construction (due to the presence of construction-related activities and the emergence of fixed structures), during the life of the Project (due to the presence of fixed structures), and during decommissioning. NSRA modeled the frequency of marine accidents under the Proposed Action assuming there would be a rerouting of common vessel traffic routes around the Wind Farm Area for cargo/carrier, tankers, passenger (cruise ships), and tugs. NSRA assumed that other vessel types, including fishing, pleasure and other vessels, would not reroute around the Wind Farm Area. The primary increase in marine accidents (derived by comparing future-case with base-case vessel traffic conditions) related to the presence of structures would be due to drift allision, resulting in an increase of 0.215 accident per year, and powered allision, resulting in an increase in 0.138 accident per year (COP Appendix X, Table E-40; Mayflower Wind 2022). The estimated increase in allision accident frequency is attributed to those vessel types that would not reroute around the Project area (fishing, other, and pleasure). Cargo, tugs, and tankers would experience only a minor increase in allision frequency. NSRA estimates there would be a slight increase of 0.4 SAR missions per year in the Project area. Because the Proposed Action would adhere to a uniform 1-nautical-mile-by-1-nautical-mile grid pattern and the markings/lightings on structures would assist with position reporting for SAR responders, impacts on SAR missions would be long term and moderate.

O&M of the Proposed Action would likely affect marine vessel radar performance near or within the Wind Farm Area. National Academies of Sciences, Engineering, and Medicine (2022) notes that WTG interference decreases the effectiveness of marine vessel radar mounted on all vessel classes. There is currently no standard system of active radar tailored to a WTG environment. Smaller vessels operating in the vicinity of the Project may experience the same challenges as larger vessels if equipped with marine vessel radar, such as clutter due to the WTGs or ambiguous detections, and may also be harder to identify as distinct targets or become lost contacts by larger vessels while in the proximity of WTGs (National Academies of Sciences, Engineering, and Medicine 2022). While radar is one of several navigational tools available to vessel captains, including navigational charts, GPS, and navigation lights mounted on the WTGs, radar is the main tool used to help locate other nearby vessels that are not otherwise visible particularly in adverse weather when visibility is limited. The navigational complexity of transiting through the Wind Farm Area, including the potential effects of WTGs and OSPs on marine radars, would increase risk of collision with other vessels (including non-Project vessels and Proposed Action vessels). Overall, the Proposed Action would have a long-term, continuous, moderate impact on navigation and vessel traffic.

Cable emplacement and maintenance: The Proposed Action would require the installation of offshore export cables and interarray and substation interconnector cables (COP Volume 1, Table 3-14; Mayflower Wind 2022). The presence of slow-moving (or stationary) installation or maintenance vessels would increase the risk of collisions and spills. Offshore export cable installation activities include site preparation, such as sand wave and boulder clearance. In areas where sand waves are present, multiple passes may be required. Vessels engaged in cable emplacement are, by definition, restricted in their ability to maneuver and other power-driven vessels must give way.[4] Cable-laying vessels would display lights at nighttime, or day shapes during the daytime to communicate with other vessels that they are restricted in their ability to maneuver. USCG "Local Notice to Mariners" may also include information affecting local waterways, such as cable emplacement activity. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes or avoid installation or maintenance areas entirely during installation and maintenance activities. Depending on the exact route of the Falmouth and Brayton Point offshore export cables within the proposed corridors, cable-installation activities may temporarily affect private and federal aids to navigation. Mayflower Wind has committed to implementing construction safety zones for offshore export cable installation in consultation with the USCG, which would include consulting in regard to potential impacts on aids to navigation. Installation and maintenance of submarine cables would have minor to moderate, localized, short-term, intermittent impacts on navigation and vessel traffic.

Traffic: Construction of the Proposed Action could generate between 15 and 35 vessels operating in the Lease Area or over the offshore export cable route at any given time (COP Volume 1, Table 3-21; Mayflower Wind 2022). Various vessel types would be deployed throughout the Offshore Project area

[4] International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS), rules 3, 18, and 27.

during the construction and installation phase, increasing the risk of allisions and collisions. During offshore export cable route construction, non-Project vessels required to travel a more restricted (narrow) lane could potentially experience greater delays waiting for cable-laying vessels to pass. Non-Project vessels transiting between the Proposed Action ports and the Project area would be able to avoid Proposed Action vessels, components, and any safety zones (where USCG is authorized and elects to establish such zones)[5] through routine adjustments to navigation. The Proposed Action's construction and installation vessel traffic would have moderate, localized, short-term impacts on overall navigation and vessel traffic in opens waters and near ports.

Operation of the Proposed Action would generate approximately one to three trips per day from O&M ports to the Wind Farm Area. Vessel traffic generated by the Proposed Action could restrict maneuvering room and cause delays accessing the port. Although vessel traffic in the Lease Area is expected to decrease once the WTGs and OSPs are in place, O&M of the Proposed Action would result in the same types of vessel traffic and navigation impacts as those described during construction. Operation of the Proposed Action would have minor, long-term, intermittent, and localized impacts on overall navigation and vessel traffic near ports and in open waters.

The NSRA risk modeling suggests that under the Proposed Action, accident frequency would increase by 0.357 marine incident per year, an average of 1 additional accident every 2.8 years (COP Appendix X, Section 11.1-1; Mayflower Wind 2022). Marine accidents involving fishing vessels represent 70 percent of the increase (Table 3.6.6-3). The increase in accident frequency represents all accidents, including accidents with small and zero consequence, such as bumping into a Project structure while drifting.

Table 3.6.6-3. NSRA modeled change in accident frequencies from the Proposed Action

Vessel Type	Increase in Frequency (number per year)	Percentage of Total (%)
Cargo/Carrier	0.012	3.4
Fishing	0.248	69.5
Other/Undefined	0.057	16.0
Passenger	0.003	0.9
Pleasure	0.029	8.1
Tanker	0.002	0.5
Tanker - Oil	0.005	1.4
Tug/Service	0.001	0.2
Total	**0.357**	**100**

Source: COP Appendix X, Table ES-1; Mayflower Wind 2022.

[5] Under the current captain of the Port Authority, USCG does not regulate the safety and security risks associated with the construction and operation of Offshore Renewable Energy Installations beyond 12 nm (USCG 2021b).

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities and ongoing and planned offshore wind activities. Ongoing and planned non-offshore wind activities related to marine transportation, military use, NMFS activities and scientific research, and fisheries use and management would contribute to impacts from increased vessel traffic, adding to congestion in waterways and increasing the potential for maritime accidents. The construction, O&M, and decommissioning of offshore wind activities would contribute to impacts on navigation and vessel traffic through the primary IPFs of anchoring, port utilization, presence of structures, cable emplacement and maintenance, and traffic.

The combined impacts of the Proposed Action and other ongoing and planned offshore wind activities on navigation and vessel traffic from anchoring would be short term and minor due to the small size of the offshore wind lease areas compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario.

Other offshore wind projects would generate comparable types and volumes of vessel traffic in ports and would require similar types of port facilities as the Proposed Action. In the geographic analysis area, the Proposed Action could overlap in construction with 10 other offshore wind projects in 2024 and 2025. The increase in port utilization due to other offshore wind project vessel activity would be limited during construction and installation of the Proposed Action. It is unlikely that all projects would use the same ports; therefore, the total increase in vessel traffic would likely be distributed across multiple ports in the region. However, there could be delays for vessels using those ports if two or more projects are under construction at the same time. Accordingly, combined port utilization impacts on navigation and vessel traffic from ongoing and planned activities, including the Proposed Action, would be continuous and moderate.

The construction of 1,048 structures under the Proposed Action and the other offshore wind projects in the geographic analysis area would increase the navigational complexity in the region, resulting in an increased risk of collisions and allisions and overall moderate impacts. The presence of neighboring offshore wind projects could affect demand for USCG SAR operations by changing vessel traffic patterns and densities. However, all Massachusetts and Rhode Island lease areas would conform to the same 1-nautical-mile-by-1-nautical-mile grid pattern recommended by the USCG MARIPARS report, which would provide a standard layout for vessels and SAR operations to navigate between lease areas and minimize overall impacts on navigation.

Cable installation and maintenance for other offshore wind activities would generate comparable types of impacts to those of the Proposed Action for each offshore export cable route and interarray and interconnector cable system. Simultaneous construction of export and interarray cables of other offshore wind projects would have an additive effect, although it is assumed that installation vessels would only be present above a portion of a project’s cable system at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export and interarray cable installation activities for other offshore wind project. The combined impacts from ongoing and planned activities, including the Proposed Action, on navigation and vessel traffic from cable installation and maintenance would be localized, short term, intermittent, and minor.

Other offshore wind projects in the geographic analysis area would contribute similar impacts from increased vessel traffic associated with construction and operation. Construction of the Proposed Action would overlap with the construction of 10 other offshore wind projects. During peak construction activity between 2024 and 2025, the Proposed Action and other projects could generate between 165 and 385 vessels operating in and near the geographic analysis area. Following construction, up to 13 offshore wind projects, including the Proposed Action, could operate in the geographic analysis area and generate 39 vessel trips per day. Traffic from these projects would likely be spread among multiple ports within and outside of the geographic analysis area for navigation and vessel traffic, thus potentially moderating the effect of offshore wind-related vessel traffic at any single location. The contribution of the Proposed Action to vessel traffic impacts from ongoing and planned activities would be moderate, localized, short term, and intermittent.

Conclusions

Impacts of the Proposed Action: Construction and installation, O&M, and decommissioning of the Proposed Action would have adverse impacts on navigation and vessel traffic. The impacts of the Proposed Action alone on navigation and vessel traffic would be **negligible** to **moderate**. Impacts on non-Project vessels would include changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions in the Wind Farm Area, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would avoid the Wind Farm Area altogether, leading to potential congestion of vessel traffic along the Project area borders.

Cumulative Impacts of the Proposed Action: In context of reasonably foreseeable environmental trends, the combination of the Proposed Action and other ongoing and planned activities would result in **negligible** to **moderate** impacts on navigation and vessel traffic. The main IPF is the presence of structures, which would increase the risk of collision/allision and navigational complexity, particularly when adjoining offshore wind projects do not share a common WTG layout or spacing and do not include a separation between adjoining lease areas.

3.6.6.6 Impacts of Alternative C on Navigation and Vessel Traffic

Impacts of Alternative C: Routing the Brayton Point offshore export cable onshore to avoid sensitive fish habitat in the Sakonnet River under Alternatives C-1 and C-2 would slightly reduce the impacts on navigation and vessel traffic from between 9 and 12 fewer miles of cable installation activities, respectively. In the narrow navigable waterway of the Sakonnet River, this would reduce the potential for collisions with slow-moving cable-laying vessels, but any reduction in impacts would be temporary during installation and would not change the overall impact magnitude. Alternatives C-1 and C-2 would also avoid potential impacts on aids to navigation in the Sakonnet River, but any impacts from cable installation would be reduced or avoided through consultation with USCG, regardless of alternative, so impacts would not be meaningfully different between the Proposed Action and Alternatives C-1 or C-2.

Whereas the Alternative C-1 export cables would exit Aquidneck Island into Mount Hope Bay following the same route as the Proposed Action, the Alternative C-2 export cables would enter Mount Hope Bay on the east side of the Sakonnet River from Tiverton, Rhode Island. In Mount Hope Bay, Alternative C-2 would cross the Fall River Harbor Federal Navigation Channel in three locations (Figure 3.6.6-3). Federal navigation channels are waterways maintained by the USACE to allow vessels to transit confined nearshore areas and use ports or harbors. The vessel traffic in this area of the Fall River Harbor Federal Navigation Channel comprises primarily of shallow draft vessels including passenger and pleasure. Alternative C-2 would result in temporary disruption to vessels transiting the channel during the construction and installation phase and when maintenance activities are required during the O&M phase. In the event that USACE needs to conduct dredging operations in the channel, the cable placement and burial depth would need to be verified and considered prior to commencing operations. Crossing the federal navigation channel under Alternative C-2 would increase short- and long-term impacts compared to the Proposed Action, but the overall impact magnitude on navigation and vessel traffic is anticipated to be the same.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives C-1 and C-2 would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternative C: Alternative C-1 would avoid installing offshore export cable in the Sakonnet River, which would slightly reduce but not change the overall **negligible** to **moderate** impact on navigation and vessel traffic compared to the Proposed Action. Alternative C-2 would also avoid installing offshore export cable in the Sakonnet River but would increase navigational impacts from crossing the Fall River Harbor Federal Navigation Channel. Impacts from Alternative C-2 would remain **moderate**.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives C-1 and C-2 would result in the same **negligible** to **moderate** impacts on navigation and vessel traffic as the Proposed Action.

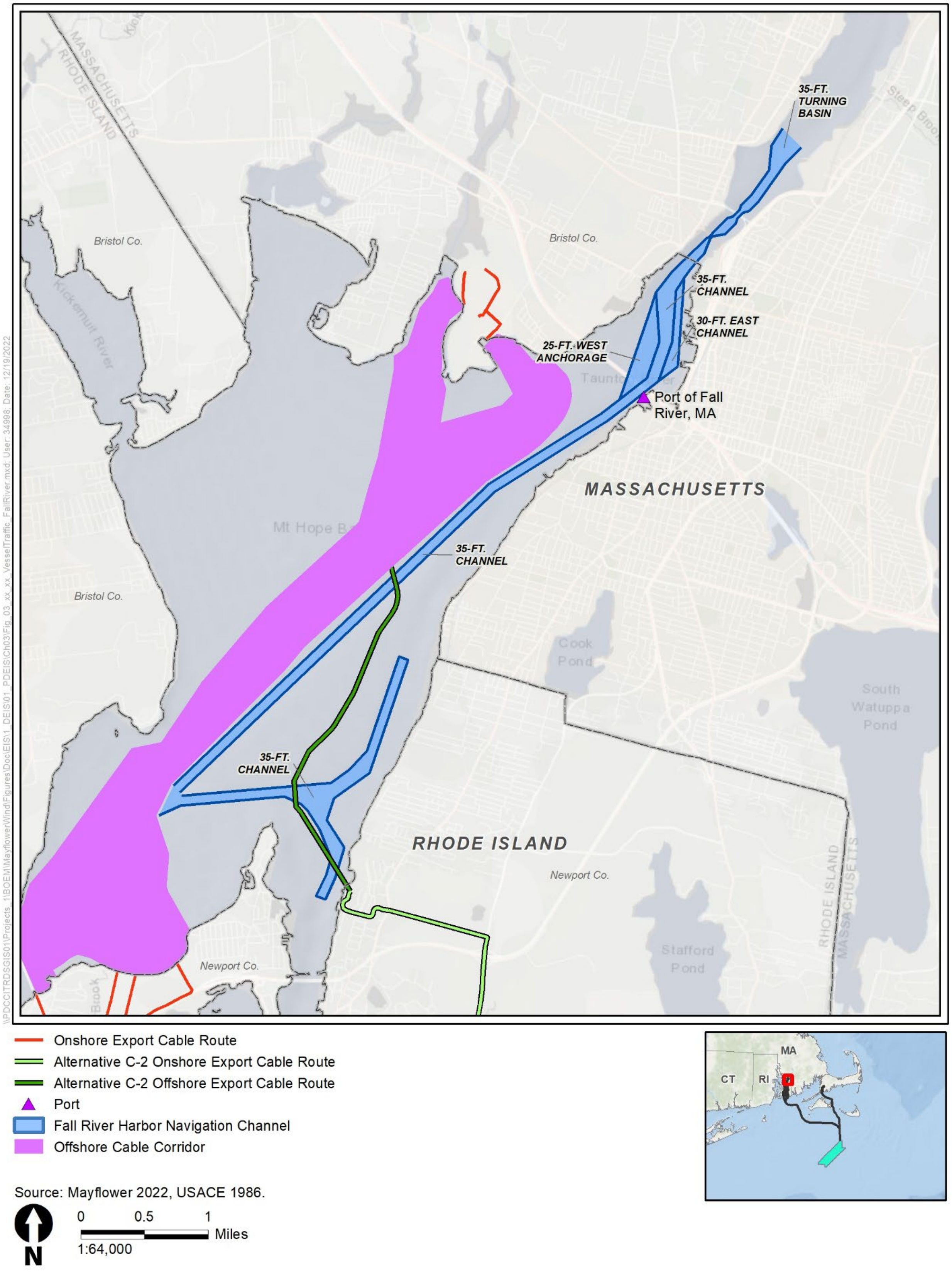

Figure 3.6.6-3. Alternative C-2 and the Fall River Harbor Federal Navigation Channel

3.6.6.7 Impacts of Alternatives D, E, and F on Navigation and Vessel Traffic

Impacts of Alternatives D, E, and F: The reduction in the number of WTGs under Alternative D, the use of specific foundation types under Alternative E, and the modifications to the offshore export cable routes under Alternative F would result in similar impacts as the Proposed Action on navigation and vessel traffic. Alternative D would exclude up to six WTGs in the northeast portion of the Lease Area nearest to Nantucket Shoals. Based on the 1-nm-by-1-nm spacing of the Lease Area, this 4 percent reduction in WTGs would leave up to 1.5 nm of open ocean at the edge of the Lease Area, which represents a small portion of the 25.5-nm length of the Lease Area (at its longest point). The WTG locations in Alternative D would incrementally decrease impacts on vessel traffic compared to the Proposed Action by providing additional space closer to Nantucket Shoals and coastal areas, which are more frequently used by fishing and recreational vessels. While Alternative D would decrease impacts on navigation and vessel traffic, it would not change the overall impact magnitudes described for the Proposed Action.

Under Alternative E, piled, suction bucket, and GBS foundations would be installed, respectively, which may slightly change the duration of foundation construction and the number of vessels, but any differences would be small and last only for the duration of construction. The overall impact on navigation and vessel traffic from the long-term presence of structures under Alternative E would not be substantively different than the Proposed Action. Under Alternative F, up to three cables would be used for the Falmouth offshore export cable, as opposed to the maximum of five cables proposed under the PDE. This may result in a slight reduction in cable-laying vessel construction activity, but overall impacts would be similar to those of the Proposed Action.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, cumulative impacts of Alternatives D, E, and F would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternatives D, E, and F: Alternatives D, E, and F would result in the same **negligible** to **moderate** impacts on navigation and vessel traffic compared to the Proposed Action. By reducing the number of WTGs in the northeast portion of the Lease Area, Alternative D would slightly reduce, but not change, the overall impact level on navigation and vessel traffic compared to the Proposed Action. The required use of specific foundation types under Alternative E would result in similar impacts as the Proposed Action. The reduction in the number of Falmouth offshore export cables under Alternative F would not have a meaningful difference in impacts compared to the Proposed Action.

Cumulative Impacts of Alternatives D, E, and F: In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternatives D, E, and F would result in the same **negligible** to **moderate** impacts on navigation and vessel traffic as the Proposed Action.

3.6.6.8 Proposed Mitigation Measures

The following mitigation measures are proposed to minimize impacts on navigation and vessel traffic (Appendix G, Table G-2). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts would be further reduced.

- **Consult on aid to navigation impacts.** Prior to cable installation, Mayflower Wind would consult with the USCG regarding potential impacts on federal aids to navigation from cable installation and maintenance.
- **Operations Center.** Mayflower Wind would operate a 24-hour manned operations center with direct communications with the USCG.
- **Mariner Communication and Outreach Plan.** Mayflower Wind would develop and implement a Mariner Communication and Outreach Plan that covers all Project phases from pre-construction to decommissioning and that facilitates coordination with all mariners, including the commercial shipping industry, commercial and for-hire fishing industries, and other recreational users.

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

3.6 Socioeconomic Conditions and Cultural Resources

3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

This section discusses potential impacts on other uses not addressed in other portions of the EIS, including marine minerals, military use, aviation, cables and pipelines, radar systems, and scientific research and surveys that would result from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis areas for other uses (marine minerals, military use, aviation, scientific research, and surveys) are described below and shown on Figure 3.6.7-1.

- Aviation and air traffic, military and national security, and radar systems: Areas within 10 miles (16.1 kilometers) of the Mayflower Wind export cable corridors and Lease Area and the nearby Massachusetts and Rhode Island lease areas, as well as Nantucket Memorial Airport on Nantucket; Katama Airfield, Trade Wind Airport, and Martha's Vineyard Airports on Martha's Vineyard; Newport State Airport on Aquidneck Island, Rhode Island; Quonset State Airport in Rhode Island; Falmouth Airport, New Bedford Regional Airport, and Westport Airport in Massachusetts (Figure 3.6.7-1).
- Cables and pipelines: Areas within 1 mile (1.6 kilometers) of the export cable corridors and Lease Area that could affect future siting or operation of cables and pipelines (Figure 3.6.7-1).
- Scientific research and surveys: Same analysis area as finfish, invertebrates, and essential fish habitat (Section 3.5.5, Figure 3.5.5-1).
- Marine minerals: Areas within 0.25 mile (0.4 kilometer) of the export cable corridors and Lease Area that could affect marine minerals extraction (Figure 3.6.7-1).

3.6.7.1 Description of the Affected Environment and Future Baseline Conditions

Marine Mineral Extraction

BOEM's Marine Mineral Program manages non-energy minerals, primarily sand and gravel, on the OCS and leases access to these resources to target shoreline erosion, beach renourishment, and restoration projects. At this time, there are no active or requested BOEM marine mineral leases offshore Massachusetts or Rhode Island (BOEM 2022). The closest active lease is offshore New Jersey, approximately 170 miles (273.6 kilometers) east of the Massachusetts Wind Energy Area (BOEM 2022).

USEPA Region 1 is responsible for designating and managing ocean disposal sites in the region of the Project, except for dredged material, which is the responsibility of USACE. While there are active and permitted dredged disposal sites in the region, there are no ocean dredged disposal sites in the geographic analysis area (USACE 2022). See Appendix D, *Planned Activities Scenario* for more information on planned marine mineral use and ocean dredged material disposal in the vicinity of the Project but outside the geographic analysis area.

National Security and Military Uses

Major onshore military uses in the region revolve around several naval bases, including Naval Station Newport in Rhode Island, which hosts U.S. Marine Corps, USCG, and U.S. Army Reserve commands and activities, such as research, development, test and evaluation, engineering, and fleet support for submarines, autonomous underwater systems, and offensive and defensive weapons systems for undersea warfare (CRMC 2010). Other military bases in the region include Naval Submarine Base New London, Connecticut; Portsmouth Naval Shipyard, Maine/New Hampshire; Naval Weapons Station Earle, New Jersey; Joint Base Cape Cod, Massachusetts; and Newport Naval Undersea Warfare Center, Rhode Island. USCG District 1 is responsible for responding to SAR incidents for both air and sea assets in the Lease Area in proximity to the Sector Southeastern New England area of responsibility, including Air Station Cape Cod and applicable Sector Command centers in the Northeast region.

The U.S. Atlantic Fleet conducts training and testing exercises in the Northeast Range Complex for the Navy. The Northeast Range Complex includes the Boston, Atlantic City, and Narraganset Bay Operating Areas. The Lease Area and a section of the offshore export cable corridors overlap with the Narraganset Bay Operating Area, which extends approximately 180 nautical miles (333 kilometers) from the coasts of Massachusetts, Rhode Island, and New York. Additionally, the Lease Area overlaps with the Navy Undersea Test and Evaluation Center, an area used for research, development, testing, and evaluation of undersea warfare systems to support Navy and Department of Defense (DoD) operations. Naval vessels occasionally transit in the vicinity of the Lease Area; however, they are not involved in range activity in proximity to the Lease Area (Mayflower Wind 2022). Offshore, special use airspace warning area W-105A overlies the Lease Area. Onshore, restricted area R-4101 overlies a portion of Joint Base Cape Cod, Massachusetts called Camp Edwards, and extends from the surface level to 9,000 feet MSL.

Two danger zone/restricted areas, areas used for munitions testing where public access is prohibited or limited due to use by the U.S. government, are within the geographic analysis area in waters surrounding Norman’s Land Island. Danger Zone 33.4.80(a) is located approximately 4.2 nautical miles (7.8 kilometers) southeast of the Brayton Point export cable corridor and Danger Zone 167.103 is located approximately 3.3 nautical miles (6.11 kilometers) east of the Brayton Point export cable corridor. Activities in the danger zones or restricted areas are not expected to have regular interaction with the Project area. Additionally, the Brayton Point export cable corridor intersects with a land-based formerly used defense site that extends into the Sakonnet River. The formerly used defense site status is listed as complete and closed out (USACE 2019).

Military activities are anticipated to continue to use onshore and offshore areas in the vicinity of the Project area into the future and may involve routine and non-routine activities.

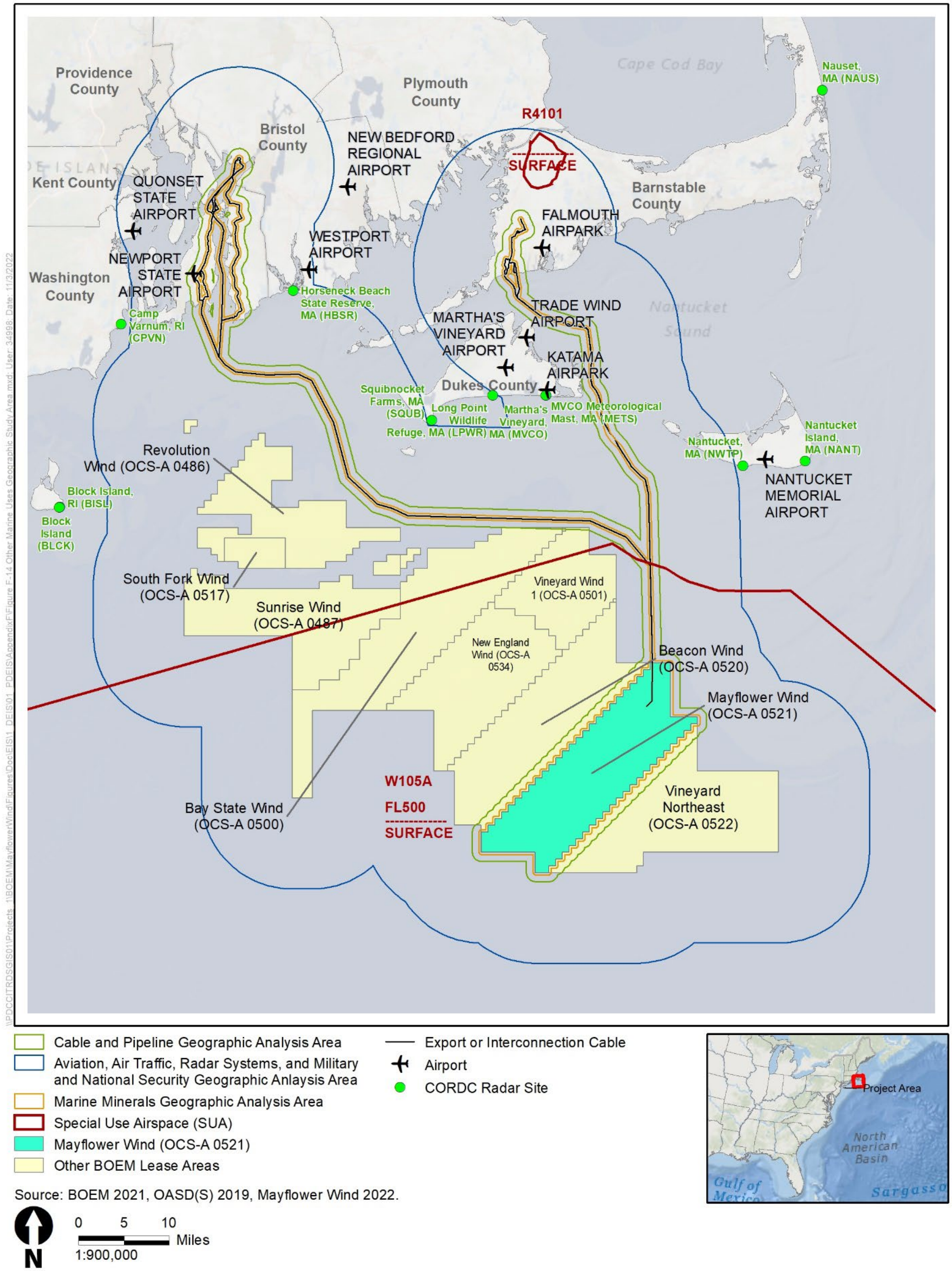

Figure 3.6.7-1. Other uses geographic analysis area

Aviation and Air Traffic

Multiple public and private-use airports serve the region surrounding the Project area including the Nantucket Memorial Airport on Nantucket; Katama Airfield, Trade Wind Airport, and Martha's Vineyard Airports on Martha's Vineyard; Newport State Airport on Aquidneck Island, Rhode Island; Quonset State Airport in Rhode Island; Falmouth Airport, Westport Airport, and New Bedford Regional Airport in Massachusetts.

The Obstruction Evaluation and Airspace Analysis completed for the Project indicates there are no visual flight rules for traffic pattern airspace, expected visual flight rules routes, instrument departure procedure obstacle clearance surfaces, or low altitude enroute airway obstacle clearance surfaces overlying the Lease Area (COP Appendix Y1; Mayflower Wind 2022). Air traffic is expected to continue at current levels in and around the Wind Farm Area.

Cables and Pipelines

No existing cables or submarine pipelines were identified in the Lease Area. In the Falmouth export cable corridor, there are up to two expected crossings of existing cables and up to seven anticipated crossings of planned cables. Cables would intersect with the Falmouth export cable corridor at two crossing locations: one south of the Muskeget Channel and one between Martha's Vineyard and Falmouth. For the Brayton Point export cable corridor, up to seven planned cables are expected to be crossed south of the Muskeget channel, up to four planned cables are anticipated to be crossed south of Nomans Island, and up to two planned cables are expected to be crossed south of the Sakonnet River, for a total of up to 13 crossings of planned cables. Additionally, the Brayton Point export cable corridor would cross three existing pipelines in the Sakonnet River.

Beyond the planned cables identified above and cables for other offshore wind projects, BOEM has not identified any additional publicly noticed plans for planned submarine cables or pipelines in the geographic analysis area.

Radar Systems

Commercial air traffic control, national defense, and weather radar systems currently operate in the region. Six DOD national defense and FAA air traffic control radar sites are in the vicinity of the Project area:

- Boston Airport Surveillance Radar-9 (ASR-9) and co-located Boston Air Traffic Control Beacon Interrogator-6.
- Falmouth Airport Surveillance Radar-8 (ASR-8)
- Nantucket ASR-9
- North Truro Air Route Surveillance Radar-4 (ARSR-4)

- Providence ASR-9
- Riverhead ARSR-4

Five high frequency radar sites used by NOAA and other agencies are in the vicinity of the Project area:

- Amagansett High Frequency radar
- Block Island High Frequency radar
- Martha's Vineyard High Frequency radar
- Nantucket High Frequency radar
- Nauset High Frequency radar

Two omnidirectional range (VOR) NAVAIDS and co-located distance measuring equipment (DME) are in the vicinity of the Project area:

- Martha's Vineyard VOR/DME
- Nantucket VOR/DME

Additionally, two Next Generation Weather radar sites are in the vicinity of the Project area:

- Boston Weather Surveillance Radar 1988 Doppler (WSR-88D)
- Brookhaven WSR-88D

Most of the Lease Area is within the line of sight of long-range radar systems used by the DoD and Department of Homeland Security for air defense and homeland security, including the Early Warning Radars at Cape Cod Air Force Station, Massachusetts, used for ballistic missile defense and space surveillance.

The high-frequency radars are used by the NOAA Integrated Ocean Observing System (IOOS) as part of its Surface Currents Program. Surface current data collected is used by the Coast Guard's Search and Rescue Optimal Planning System (SAROPS), a decision-support tool that uses ocean observations to narrow search areas.

Existing radar systems will continue to provide weather, navigational, and national security support to the region. The number of radars and their coverage area are anticipated to remain at current levels for the foreseeable future.

Scientific Research and Surveys

Research in the geographic analysis area includes oceanographic, biological, geophysical, and archaeological surveys focused on the OCS and nearshore environments and resources that may be affected by offshore wind development. Federal and state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing offshore research in the Wind Farm Area and surrounding waters.

The following current fisheries management and ecosystem monitoring surveys conducted by or in coordination with the NMFS NEFSC could overlap with offshore wind lease areas in the Mid-Atlantic region.

- NEFSC Bottom Trawl Survey, a more than 50-year multispecies stock-assessment tool using a bottom trawl.
- NEFSC Sea Scallop/Integrated Habitat Survey, a sea scallop stock-assessment and habitat-characterization tool, using a bottom dredge and camera tow.
- NEFSC Surfclam/Ocean Quahog Survey, a stock-assessment tool for both species using a bottom dredge.
- NEFSC Ecosystem Monitoring Program, a more than 40-year shelf-ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units.
- Atlantic Marine Assessment Program for Protected Species shipboard and aerial surveys.
- North Atlantic Right Whale Sighting Advisory System aerial survey (BOEM 2021).

These surveys support management of more than 40 fisheries in the region, more than 30 marine mammal species, and 14 threatened and endangered species (Hare et al. 2022). Additionally, these surveys support numerous other science products produced by NOAA Fisheries, including ecosystem and climate assessments.

As offshore wind development continues, alternative platforms, sampling designs, and sampling methodologies could be needed to maintain surveys conducted in or near the Project area.

3.6.7.2 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)

Impact level definitions for other uses are provided in Table 3.6.7-1.

Table 3.6.7-1. Impact level definitions for other uses

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Impacts on the affected activity would be avoided, and impacts would not disrupt the normal or routine functions of the affected activity. Once the Project is decommissioned, the affected activity would return to a condition with no measurable effects.
Moderate	Adverse	Impacts on the affected activity would be unavoidable. The affected activity would have to adjust to account for disruptions due to impacts of the Project, or, once the Project is decommissioned, the affected activity could return to a condition with no measurable effects if proper remedial action is taken.
Major	Adverse	The affected activity would experience unavoidable disruptions to a degree beyond what is normally acceptable, and, once the Project is decommissioned, the affected activity could retain measurable effects indefinitely, even if remedial action is taken.

3.6.7.3 Impacts of Alternative A – No Action on Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)

When analyzing the impacts of the No Action Alternative on Other Uses, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for other uses. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario.*

Impacts of the No Action Alternative

Under the No Action Alternative, marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities in the geographic analysis area that would contribute to impacts on other uses would generally be associated with offshore developments and climate change. The ongoing offshore wind activities in the geographic analysis area for marine minerals, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems include the Vineyard Wind 1 project in lease area OCS-A 0501 and South Fork Wind Farm in lease area OCS-A 0517. Impacts from ongoing construction of these projects would be similar to those described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity. The geographic analysis area for scientific research and surveys includes Block Island Wind Farm offshore Rhode Island and CVOW Pilot Project offshore Virginia, in addition to the Vineyard Wind 1 project and South Fork Wind Farm.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

No offshore developments, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified (see Appendix D, Section D.2, for a complete description of planned activities). In addition to the ongoing offshore wind activities identified above, other planned offshore wind activities in the geographic analysis area for other uses include the construction, O&M, and decommissioning of the Revolution Wind project in lease area OCS-A 0488, Sunrise Wind in lease area OCS-A 0487, Bay State Wind in lease area OCS-A 0500, New England Wind in lease area OCS-A 0534, Beacon Wind in lease area OCS-A 0520, and Vineyard Wind Northeast in lease area OCS-A 0522. The following sections summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on other uses during construction, O&M, and decommissioning of the projects.

BOEM expects other offshore wind development in the geographic analysis area to primarily affect other uses through the following IPFs.

Marine Mineral Extraction

Presence of structures: The demands for sand and gravel resources is expected to grow with increasing trends in coastal erosion, storm events, and sea level rise. There are no mineral leases, sand resource areas, borrow sites, or ocean disposal sites in the geographic analysis area. Offshore wind project infrastructure, including WTGs and transmission cables, could prevent future marine mineral extraction activities where the Project area overlaps with the extraction area. Marine mineral extraction typically occurs within 8 miles of the shoreline, limiting adverse impacts on the offshore export cable routes. Additionally, other offshore wind projects may be able to minimize impacts on existing and proposed borrow areas through consultation with the BOEM Marine Minerals Program and USACE before an offshore wind cable route is approved. The adverse impacts on sand and marine mineral extraction of offshore wind activities without the Proposed Action are anticipated to be negligible.

National Security and Military Uses

The offshore wind lease area geographic boundaries were developed through coordination with stakeholders to address concerns surrounding overlapping military and security uses. BOEM continues to coordinate with stakeholders to minimize these concerns, as needed.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area and include the meteorological buoys operated for offshore wind farm site assessment. Dock facilities and other structures are concentrated along the coastline. Installation of up to 901 WTGs as part of other offshore wind projects in the geographic analysis area would affect military and national security, including USCG SAR operations, primarily through increased risk in transiting the Lease Area due to the risk of allision with foundations and other stationary structures (USCG 2021). Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations or other non-typical activities. Smaller-draft vessels moving within or near the offshore wind facilities would have a higher risk of allision with the offshore wind structures. Wind energy structures would be lighted according to USCG and BOEM requirements at sea level to decrease allision risk. Allision risk would be further mitigated through coordination with stakeholders on WTG layouts to allow for safe navigation through the offshore wind lease areas in the geographic analysis area.

The construction of offshore wind projects in the geographic analysis area would incrementally change navigational patterns and would increase navigational complexity for vessels and military aircraft operating in the region around the wind energy projects. The structures associated with offshore wind energy may necessitate route changes to navigate around the offshore wind lease areas and vessels associated with the construction of a project. Military and national security aircraft would be affected by the presence of tall equipment necessary for offshore wind facility construction, such as stationary lift vessels and cranes, which would increase navigational complexity in the area. Additionally, military and national security operations conducted within the Northeast Range Complex, Narraganset Bay Operating Area, Navy Undersea Test and Evaluation Center, and special use airspace warning area W-105A would be affected during the construction and operation periods of offshore wind activities. It is assumed, however, that all offshore wind energy projects would coordinate with relevant agencies during the COP development process to identify and minimize conflicts with military and national security operations. Refer to Section 3.6.6, *Navigation and Vessel Traffic*, for additional discussion on navigation impacts in the offshore wind lease areas.

Once the WTGs are operational, the artificial reef effect created by the offshore structures could attract commercial and recreational fishing vessels farther offshore than currently, possibly leading to use conflicts. An increase in commercial and recreational vessels in and around offshore wind projects could increase the risk of vessel collisions with military and national security vessels and may lead to an increased demand for USCG SAR operations.

Potential measures mitigating risks that offshore wind projects could include operational protocols to stop WTG rotation during SAR aircraft operations and implementation of FAA- and BOEM-recommended navigational lighting and marking to reduce the risk of aircraft collisions. Wind energy structures would be visible on military and national security vessel and aircraft radar. Even if these mitigation measures were implemented, the presence and layout of large numbers of WTGs could make it more difficult for SAR aircraft to perform operations, leading to less-effective search patterns or earlier abandonment of searches. This could result in otherwise avoidable loss of life due to maritime incidents.

Navigational hazards would be eliminated as structures are removed during decommissioning. Due to anticipated coordination with agencies and the mitigation measures described above, the overall impacts on military and national security uses from offshore wind energy activities are anticipated to be minor, except for USCG SAR operations, which would have moderate adverse impacts.

Traffic: Impacts on military operations from vessel traffic related to the construction and operation of offshore wind activities on the OCS are expected to be short term, localized, and minor. Vessel traffic is expected to increase during construction. Construction periods for the planned offshore wind energy projects in the geographic analysis area are expected to overlap in 2025 to 2030, which would result in a cumulative impact on traffic volumes. Military and national security vessels may experience congestion and delays in ports due to the increase in vessels associated with offshore wind.

Aviation and Air Traffic

Presence of structures: Other offshore wind development could add up to 901 WTGs to the offshore environment in the nearby OCS. WTGs could have a maximum blade tip height of 1,171 feet (357 meters) AMSL. As these structures are built, aircraft navigational patterns and complexity would incrementally increase in the region around the offshore wind lease areas, along transit routes between ports and construction sites, and locally around ports. These changes could compress lower-altitude aviation activity into more limited airspace in these areas, leading to airspace conflicts or congestion and increasing collision risks for low-flying aircraft. After all foreseeable offshore wind energy projects are built, there would still be open airspace available over the open ocean. Navigational hazards and collision risks in transit routes would be reduced as construction is completed and would be gradually eliminated during decommissioning as offshore WTGs are removed.

All stationary structures would have aviation and navigational marking and lighting in accordance with FAA, USCG, and BOEM requirements and guidelines to minimize and mitigate impacts on air traffic. BOEM assumes that offshore wind projects would coordinate with aviation interests through the planning, construction, operation, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic. For this reason, the adverse impacts on aviation and airports are anticipated to be minor.

Cables and Pipelines

Presence of structures: Two existing submarine cables were identified between Martha's Vineyard and Falmouth, and three existing submarine pipelines have been identified in the Sakonnet River. The majority of the cables identified in the geographic analysis area are planned offshore export cables associated with other offshore wind projects. Up to 3,520 statute miles (5,667 kilometers) of submarine cables are expected to be installed for the projects in the geographic analysis area. The installation of WTGs and OSPs could preclude future submarine cable placement within the foundation footprint, which would cause future cables to route around these areas. In the majority of circumstances, the presence of existing submarine cables from these projects would not prohibit the placement of additional cables and pipelines. Following standard industry procedures, cables and pipelines can be crossed without adverse impact to existing cables or pipelines.

However, in locations where there are many existing and planned cables and pipelines, there reaches a saturation point where there is not sufficient accommodation space within possible offshore routes or at the shore approach where limited landfall locations exist. Impacts on submarine cables would be eliminated during decommissioning of offshore wind farms when foundations are removed and if the export and interarray cables associated with those projects are removed. Minor adverse impacts on existing cables and pipelines due to anticipated offshore wind projects are expected.

Installed WTGs and OSPs, and the stationary lift vessels used during construction of offshore wind energy project infrastructure, may pose allision or collision risks and navigational hazards to vessels conducting maintenance activities on these existing cables and pipelines. Risk to cable maintenance vessels during construction and operations of nearby offshore wind projects would be limited due to the infrequent submarine cable maintenance required at any single location along existing cable routes. Allision risks would be mitigated by navigational hazard markings per FAA, BOEM, and USCG requirements and guidelines. Risk of allision by cable maintenance vessels would decrease to zero after project decommissioning as structures are removed.

Radar Systems

Presence of structures: WTGs that are near to or in the direct line of sight of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal. Construction of other wind energy projects would add up to 901 WTGs with a maximum blade tip height of up to 1,171 feet (357 meters) AMSL in the geographic analysis area. The presence of wind energy infrastructure could lead to localized, long-term, moderate impacts on radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars. Most offshore wind structures would be sited at such a distance from existing and proposed land-based radar systems to minimize interference to most radar systems, but some impacts are anticipated.

For radar structures with a co-located secondary surveillance radar systems (including Falmouth ASR-8, North Truro ARSR-4, Riverhead ARSR-4, Boston ASR-9, Nantucket ASR-9, and Providence ASR-9), the secondary surveillance radar is the main source of aircraft identification and positional data for air traffic control. A Department of Homeland Security–funded study found that secondary radar tracks were rarely affected by wind turbines (JASON 2008). Additional flight trials by the Department of Energy, Department of Homeland Security, DoD, and FAA found that while primary surveillance radars were affected by wind turbines, beacon transponder-based secondary surveillance radars were not affected (Sandia National Laboratories, MIT Lincoln Laboratory 2014).

BOEM assumes that Project proponents would conduct an independent radar analysis and coordinate with FAA, NOAA, and DoD to identify potential impacts and any mitigation measures specific to aeronautical, military, oceanographic, and weather radar systems. BOEM would continue to coordinate with the Military Aviation and Installation Assurance Siting Clearinghouse to review each proposed offshore wind project on a project-by-project basis and would attempt to resolve project concerns identified through such consultation related to military and national security radar systems with COP approval conditions. Refer to Section 3.6.6, *Navigation and Vessel Traffic*, for a discussion of impacts on marine vessel radar.

Scientific Research and Surveys

Presence of structures: Construction of other wind energy projects between 2023 and 2030 in the geographic analysis area for scientific research and surveys would add up to 2,945 offshore wind structures, associated cable systems, and associated vessel activity that would present additional navigational obstructions for sea- and air-based scientific studies. Collectively, these developments would prevent NOAA from continuing scientific research surveys or protected species surveys under current vessel capacities, would affect monitoring protocols in the geographic analysis area, could conflict with state and nearshore surveys, and may reduce opportunities for other NOAA scientific research studies in the area. This EIS incorporates by reference the detailed summary of and potential impacts on NOAA's scientific research provided in the *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement* (Vineyard Wind 1 Final EIS) in, Section 3.12.2.5, *Scientific Research and Surveys* (BOEM 2021). In summary, offshore wind facilities actuate impacts on scientific surveys by precluding NOAA survey vessels and aircraft from sampling, impacts on the random-stratified statistical design that is the basis for assessments; alter benthic and pelagic habitats and airspace in and around the wind energy development, which would require new designs and methods to sample new habitats; and reduce sampling productivity through navigation impacts of wind energy infrastructure on aerial and vessel surveys. NOAA has determined that survey activities in offshore wind facilities are outside of safety and operational limits. Survey vessels would be required to navigate around offshore wind projects to access survey locations, leading to a decrease in survey precision and operational efficiency. The height of turbines would affect aerial survey design and protocols, requiring flight altitudes and transects to change. Scientific survey and protected species survey operations would, therefore, be reduced or eliminated as offshore wind facilities are constructed. If stock or population changes, biomass estimates, or other environmental parameters differ in the offshore wind lease areas but cannot be observed as part of surveys, resulting survey indices could be biased and unsuitable for monitoring stock status. Offshore wind facilities will disrupt survey sampling statistical designs, such as random-stratified sampling. Impacts on the statistical design of region-wide surveys violate the assumptions of probabilistic sampling methods. Development of new survey technologies, changes in survey methodologies, and required calibrations could help to mitigate losses in accuracy and precision of current practices caused by the impacts of wind development on survey strata.

Other offshore wind projects could also require implementation of mitigation and monitoring measures identified in their associated records of decision. Identification and analysis of specific measures are speculative at this time; however, these measures could further affect NOAA’s ongoing scientific research surveys or protected-species surveys because of increased vessel activity or in-water structures from these other projects. BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies as a result of offshore wind farms.

Overall, reasonably foreseeable offshore wind energy projects in the area would have major effects on NOAA’s scientific research and protected-species surveys, potentially leading to impacts on fishery participants and communities, as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

Conclusions

Impacts of the No Action Alternative: BOEM expects ongoing activities, including offshore wind development, to have continuing impacts on marine mineral extraction, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys, primarily through the presence of structures that introduce navigational complexities and vessel traffic.

BOEM anticipates that the impacts of ongoing activities on other uses would be **negligible** for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Military and national security use, aviation and air traffic, vessel traffic, commercial fishing, and scientific research and surveys are expected to continue in the geographic analysis area. Impacts of ongoing activities on scientific research and surveys are anticipated to be **major** for scientific research and surveys due to the impacts from ongoing offshore wind activity (e.g., Block Island Wind Farm).

Cumulative Impacts of the No Action Alternative: In addition to ongoing activities, BOEM anticipates that planned activities would contribute to impacts on other uses from increasing vessel traffic; residential, commercial, and industrial development onshore and along the shoreline; and development of FAA-regulated structures including cell towers and onshore wind turbines. BOEM anticipates that any issues with aviation routes or radar systems would be resolved through coordination with DoD or FAA, as well as through implementation of aviation and navigational marking and lighting of structures according to FAA, USCG, and BOEM requirements and guidelines. There are no planned offshore activities anticipated to affect marine mineral extraction or cable and pipeline infrastructure.

BOEM anticipates that the cumulative impact of the No Action Alternative would result in **negligible** impacts for marine mineral extraction; **minor** impacts for aviation and air traffic, and cables and pipelines; **moderate** for radar systems due to WTG interference; **minor** for most military and national security uses, except for USCG SAR operations, which would have **moderate** adverse impacts; and **major** for scientific research and surveys. The presence of stationary structures associated with ongoing and planned offshore wind energy projects could prevent or impede continued NOAA scientific research surveys using current vessel capacities and monitoring protocols or reduce opportunities for other NOAA scientific research studies in the area. Coordinators of large-vessel survey operations or operations deploying mobile survey gear have determined that activities in offshore wind facilities would not be within current safety and operational limits. In addition, changes in required flight altitudes due to the proposed WTG height would affect aerial survey design and protocols.

3.6.7.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on other uses:

- The number, size, location, and spacing of WTGs.
- Timing of offshore construction and installation activities.
- Location and route of offshore export cable corridor.

Variability of the proposed Project design exists as outlined in Appendix C. The following summarizes the potential variances in impacts.

- WTG size and location: Larger turbines closer to shore could increase impacts on land-based radar systems, movements of civilian and military aircraft, and military vessels.
- WTG spacing: Removal of groups of WTGs, creating spacing of greater than 1 nautical mile, could allow for scientific research and surveys in those areas, decreasing the impact.
- Timing of construction: Construction could affect submarine or surface military vessel activity during typical operations and training exercises.
- Offshore cable route options: The route chosen (including variants in the general route) could conflict with marine mineral extraction or cables and pipelines.
- Mayflower Wind has committed to measures to minimize impacts on other uses, which include, but are not limited to, complying with USCG, BOEM, and FAA marking and lighting guidelines, avoiding, minimizing, or mitigating effects on navigation by equipping all Project-related vessels and relevant infrastructure with the required navigation marking and lighting and day shapes, use of established

standard techniques for adequately protecting existing and newly installed cables, and liaising with the military and national security stakeholders to reduce potential conflicts (COP Volume 2, Table 16-1; Mayflower Wind 2022).

3.6.7.5 Impacts of Alternative B – Proposed Action on Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)

Marine Mineral Extraction

Presence of structures: Offshore wind project infrastructure, including WTGs and transmission cables, has the potential to prevent future marine mineral extraction activities where the footprint of the structures and cable corridors overlaps with the extraction area. Because there are no borrow areas, sand resource areas, or ocean disposal sites located in the vicinity of the Project, negligible impacts associated with construction, O&M, and decommissioning are anticipated.

National Security and Military Uses

Presence of structures: The addition of up to 149 substructures, supporting a combination of WTGs and OSPs, would increase the risk of allisions for military vessels during Project O&M, particularly during bad weather or low visibility, resulting in minor impacts on most national security and military uses. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG guidelines, and WTGs would be visible on military and national security vessel and aircraft radar, minimizing the potential for allision and increased navigational complexity. Additional navigational complexity would increase the risk of collision and allisions for military and national security vessels or aircraft in the Project area.

While warning Area W-105A overlies the entire Lease Area, it does not overlap any submarine transit lanes, torpedo exercise areas, danger zones or restricted areas (Mayflower Wind 2022). WTGs in this portion of the Lease Area may create conflicts with the U.S. Air Force and Navy Fleet Area Control and Surveillance Facility, Virginia Capes, or other units that use the airspace. Mayflower Wind has submitted an informal review request to the DoD in May 2020 and has agreed to continue to engage with the DoD and relevant agencies as the Project progresses. These coordination activities would ensure the Project is designed and operated in a manner that would minimize impacts on military use in the Project area to the extent feasible. Potential impacts on military operations from the permanent placement of structures within the water column and above the sea surface in the Wind Farm Area are expected to be long term and localized.

USCG SAR activities could be hindered in the Wind Farm Area due to navigational complexity and safety concerns of operating among WTGs. Changing navigational patterns could also concentrate vessels within and around the outsides of the Project area, potentially causing space use conflicts in these locations or reducing the efficiency of SAR operations, resulting in moderate adverse impacts on SAR operations. USCG may need to adjust its SAR planning and search patterns to accommodate the WTG layout, leading to a less optimized search pattern and a lower probability of success. This could lead to increased loss of life due to maritime incidents.

Additionally, construction of the Proposed Action would add up to 149 substructures that could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing, which would attract additional recreational vessels in addition to existing vessel traffic in the area. The presence of additional recreational vessels would add to the space use conflict and collision risks for military and national security vessels.

Traffic: Though the Lease Area overlaps with a portion of the W-105A warning area within the Narraganset Bay Operating Area, military traffic in the MA Wind Energy Area is relatively low, with four vessels recorded between 2016 and 2017 (BOEM 2021). Increased vessel traffic in the Project area during construction, operations, and decommissioning could result in an increased risk of vessel collision with military and national security vessels, could cause military and national security vessels to change routes, and could result in congestion and delays in ports. Impacts are anticipated to be minor and would be greatest during construction when vessel traffic is greatest and would be reduced during operations. Vessel traffic and navigation impacts are summarized in Section 3.6.6, *Navigation and Vessel Traffic*.

Aviation and Air Traffic

Presence of structures: The Proposed Action would install up to 147 WTGs with a maximum blade tip height of 1,066.3 feet (325 meters) AMSL in the Wind Farm Area. The addition of these structures would increase navigational complexity and change aircraft navigational patterns around the Wind Farm Area.

The Boston Consolidated (A90) Terminal Radar Approach Control (TRACON) overlaps with the northern portion of the Lease Area and has a minimum vectoring altitude of 2,000 feet (610 meters). With the maximum design scenario WTG height of 1,066.3 feet (325 meters), there would be a vertical distance of 933.7 feet (284.6 meters) between the maximum WTG blade tip height and the minimum vectoring altitude. Due to their height, the WTGs proposed in the northern portion of the Lease Area would be considered obstructions to air navigation. An increase to the minimum vectoring altitude would likely be required, pending coordination with the FAA (COP Volume 2, Section 14.2.3.1.1; Mayflower Wind 2022).

WTGs and OSPs would comply with lighting and marking regulations and be marked per FAA and USCG rules to minimize and mitigate impacts on air traffic. Due to their size, WTGs would also be visible on aircraft radars. Navigational hazards and collision risks in transit routes would be reduced as construction is completed and would be gradually eliminated during decommissioning as offshore WTGs are removed. Adverse impacts on air traffic are anticipated to be localized, long term, and minor.

Cables and Pipelines

Presence of structures: It is anticipated that there would be two potential crossing areas along the Falmouth export cable corridor. Between Martha’s Vineyard and Falmouth, Massachusetts, the export cable corridor for the Proposed Action would cross up to two existing cables. South of the Muskeget Channel, the export cable corridor would cross up to seven planned cables associated with the Vineyard Wind offshore wind project. The Brayton Point export cable corridor is anticipated to have five potential crossing areas. The Proposed Action would cross up to seven planned cables associated with the

Vineyard Wind offshore wind project. Up to four planned cables would be crossed south of Nomans Land. The Brayton Point export cable corridor would cross three existing pipelines at the Sakonnet River (COP Volume 2, Section 14.1.4; Mayflower Wind 2022).

Where cable or pipeline crossings along the offshore export cable corridor are necessary, Mayflower Wind would use well-established standard techniques for adequately avoiding, minimizing, or mitigating the impacts on existing cables and the newly installed Project offshore export cables. Additionally, Mayflower Wind would coordinate with the owners of existing and planned cables and pipelines to coordinate crossing design, installation, and maintenance requirements. The presence of offshore wind energy structures, such as WTG foundations, could preclude future submarine cable placement within the foundation footprint, requiring future cables to route around these areas. In most situations, the placement and presence of the Proposed Action’s offshore export cables would not prohibit the placement of additional cables and pipelines because these could be crossed following standard industry protection techniques and impacts would be negligible. However, in locations where there are many existing and planned cables and pipelines, there reaches a saturation point where there is not sufficient accommodation space within possible offshore routes or at the shore approach where limited landfall locations exist. It is expected that this saturation will be reached along the Falmouth offshore export cable corridor within the Muskeget Channel where technically feasible routes are limited and multiple offshore wind project cables in the same location are planned. In these situations, additional coordination with cable operators and additional cable protection systems may be required. Impacts on submarine cables and pipelines would be eliminated during decommissioning of the projects as the foundations and export and interarray cables are removed.

Project structures including WTGs and OSPs, and the stationary lift vessels used during Project construction and installation, may pose allision risks and navigational hazards to vessels conducting maintenance activities on existing submarine telecommunications cables. However, FAA, USCG, and BOEM navigational hazard marking, as well as the relative infrequency of cable maintenance activities would minimize the risk of allision. Risk of vessel collisions between cable maintenance vessels and vessels associated with the projects would be limited to the construction and installation phase and during planned maintenance activities during the operational phase.

Radar Systems

Presence of structures: Air traffic control, national defense, weather, and oceanographic radar in the line of sight of the offshore infrastructure associated with the Proposed Action may be affected by the O&M phase of the projects. Potential impacts for radar operations over and in the immediate vicinity of the Project area include unwanted radar returns (clutter) resulting in a partial loss of primary target detection and a number of false primary targets, and a partial loss of weather detection including false weather indications.

A review of the radar line of sight found that the proposed WTGs at a maximum height of 1,066.3 feet (325 meters) would be either partially or fully in the line of sight for the following radar systems: Falmouth (ASR-8), Nantucket (ASR-9), North Truro (ARSR-4), Riverhead (ARSR-4), Martha’s Vineyard High

Frequency Radar, Block Island High Frequency Radar, and Nantucket High Frequency Radar. The Project may also affect additional high-frequency radars, as these instruments measure areas over-the-horizon, beyond line of sight. Radar effects may include unwanted radar returns resulting in a partial loss of primary target detection and a number of false primary targets over and in the immediate vicinity of the WTGs in the line of sight. Other possible radar effects include a partial loss of weather detection, including false weather indications. For oceanographic high-frequency radars, anticipated impacts include a loss of ocean surface current and wave measurements in an area extending within and substantially beyond the Project area. In addition, the following FAA radar sites for air traffic control would be in the line of sight: Boston Consolidated A90 TRACON, Nantucket Air Traffic Control Tower, and the Providence TRACON. WTGs in the northern half of the Lease Area would be in the line of sight of the Cape Cod Air Force Station Early Warning Radar used for ballistic missile defense and space surveillance, which could have impacts on the radar system. Mayflower Wind has committed to working with the DoD Siting Clearinghouse to identify and implement appropriate mitigation measures, and therefore impacts are anticipated to be minor. COP Appendix Y4 provides additional information on the radar line of sight study (Mayflower Wind 2022).

Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs, could be affected during construction and operations of the Proposed Action; however, research activities may continue in the proposed Project area, as permissible by survey operators. The Proposed Action would affect survey operations by excluding certain portions of the Lease Area occupied by Project components from sampling, affecting the statistical design of surveys, reducing survey efficiency, and causing habitat alteration in the Wind Farm Area that cannot be monitored.

This Draft EIS incorporates by reference the detailed analysis of potential impacts on scientific research and surveys provided in the Vineyard Wind 1 Final EIS (BOEM 2021). The analysis in the Vineyard Wind 1 Final EIS is summarized in Section 3.6.7.3.

The Proposed Action would install up to 147 WTGs with a maximum blade tip of 1,066.3 feet (325 meters) AMSL. Aerial survey track lines for cetacean and sea turtle abundance surveys could not continue at the current altitude (600 feet AMSL) in the Project area because the planned maximum-case scenario for WTG blade tip height would exceed the survey altitude. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially smaller species. Agencies would need to expend resources to update scientific survey methodologies due to construction and operation of the Proposed Action, as well as to evaluate these changes on stock assessments and fisheries management, resulting in major impacts for scientific research and surveys.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considers the impacts of the Proposed Action in combination with the other ongoing and planned non-offshore wind activities and other ongoing and planned offshore wind activities. BOEM anticipates that the other offshore wind projects could be designed to avoid existing and proposed marine mineral extraction areas through consultation with USACE, BOEM, and relevant state and local agencies; therefore, there would be negligible impacts on future marine mineral extraction activity.

The Proposed Action would contribute to the combined impacts on military use from ongoing and planned activities, including offshore wind, through the construction and operation of offshore structures. While potential impacts on most military and national security uses are anticipated to be minor, installation of WTGs throughout the geographic analysis area would hinder USCG SAR operations across a larger area, resulting in moderate impacts and potentially leading to increased loss of life. The Proposed Action and ongoing and planned activities would contribute to localized and temporary impacts on military and national security related traffic, which are most likely to occur during the construction and decommissioning timeframes.

While open airspace around the offshore wind lease areas in the geographic analysis area would still exist after all foreseeable future offshore wind energy projects are built, the WTGs for the Proposed Action and other offshore wind projects would contribute to the increased navigational complexity for aviation and air traffic, resulting in minor cumulative impacts. BOEM assumes that offshore wind project operators would coordinate with aviation interests throughout the planning, construction, operations, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic.

The contribution of the Proposed Action to the impacts on cables and pipelines from ongoing and planned activities could result in some localized and long-term impacts. However, these impacts are not anticipated to appreciably contribute to cumulative impacts because they can be avoided by standard protection techniques.

The Proposed Action would contribute to the impacts on radar systems from ongoing and planned activities, primarily due to the presence of WTGs in the line of sight causing interference with radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars, resulting in moderate cumulative impacts.

The cumulative impacts of the Proposed Action would result in long-term and major impacts on scientific research and surveys, particularly for NOAA surveys that support commercial fisheries and protected-species research programs. The entities conducting scientific research and surveys would have to make significant investments to change methodologies to account for areas occupied by offshore energy components, such as WTGs and cable routes, that are no longer able to be sampled.

Conclusions

Impacts of the Proposed Action: Under the Proposed Action, up to 147 WTGs with a maximum blade tip of 1,066.3 feet (325 meters) AMSL would be installed, operate, and eventually be decommissioned in the Project area. The presence of these structures would introduce navigational complexity and increased vessel traffic in the area that would continue to have temporary to long-term impacts that range from **negligible** to **major** on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

- Marine mineral extraction: The Wind Farm Area and offshore export cable routes for the Proposed Action would avoid sand resource, borrow, and ocean disposal areas, resulting in **negligible** potential impacts.
- Military and national security uses: The installation of WTGs in the Project area would result in increased navigational complexity and increased allision risk, creating potential **moderate** adverse impacts on USCG SAR operations and potential **minor** impacts on all other military and national security uses.
- Aviation and air traffic: Potential **minor** impacts on low-level flights would occur, primarily due to the installation of WTGs in the Project area and changes in navigation patterns.
- Cables and pipelines: Potential impacts on cables and pipelines would be **negligible** due to the use of standard protection techniques to avoid impacts.
- Radar: Potential **minor** adverse impacts on radar systems would primarily be caused by the presence of WTGs in the line of sight causing interference with radar systems. Options are available to minimize or mitigate impacts and Mayflower Wind would continue to coordinate with FAA, DoD, and NOAA on impacts.
- Scientific research and surveys: Potential impacts on scientific research and surveys would generally be **major**, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs. The presence of structures would exclude certain areas occupied by Project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling, and could affect survey gear performance, efficiency, and availability.

Cumulative Impacts of the Proposed Action: In context of reasonably foreseeable environmental trends, the cumulative impacts on other uses from the Proposed Action in combination with ongoing and planned activities would range from **negligible** to **major**. Considering all of the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with ongoing and planned activities would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems and USCG SAR operations; and **major** for NOAA's scientific research and surveys. The presence of structures associated with the Proposed Action and increased risk of allisions are the primary drivers for impacts on other marine uses. Impacts on NOAA scientific research and surveys would qualify as major because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas, with potential long-term and irreversible impacts on fisheries and protected species research as a whole, as well as on the commercial fisheries community. There could be impacts on other types of surveys, and increased opportunities to study impacts of offshore wind development on a variety of resources.

3.6.7.6 Impacts of Alternative C on Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Impacts of Alternative C: Under Alternative C, a portion of the Brayton Point offshore export cables would be routed onshore to avoid placing cables in the Sakonnet River. Routing the export cables onshore would avoid the planned crossing of three existing pipelines in the Sakonnet River, which would reduce localized impacts on cables and pipelines. However, the overall impact on cables and pipelines would remain the same as described under the Proposed Action. Under Alternative C-2, the Brayton Point export cable corridor would intersect with the Fort Church formerly used defense site. The site status is listed as complete and closed out and has not been used for military use since 1960 (USACE 2019). Impacts on military and national security uses would remain the same as described under the Proposed Action.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative C would be the same as under the Proposed Action.

Conclusions

Impacts of Alternative C: The implementation of Alternative C would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The impact of the alternative alone resulting from individual IPFs would be **negligible** for marine mineral extraction and for cables and pipelines; **minor** for aviation and air traffic and for radar systems; **minor** for most military and national security uses, but **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative C would be the same as the Proposed Action - **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems and SAR operations; and **major** for scientific research and surveys.

3.6.7.7 Impacts of Alternative D on Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Impacts of Alternative D: Impacts of Alternative D would be similar to those of the Proposed Action on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and scientific research and surveys. Alternative D could potentially decrease impacts on radar systems on Nantucket Island by removing up to six WTGs closest to shore in the northeastern portion of the Lease Area. While this could reduce line-of-sight impacts for the three radar systems on Nantucket Island, localized, long-term, minor impacts on the other radar systems in the geographic analysis area are still anticipated.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative D would be the same as under the Proposed Action.

Conclusions

Impacts of Alternative D: The implementation of Alternative D would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The impact of the alternative alone resulting from individual IPFs would be **negligible** for marine mineral extraction and for cables and pipelines; **minor** for aviation and air traffic and for radar systems; **minor** for most military and national security uses, but **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative D would be the same as the Proposed Action - **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems and SAR operations; and **major** for scientific research and surveys.

3.6.7.8 Impacts of Alternatives E and F on Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Impacts of Alternatives E and F: Impacts of Alternative E would be similar to those of the Proposed Action for marine mineral extraction, military and national security uses, aviation and air traffic, radar systems, and scientific research and surveys. The presence of WTG and OSP foundations would preclude future submarine cables and pipelines placement within the footprint of the foundation. Due to their structure, the suction bucket and GBS foundations proposed under Alternative E-2 and Alternative E-3, respectively, would have a larger footprint on the seabed and would exclude more area from future submarine cable and pipeline placement as compared to the piled foundations proposed under Alternative E-1. Impacts on cables and pipelines would remain the same as described under the Proposed Action because no publicly noticed plans for additional submarine cables or pipelines in the geographic analysis area were identified and future submarine cables and pipelines would have the option to route around foundations.

Impacts of Alternative F would be similar to those of the Proposed Action for marine mineral extraction, military and national security uses, aviation and air traffic, radar systems, and scientific research and surveys. Under Alternative F, up to three HVDC cables would be used for the Falmouth offshore export cable, as opposed to the maximum of five as proposed under the Proposed Action. Reducing the number of cables within the Falmouth offshore export cable corridor has the potential to reduce impacts on existing and planned cables in the Muskeget Channel east of Martha’s Vineyard because it would reduce the number of crossings required and associated cable protection. However, because crossings would still be required at this location, the overall impact on cables and pipelines would remain the same as described under the Proposed Action.

Cumulative Impacts of Alternatives E and F: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives E and F would be the same as under the Proposed Action.

Conclusions

Impacts of Alternatives E and F: The implementation of Alternative E and Alternative F would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The impact of the alternatives alone would be **negligible** for marine mineral extraction and for cables and pipelines; **minor** for aviation and air traffic and for radar systems; **minor** for most military and national security uses, but **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternatives E and F: In the context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with Alternative E and Alternative F would be the same as the Proposed Action - **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems and SAR operations; and **major** for scientific research and surveys.

3.6.7.9 Proposed Mitigation Measures

The following mitigation measures are proposed to minimize impacts on other uses (Appendix G, Table G-2).

- **Federal survey mitigation implementation strategy for the Northeast U.S. region.** BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies because of offshore wind farms. In response to major impacts on NOAA surveys identified during the environmental review of the first offshore wind energy project in federal waters, BOEM and NOAA have agreed to develop and implement the NOAA Fisheries and BOEM Federal Survey Mitigation Program (Hare et al. 2022). This strategy also defines stakeholders, partners, and other ocean users that will be engaged throughout the process and identifies potential resources for successful implementation. Generally, survey mitigation in response to offshore wind development involves developing and deploying new approaches to surveying in and around offshore wind energy developments that generate comparable data to the impacted surveys. Potential impacts on surveys will continue to be documented during the environmental review process and considered in the approval of wind energy lease areas. If impacts cannot be avoided or minimized, strategies outlined in the NOAA Fisheries and BOEM Federal Survey Mitigation Strategy can be used to mitigate the impacts, such as applying survey-specific mitigation plans or, to the extent practicable, integrating wind energy development monitoring studies with NOAA surveys.
- **High frequency radar system mitigation.** To mitigate for potential impacts on high-frequency radar systems, Mayflower Wind would develop a mitigation plan, to be reviewed by and coordinated with the NOAA IOOS Office’s Surface Currents Program. The mitigation plan would include measures that correct for impacts on radars, including Mayflower Wind sharing real-time telemetry of surface currents, waves, and other oceanographic data with the Surface Currents Program. The data would be measured at locations confirmed by the Surface Currents Program and its high-frequency radar operators in the geographic analysis area to allow NOAA IOOS mission objectives to be met.

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

3.6 Socioeconomic Conditions and Cultural Resources

3.6.8 Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources and activities from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area for recreation and tourism, as shown on Figure 3.6.8-1, corresponds to the scenic and visual resources geographic analysis area (Section 3.6.9) and includes a 42.8-mile (68.9-kilometer) buffer around the Lease Area, a 3-mile (4.8-kilometer) buffer around the onshore substation and converter station sites, and a 0.5-mile (0.8-kilometer) buffer around the export cables. The geographic analysis area encompasses Barnstable, Bristol, Dukes, and Nantucket Counties in Massachusetts, and Bristol and Newport Counties, in Rhode Island. Section 3.6.3, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the Project area.

3.6.8.1 Description of the Affected Environment and Future Baseline Conditions

Regional Setting

Proposed Project facilities would be within and off the coast of Massachusetts and Rhode Island. The coastal areas support ocean-based recreation and tourist activities that include boating, swimming, surfing, scuba diving, sailing, and paddle sports. As indicated in Section 3.6.3, recreation and tourism contribute substantially to the economies of Massachusetts' and Rhode Island's coastal counties. Tourism in these coastal communities is a multibillion-dollar industry. There were 4,096,104 visits to the Cape Cod National Seashore in 2019 (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022)

Coastal Massachusetts and Rhode Island have a wide range of visual characteristics, with communities and landscapes ranging from large cities to small towns, suburbs, rural areas, and wildlife preserves. As a result of the proximity of the Atlantic Ocean, as well as the views associated with the shoreline, the Massachusetts and Rhode Island shores have been extensively developed for water-based recreation and tourism.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Additionally, the visual qualities of these historic coastal towns, which include marine activities in small-scale harbors, and the ability to view birds and marine life are important community characteristics.

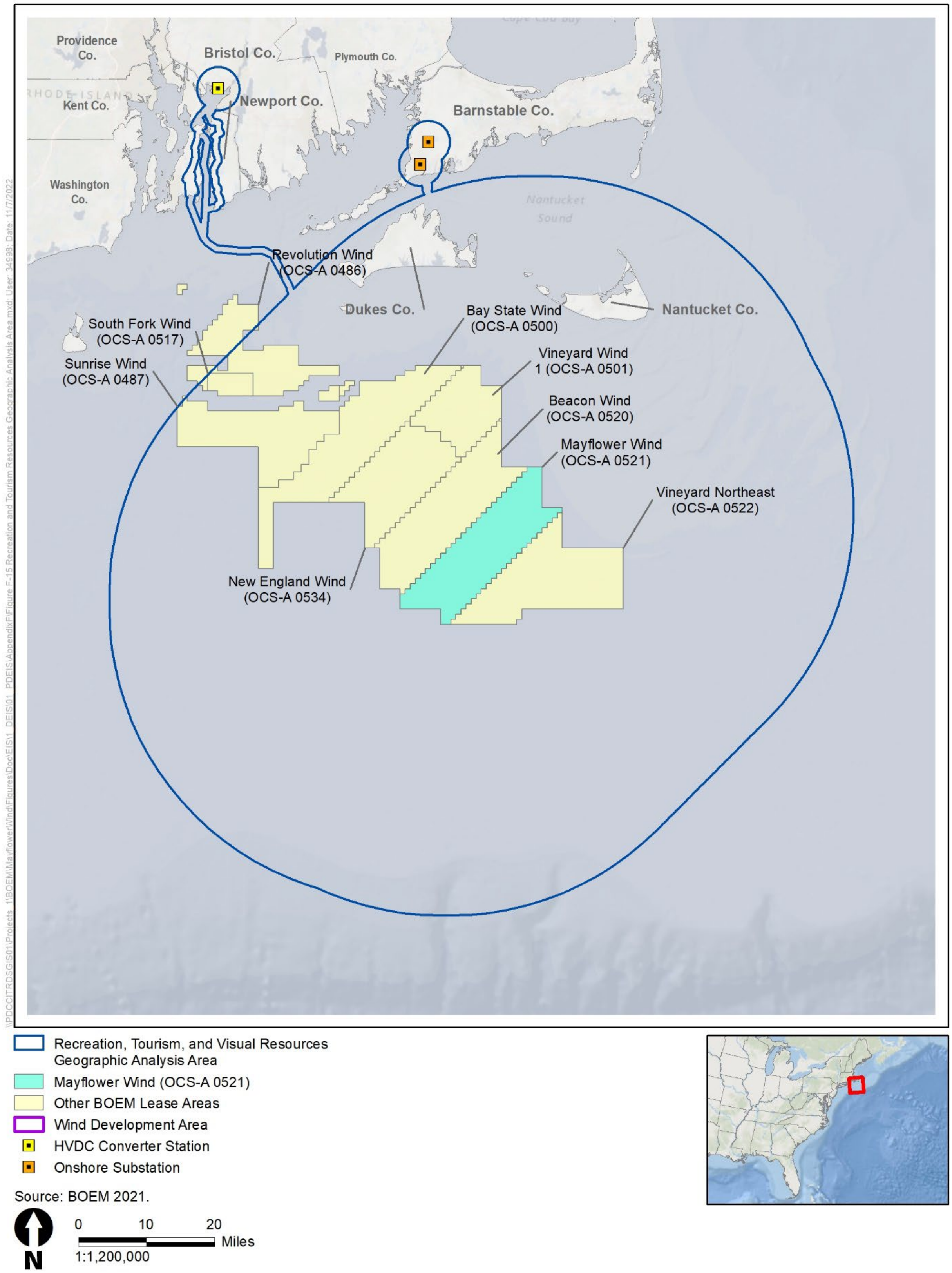

Figure 3.6.8-1. Recreation and tourism geographic analysis area

Project Area

Recreational and tourist-oriented activities are concentrated in the coastal communities in Barnstable, Bristol, Dukes, and Nantucket Counties in Massachusetts, and Bristol and Newport Counties, in Rhode Island. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year. Although many of the coastal and ocean amenities, such as beaches, that attract visitors to these regions are accessible to the public for free and, thus, do not directly generate employment, these nonmarket features function as key drivers for recreation and tourism businesses.

Water-oriented recreational activities in the Project area include boating, visiting beaches, hiking, fishing, shellfishing, and bird and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding.

Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks. As discussed in Section 3.6.3, recreation and hospitality are major sectors of the economy in Barnstable, Bristol, Dukes, and Nantucket Counties in Massachusetts, and Bristol and Newport Counties, in Rhode Island, supported by the ocean-based recreation uses.

Inland recreational facilities are also popular but bear less of a relationship to possible impacts of the Project; this section does not address them in detail. These include inland waters, such as ponds and rivers, wildlife sanctuaries, golf courses, athletic facilities, parks, and picnic grounds.

Coastal and Offshore Recreation

Recreational boating activities occur along the coastline, especially during the summer months (COP Volume 2, Section 10.3.1.2.1; Mayflower Wind 2022). Swimming and surfing are also popular during the summer months along the miles of white sand beaches. Surfers frequent several towns and cities along the coastline, including those in Cape Cod and the City of Newport (COP Volume 2, Sections 10.3.1.1.1 and 10.3.1.1.2.2; Mayflower Wind 2022). Scuba diving and snorkeling are identified as dominant uses offshore from the Cape Cod Peninsula with dive sites that include shipwrecks, artificial reefs, beach dives, and various inland sites (COP Volume 2, Sections 10.3.1.1.1 and 11.1.3.3.2; Mayflower Wind 2022). The sailing and boating season typically runs from May to October with a peak in July and August and primarily occurs in relatively small areas in the bays and inlets and just along the coastline (COP Volume 2, Section 10.3.1.2.1; Mayflower Wind 2022).

There is a large and robust recreational fishing industry in Massachusetts and Rhode Island. The *Fisheries Economics of the United States Report of 2019* estimates that recreational fishing had a $286 million impact on Massachusetts and Rhode Island's economy in 2019 (NOAA 2022a). Collectively, there were close to 2 million recreational angler trips (i.e., party boats, rental/private boats, and shore) made per year in Massachusetts and Rhode Island from 2007 to 2012 (COP Volume 2, Section 10.3.1.2.2; Mayflower Wind 2022). Fishing activity mainly takes place along the coast near Falmouth, as well as

Tisbury and Oak Bluffs on Martha's Vineyard (COP Volume 2, Section 10.3.1.2.2; Mayflower Wind 2022). There are also up to 60 saltwater fishing tournaments held annually during the summer in coastal towns. Saltwater fishing tournaments target a variety of fish Atlantic cod, black sea bass, bluefish, striped bass, haddock, and bluefin and yellowfin tuna (COP Volume 2, Section 10.3.1.2.2; Mayflower Wind 2022). According to NOAA Fisheries One Stop Shop database, recreational anglers off the coast of Massachusetts and Rhode Island caught 133,509,942 pounds of fish in 2017; 23,735,123 pounds in 2018; 24,820,923 pounds in 2019; and 16,323,813 pounds in 2020 (NOAA 2022b).

NOAA's social indicator mapping tool (NOAA 2022d) identifies the importance or level of dependence of recreational fishing to coastal communities. The tool classifies communities based on recreational fishing reliance, which measures the presence of recreational fishing in relation to the population size of a community, and recreational fishing engagement, which measures the presence of recreational fishing through fishing activity estimates. Within the geographic analysis area, only one community, Bourne, Massachusetts has a high reliance on recreational fishing but there are several communities with a medium reliance in Barnstable and Nantucket Counties. Communities with high and medium high recreational fishing engagement are Nantucket, Barnstable Town, Yarmouth, Dennis, Sandwich, Bourne, Forestdale, and Westport in Massachusetts and Newport in Rhode Island. The communities with the highest recreational fishing reliance and recreational fishing engagement would be most affected by impacts on recreational fishing from offshore wind development.

Wildlife viewing is popular as well, occurring along the coast of Naushon, Gosnold, and Nashawena Islands, and along the eastern coast of Nantucket (COP Volume 2, Section 10.3.1.2.2; Mayflower Wind 2022). People also partake in whale watching through the New Bedford Whaling National Historical Park.

Barnstable County (Massachusetts)

Barnstable County lies in southeastern Massachusetts and encompasses approximately 394 square miles of land (U.S. Census Bureau 2021a). The county consists of 15 historic towns and contains the Cape Cod Peninsula (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). There are 30 harbors, 40 marinas and boatyards, and about 24 private boating and yacht clubs. It has approximately 550 miles (884 kilometers) of coastline and over 150 beaches. Popular recreational activities in the area include beach going, snorkeling, windsurfing, boating, fishing, paddle sports, and diving. Canoeing, kayaking, and paddle boarding typically occur within 1 mile (1.6 kilometers) of the coastline. In 2019, there were 4,096,104 visits to the Cape Code National Seashore.

Bristol County

Bristol County is in the southeastern part of Massachusetts, bordering Rhode Island, and is approximately 553 square miles of land (U.S. Census Bureau 2021b and COP Volume 2, Section 10.3.1.1.2.1; Mayflower Wind 2022). The county consists of 20 municipalities, including the town of Somerset (COP Volume 2, Section 10.1.1.1.4; Mayflower Wind 2022). Popular recreational activities in the area include swimming, fishing, and wildlife viewing (COP Volume 2, Section 10.3.1.1.2.1; Mayflower

Wind 2022). People also take part in whale watching at the New Bedford Whaling National Historical Park (COP Volume 2, Section 10.3.1.2.2; Mayflower Wind 2022).

Dukes County

Dukes County is in southeastern Massachusetts and encompasses 103 square miles of land area (U.S. Census Bureau 2021c). The county contains Martha's Vineyard, the Elizabeth Islands, and Nomans Land (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). There are many public and private beaches, harbors, marinas/boatyards, yacht clubs, and public launch facilities in the county. Due to tourists and seasonal residents, the population of Martha's Vineyard increases by a factor of ten in the summer months (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). Popular tourist destinations include the West Chop Lighthouse, located in Vineyard Haven, the East Chop Lighthouse, located in Oak Bluffs, and the Menemsha Fishing Village and Harbor, located in Chilmark (Martha's Vineyard Chamber of Commerce 2022).

Nantucket County

Nantucket County is south of Cape Cod and encompasses approximately 44.97 square miles of land (U.S. Census Bureau 2021d). It is 14 miles long and 3.5 miles wide (Town & County of Nantucket, MA 2022a). The county consists of the Island of Nantucket, which is an extremely popular summer tourist destination. In the summer months, the population of the Island of Nantucket increases by a factor of five due to tourists and seasonal residents (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). The county is home to many beaches, such as Brant Point Beach, which is home to the Brant Point Lighthouse. One of the most popular beaches on the island is Jetties Beach, which has a café, restaurant, and tourist shop during the summer (Town and County of Nantucket 2022b).

Bristol County (Rhode Island)

Bristol County, located in eastern Rhode Island, is approximately 24 square miles of land (U.S. Census Bureau 2019a). The county includes the towns of Barrington, Bristol, and Warren and is connected to Newport County and Aquidneck Island by the Mount Hope Bay Ridge (COP Volume 2, Section 10.3.1.1.2.3; Mayflower Wind 2022). Tourists visit the county for its miles of coastlines, beaches, and boating opportunities. There are many boat ramps that support the boating community, such as Colt State Park Boat Ramp, Mount Hope Boat Ramp, and Independence Park Boat Ramp (Town of Bristol 2022).

Newport County

Newport County is located in eastern Rhode Island and encompasses about 102 square miles of land (U.S. Census Bureau 2019b). The county is made up of nine municipalities across Aquidneck Island in the southeastern region of Rhode Island and various islands in Narragansett Bay (COP Volume 2, Section 10.1.1.1.5; Mayflower Wind 2022). It includes the City of Newport, Jamestown, Little Compton, Middletown, Portsmouth, and Tiverton. The City of Newport is located in the southwest corner of the county, and Portsmouth is located in the northeastern corner of the county. The City of Newport is especially popular among tourists for its sailing, swimming, and surfing opportunities (COP Volume 2, Section 10.3.1.1.2.2; Mayflower Wind 2022).

Onshore Recreation

Barnstable County

Barnstable County is home to about 1,000 freshwater ponds and over 100,000 acres of habitat, wetlands, and protected open space (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). In 2017, the county's tourism industry generated $1.1 billion in direct spending and $122 in state and local taxes. The town of Falmouth has many restaurants, galleries, theaters, and concerts, as well as opportunities for hiking, camping, and bird watching. About 32 percent of the 62,705 residential units located in the county are used for seasonal, occupational, or occasional use.

Bristol County (Massachusetts)

Bristol County is home to Buttonwood Park, Freetown-Fall River National Forest, Horseneck Beach State Reservation, and New Bedford Whaling National Historic Park (COP Volume 2, Section 10.3.1.1.2.1; Mayflower Wind 2022). Popular recreational activities include biking, hiking, and camping throughout the county. Inland marine recreational activities, such as fishing and boating, are also popular in the Taunton, Achushnet, Ten Mile, Westport, and Warren Rivers and in the North and South Watuppa Lakes.

Dukes County

Dukes County contains only one federally protected area called Nomans Land Island National Wildlife Refuge (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). The county has many short-term accommodation lodgings, food and drink establishments, and other amenities. About 40 percent of Martha's Vineyard (19,968 acres [8,100 hectares]) is conserved open space (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). Areas of interest include the cultural district of Vineyard Haven, in which people can shop, dine, lodge, and attend theater and historic sites (Martha's Vineyard Chamber of Commerce 2022). Oak Bluffs is known for its shops, restaurants, carousel, and museums. Edgartown has a historic downtown with many museums, and Aquinnah is the western-most town on the island, which is home to colorful cliffs and the Aquinnah Circle Cultural District.

Nantucket County

Nantucket County is home to only one federally protected area, the Nantucket National Wildlife Refuge, which consists of 24 acres (9.7 hectares) of federally protected land, and about 50 percent of Nantucket is conserved open space (COP Volume 2, Section 10.3.1.1.1; Mayflower Wind 2022). The county is home to over 40 miles of bike paths and walking trails and three lighthouses. Popular bike paths on the island include Cliff Road Path, Eel Point Road Path, and Surfside Road Path (Town & County of Nantucket 2022c). The county hosts many food festivals throughout the year, such as the Nantucket Wine and Food Festival, as well as musical events and fairs, such as the Boston Pops at Jetties Beach and the Nantucket Island Fair (Culture & Tourism 2022).

Bristol County (Rhode Island)

Bristol County encompasses Colt State Park, which has 464 acres of lawns and 4 miles of paved pathways, hiking trails, historic stone walls, and shoreline. The park borders Narragansett Bay on its west side and is a popular destination for boating, biking, and wildlife viewing (Rhode Island State Parks 2022a). The county is also home to the East Bay Bike Path, which is 13.8 miles long and connects eight parks (Rhode Island State Parks 2022b). The Montaup Country Club is a popular and semi-private golf course in the county (COP Volume 2, Section 10.3.1.1.2.3; Mayflower Wind 2022).

Newport County

Newport County is home to many parks with sports fields, concession stands, and historic buildings, including Aquidneck Park, Ballard Park, Brenton Point State Park, and Morton Park (City of Newport 2019). Popular tourist activities include museum and mansion tours, as well as the Cliff Walk, a 3.5-mile (5.6-kilometer) public access walk located along the eastern shore of the City of Newport (COP Volume 2, Section 10.3.1.1.2.2; Mayflower Wind 2022). Tours of wineries and breweries are also very popular due to the large number of vineyards in the county. One of the most popular activities in Newport is the 10-mile coastal drive along the coast, which also includes bike paths (Discover Newport 2021).

3.6.8.2 Impact Level Definitions for Recreation and Tourism

Definitions of impact levels are provided in Table 3.6.8-1.

Table 3.6.8-1. Impact level definitions for recreation and tourism

Impact Level	Adverse or Beneficial	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Impacts on the affected activity or community would not disrupt the normal or routine functions of the affected activity or community.
	Beneficial	Small or measurable effects that would result in an economic improvement.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Project.
	Beneficial	Notable and measurable effects that would result in an economic improvement
Major	Adverse	The affected activity or community would experience substantial disruptions due to the Project.
	Beneficial	Large local or notable regional effects that would result in an economic improvement.

3.6.8.3 Impacts of Alternative A – No Action on Recreation and Tourism

When analyzing the impacts of the No Action Alternative on recreation and tourism, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for recreation and tourism. The cumulative impacts of the No Action

Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, recreation and tourism in the geographic analysis area would continue to be affected by ongoing non-offshore wind activities, especially ongoing vessel traffic; noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, and offshore cables; and onshore development activities. These activities would contribute to periodic disruptions to recreational and tourism activities but are a typical part of daily life along the Massachusetts and Rhode Island coastline and would not substantially affect recreational enjoyment in the geographic analysis area. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for tourism and recreation. The geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on recreation and tourism include ongoing construction of the Vineyard Wind 1 project (62 WTGs and 1 OSP) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSP) in OCS-A 0517. Ongoing construction of the Vineyard Wind 1 and South Fork projects would have the same type of impacts on recreation and tourism that are described in detail in *Cumulative Impacts of the No Action Alternative* for all ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect recreation and tourism include emplacement of submarine cables and pipelines, dredging and port improvements, marine mineral use, and military use. Like ongoing activities, other planned non-offshore wind activities may result in periodic disruptions to recreation and tourism activities along the coast. However, visitors are expected to be able to continue to pursue activities that rely on other coastal and ocean environments, scenic qualities, natural resources and establishments that provide services to recreation and tourism.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on recreation and tourism during construction, O&M, and decommissioning of the projects. Offshore wind projects other than the Proposed Action that contribute to impacts on recreation and tourism include projects within all or portions of the following lease areas: OCS-A-0486 (Revolution Wind), OCS-A-0487 (Sunrise Wind), OCS-A-0500 (Bay State Wind), OCS-A 0501 (Vineyard Wind 1), OCS-A 0517 (South Fork Wind), OCS-A-0520 (Beacon Wind), OCS-A 0522 (Vineyard Wind Northeast), and OCS-A 0534 (New England Wind) (Table D2-1, Appendix D).

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

Increased vessel anchoring during offshore wind development between 2023 and 2030 would affect recreational boaters. The greatest volume of anchored vessels would occur in offshore work areas during construction. The COP estimates there would be a maximum of 50 vessels in the Lease Area at one time (COP Volume 1, Section 3.3.14.1; Mayflower Wind 2022). Offshore wind projects may generate similar numbers of active and anchored vessels, depending on project size and construction schedule. Anchored construction-related vessels may be within temporary safety zones established in coordination with USCG for active construction areas (COP Volume 2, Section 10.3.2.1.1; Mayflower Wind 2022). Offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods between 2023 and 2030.

Vessel anchoring would also occur during maintenance and monitoring activities during operations. Following construction of other offshore projects (if approved), the presence of operating offshore wind projects in the geographic analysis area would result in a long-term increase in the number of vessels anchored during periodic maintenance and monitoring. Vessel anchoring during maintenance and monitoring would have minor impacts on recreation and tourism.

Anchored construction, survey, or service vessels would have localized, temporary impacts on recreational boating. Recreational vessels could navigate around anchored vessels with only some brief inconvenience. The temporary turbidity from anchoring would briefly alter the behavior of species important to recreational fishing (Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*) and sightseeing (primarily whales, but also dolphins and seals) (Section 3.5.6, *Marine Mammals*). Inconvenience and navigational complexity for recreational vessels would be localized, variable, and long term, with increased frequency of anchored vessels during surveying and construction and reduced frequency of anchored vessels during operations. Construction, survey, and service vessel anchoring would have minor impacts on recreation and tourism.

Land disturbance: Other offshore wind development would require installation of onshore export cables and onshore substation infrastructure, which would cause temporary traffic delays and could temporarily affect access to adjacent properties, resulting in localized, temporary disturbances of recreational activity or tourism-based businesses near cable routes and construction sites for substations and other electrical infrastructure. These impacts would only last through construction and occasionally during maintenance events. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for offshore wind energy projects; however, it is anticipated these projects would generally have localized, short-term impacts during construction or maintenance and no long-term impacts on recreation and tourism use.

Lighting: Construction-related nighttime vessel lighting would be used if offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for other offshore wind projects in the geographic analysis area simultaneously under active construction (Appendix D). 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.

In the geographic analysis area, permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines of Martha's Vineyard and Nantucket and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for up to 901 WTGs. The amassing of these WTGs and associated synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle in the offshore wind lease areas would have long-term impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors, such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations (Section 3.6.9, *Visual Resources*).

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS). A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles [8 to 13 kilometers]) would adversely affect the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. Most WTG positions likely to be present based on anticipated offshore wind lease area build-out in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

In addition to recreational fishing, some recreational boating in the region involves whale watching and other wildlife-viewing activity. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines "appear to provide for the marking and lighting of [WTGs] that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish" (Orr et al. 2013). By extension, existing lighting guidelines or ADLS (if implemented) would impose a minimal impact on recreational fishing or wildlife viewing.

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

The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. ADLS controlled obstruction lights would be activated in the Lease Area for less than 5 hours per year (COP Appendix T Section 5.1.3; Mayflower Wind 2022). It is anticipated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS.

Cable emplacement and maintenance: Other offshore wind export cables in the geographic analysis area could total 1,738 miles (2,797 kilometers), while interarray cables could total 1,782 miles (2,868 kilometers) (excluding the Proposed Action). Cables for other offshore wind projects would likely be emplaced in the geographic analysis area between 2023 and 2030. Offshore cable emplacement for offshore wind development projects would have temporary, localized, adverse impacts on recreational boating while cables are being installed, because vessels would need to navigate around work areas, and recreational boaters would likely prefer to avoid the noise and disruption caused by installation. Cable installation could also have temporary impacts on fish and invertebrates of interest for recreational fishing, due to the required dredging, turbulence, and disturbance; however, species would recover upon completion (Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*). The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Active work and restricted areas would only occur over the cable segment being emplaced at a given time. Once installed, cables would affect recreational boating only during maintenance operations, except that the mattresses covering cables in hard-bottom areas could hinder anchoring and result in gear entanglement or loss.

Impacts of cable emplacement and maintenance on recreational boating and tourism would be short term, continuous, adverse, and localized. Disruptions from cable emplacement and maintenance are anticipated to have a minor impact of recreation and tourism.

Noise: Noise from construction, pile driving, HRG survey activities, trenching, O&M, and vessels could result in adverse impacts on recreation and tourism.

Onshore construction noise from cable installation at the landfall sites, and inland if cable routes are near parkland, recreation areas, or other areas of public interest, would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore noise from HRG survey activities, pile driving, trenching, and construction-related vessels would intrude upon the natural sounds of the marine environment. This noise could cause some boaters to avoid areas of noise-generating activity, although some of the most intense noise could be within safety zones that USCG may establish within 12 nautical miles of the coast for areas of active construction, which would be off-limits to boaters. BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region. Results showed the construction phase is expected to have a slightly negative to neutral impact on recreational fisheries due to both direct exclusion of fishing activities and displacement of mobile target species by the construction noise (Kirkpatrick et al. 2017). The impact of noise on recreation and tourism during construction would be adverse, intense, and disruptive, but short term and localized.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing in the geographic analysis area and along cable routes. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by construction noise of WTGs. Recreational fishing for highly migratory species, such as tuna, shark, and marlin, is more likely to be affected, as the highly migratory species fishery usually occurs farther offshore than most recreational fisheries and, therefore, is more likely to experience temporary impacts resulting from the noise generated by offshore wind construction. Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on marine sightseeing that relies on the presence of mammals, primarily whales. However, as noted in Section 3.5.6, other projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

Offshore wind surveying and construction would occur in the geographic analysis area between 2023 and 2030. Based on the discussion above, offshore wind construction would result in short-term, localized, adverse impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple construction projects would increase the spatial and temporal extent of temporary disturbance to marine species in the geographic analysis area. As indicated in Appendix D, *Planned Activities Scenario*, up to 901 offshore WTGs could be installed between 2023 and 2030 in the geographic analysis area, not including the Proposed Action. No long-term, adverse impacts are anticipated that would result in population-level harm to fish and marine mammal populations.

During operations, the continuous noise generated by WTG operation would occur at least 12 miles (32 kilometers) from any onshore noise-sensitive locations and is not expected to produce sound in excess of background levels at any onshore locations. Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals and, therefore, little effect on recreational fishing or sightseeing. The impact of noise during O&M would be negligible, localized, continuous, and long term, with brief, more-intensive noise during occasional repair activities.

Port utilization: Ports in the geographic analysis area for recreation and tourism that could be used for construction and O&M of offshore wind development include ports off the coast of Massachusetts, Rhode Island, Connecticut, and Virginia (COP Volume 1, Section 3.3.13; Mayflower Wind 2022). These ports may also provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity, expansion, or dredging. Regional ports suitable for staging and construction of other offshore wind development are primarily industrial in character, with recreational activity as a secondary use.

Port improvements could result in short-term delays and crowding during construction but could provide long-term benefits to recreational boating if the improvements result in increased berths and amenities for recreational vessels, or improved navigational channels.

Presence of structures: The placement of 901 WTGs (excluding the Proposed Action) in the geographic analysis area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects. The WTGs installed for offshore wind development (excluding the Proposed Action) are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. The increased number of fishing trips out of nearby ports could also support increased angler expenditures at local bait shops, gas stations, and other shore-side dependents.

Offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the offshore wind structures on recreational boating would be limited by the distance offshore. Most recreational boating takes place within 3 nautical miles (5.5 kilometers) of the shore and within state waters (COP Volume 2, Section 10.3.1.2.1; Mayflower Wind 2022). Boating routes with the highest density in Nantucket Sound were located in the channel between Falmouth and Martha's Vineyard and north of the Nantucket Boat Basin. In addition, sailing in the geographic analysis area primarily occurs in relatively small areas in the bays and inlets and just along the coastline.

WTG foundations, associated scour protection, and cable protection for export and interarray cables would result in an increased risk of entanglement. The cable protection would also present a hazard for anchoring, because 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.

Offshore WTGs could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The structures could produce artificial reef effects. The "reef effect" refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat (COP Volume 2, Section 6.7.4.3, Table 6-56; Mayflower Wind 2022). The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters traveling farther from shore to fish in the geographic analysis area.

As it relates to the visual impacts of structures, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.6.9, *Scenic and Visual Resources*, describes the visual impacts from offshore wind infrastructure. Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism found that established offshore wind facilities in Europe did not result in decreased tourist numbers, tourist experience, or tourist revenue, and that Block Island Wind Farm's WTGs provide excellent sites for fishing and shellfishing (Smythe et al. 2018). A survey-based study found that, for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore is correlated to the share of respondents who would expect a worsened experience visiting the coast (Parsons and Firestone 2018).

- At 15 miles (24.1 kilometers), the percentage of respondents who reported that their beach experience would be worsened by the visibility of WTGs was about the same as the percentage of those who reported that their experience would be improved (e.g., by knowledge of the benefits of offshore wind).
- About 68 percent of respondents indicated that the visibility of WTGs would neither improve nor worsen their experience.
- Reported trip loss (respondents who stated that they would visit a different beach without offshore wind development) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.
- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreational activities, such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast. Most (77 percent) supported offshore wind development along the New Hampshire coast, while 12 percent opposed it and 11 percent were neutral. Regarding the impact on their outdoor recreation experience, 43 percent anticipated that offshore wind development would have a beneficial impact, 31 percent anticipated a neutral impact, and 26 percent anticipated an adverse impact (BOEM 2021).

Portions of the WTGs in the geographic analysis area associated with other offshore wind projects could be visible from shorelines (depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity). WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernable due to the introduction of industrial elements in previously undeveloped views. Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be moderate, long term, continuous, and adverse. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole.

Traffic: Other offshore wind project construction and decommissioning and, to a lesser extent, offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic in the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the offshore wind construction areas. Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate between 15 and 35 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time (COP Volume 1, Section 3.3.14.1; Mayflower Wind 2022). Between 2023 and 2030 as many as 12 offshore wind projects (not including the Proposed Action) could be under construction. During periods of overlapping construction and assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate up to 420 vessels (either underway or at anchor) at any given time in the geographic analysis area.

Increased vessel traffic would require increased alertness on the part of recreational or tourist-related vessels and would result in minor delays or route adjustments. The likelihood of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. The possibility of delays and risk of collisions would increase if more than one offshore wind facility is under construction at the same time. Vessel traffic associated with offshore wind would have long-term, variable, adverse impacts on vessel traffic related to recreation and tourism. Higher volumes during construction would result in greater inconvenience, disruption of the natural marine environment, and risk of collision. Vessel traffic during operations would represent only a modest increase in the background volumes of vessel traffic, with minimal impacts on recreational vessels.

Conclusions

Impacts of the No Action Alternative: BOEM expects ongoing non-offshore wind activities and offshore wind activities to have continuing impacts on recreation and tourism. The impacts of ongoing activities, including ongoing construction of the Vineyard Wind 1 and South Fork projects, ongoing vessel traffic, presence of structures, and the noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, or offshore cables, would be **minor**.

Cumulative Impacts of the No Action Alternative: BOEM anticipates that planned activities would have a noticeable incremental effect on the cumulative impacts of the No Action Alternative, which would be **moderate** adverse and **minor beneficial**. Planned offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and vessel traffic during construction and the presence of offshore structures during operations. Noise and vessel traffic would have impacts on visitors, who may avoid onshore and offshore noise sources and vessels, and on recreational fishing and sightseeing as a result of the impacts on fish, invertebrates, and marine mammals. BOEM also anticipates that the offshore wind activities in the geographic analysis area would result in minor beneficial impacts due to the presence of offshore structures and cable hardcover, which could provide opportunities for fishing and sightseeing. Planned non-offshore activities including emplacement of submarine cables and pipelines, dredging and port improvements, marine mineral use, and military use would also contribute to impacts, but any disruptions to recreational activity would be temporary and minimal.

3.6.8.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the following sections.

The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on recreation and tourism.

- The Project layout including the number, type, height, and placement of the WTGs and OSPs, and the design and visibility of lighting on the structures.
- Arrangement of WTGs and accessibility of the Wind Farm Area to recreational boaters.
- The time of year during which onshore and nearshore construction occurs.

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

- **WTG number, size, location, and lighting**: More WTGs and larger turbine sizes closer to shore could increase visual impacts that affect onshore recreation and tourism, as well as recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- **WTG arrangement and orientation**: Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- **Time of construction**: Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season.

Mayflower Wind has committed to measures to minimize impacts on recreation and tourism, which include, but are not limited to, developing, and implementing a Traffic Management Plan to minimize disruptions to residences and commercial establishments in the vicinity of onshore construction activities and development of an onshore construction schedule to minimize effects on recreational uses and tourism-related activities to the extent feasible (COP Volume 2, Table 16-1; Mayflower Wind 2022).

3.6.8.5 Impacts of Alternative B – Proposed Action on Recreation and Tourism

The Proposed Action would have long-term, minor impacts on recreation and tourism in the geographic analysis area due to the visual impact of the 147 WTGs from coastal locations and the greater navigational risks for recreational vessels in the Wind Farm Area. It would also have long-term, minor beneficial impacts due to the fish aggregation and habitat conversion impacts of the WTGs and OSPs, resulting in new fishing and sightseeing opportunities. The Proposed Action would have short-term, minor impacts during construction due to the temporary impacts of noise and vessel traffic on recreational vessel traffic, the natural environment, and species important for recreational fishing and sightseeing.

Anchoring: Anchoring by Proposed Action construction, O&M, and decommissioning vessels would contribute to disturbance of marine species and inconvenience to recreational vessels that must navigate around the anchored vessels. Construction of the Proposed Action would generate between 15 and 35 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time (COP Volume 1, Section 3.3.14.1; Mayflower Wind 2022). Mayflower Wind has proposed implementing safety zones around offshore construction areas in consultation with the USCG, which would minimize the potential for recreational boater interaction with anchored construction vessels in these areas (COP Volume 2, Section 10.3.2.1.1; Mayflower Wind 2022). Vessel anchoring for construction of the Proposed Action would have localized, short-term, minor impacts on tourism and recreation due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing.

Land disturbance: Onshore construction would affect recreation and tourism where construction activity interferes with access to recreation sites or increases traffic, noise, or temporary emissions that degrade the recreational experience. Ground disturbance from installation of the cables would be localized to the immediate vicinity of construction (COP Volume 1, Section 3.4.1.4.1; Mayflower Wind 2022). Several of the proposed landfall sites for both export cable corridors would occur within or adjacent to recreational areas. For the Falmouth onshore export cable, these areas include a landfall in Worcester Park near Falmouth Heights Beach, within Central Park at Falmouth Heights Beach, and at a public parking area at Surf Drive Beach. For the Brayton Point onshore export cable, these areas include a landfall at the Bertha K. Russel Preserve and within a parking lot at the Montaup Country Club at the intermediate landfall on Aquidneck Island. During HDD activity at these landfalls, recreational users of these and nearby sites would experience temporary disruptions including elevated noise, emissions, and visual disturbances that may decrease recreational enjoyment. Sites may need to be fully or partially closed while construction activity is taking place, further restricting the recreational use of these areas. Because the HDD landfall sites are proposed inland, no impacts on beach access or recreational fishing is expected, with the exception of the Falmouth landfall in the public parking area at Surf Drive Beach where use of the parking lot may be restricted during construction. Based on NOAA's Marine Recreational Information Program (NOAA 2022c), no public fishing sites are in the immediate vicinity to these landfall sites that would be affected by HDD or other cable installation activities.

Following construction, these sites would be returned to their previous condition, with the exception of a transition joint/vault that can be accessed for maintenance, and recreational use would be restored. From the point of landfall, cables would installed in trenches within existing roadways where feasible (OP Volume 1, 3.3.7.1; Mayflower Wind 2022). Because the onshore cable routes would mostly follow existing road rights-of-way, there would be no direct impacts on recreational sites or activities, although there may be some temporary indirect impacts due to temporary road closures and vehicle congestion. Overall, installation of the landfall locations and onshore cable routes would result in localized, short-term, and minor impacts on recreation and tourism. The proposed onshore substations and converter station would be located on gravel quarry sites and a former power plant where no recreational activity occurs. Therefore, impacts from onshore construction of these facilities would be localized, temporary, and negligible.

As discussed in Section 3.6.3, the employment and economic impact would be localized, short term, and minor. As discussed in Section 3.6.5, *Land Use and Coastal Infrastructure*, technologies may be used to minimize impacts on land disturbance. Mayflower Wind has committed to implementing a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (COP Volume 2, Section 16, Table 16-1; Mayflower Wind 2022). These measures would minimize impacts on recreation and tourism from construction activities.

Lighting: When nighttime construction occurs, the vessel lighting for vessels traveling to and working at the Proposed Action's offshore construction areas may be visible from onshore locations depending upon the distance from shore, vessel height, and atmospheric conditions. Visibility would be sporadic and variable. Although most construction is expected to occur during daylight hours, construction vessels would use work lights to improve visibility during night or poor visibility, in accordance with USCG requirements.

During operations, the Proposed Action would have a discrete contribution to nighttime visibility of the WTGs due to required aviation hazard lighting. Mayflower Wind has committed to voluntarily implementing ADLS, which would activate the Proposed Action's WTG lighting only when aircraft approach the WTGs (COP Volume 2, Section 8.2.2.2; Mayflower Wind 2022). The implementation of ADLS would reduce the duration of the potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS (COP Appendix T, Section 5.1.3; Mayflower Wind 2022). During times when the Proposed Action's aviation warning lighting is visible, this lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the limited duration and frequency of such events and the distance of the Proposed Action's WTGs from shore, visible aviation hazard lighting for the Proposed Action would result in a long-term, intermittent, negligible impact on recreation and tourism. For the onshore substations, Mayflower Wind will work with Falmouth and Somerset, Massachusetts to ensure the lighting scheme for the onshore substation and converter station complies with Town requirements. Operational lighting would be down-shielded to mitigate light pollution and will be designed to comply with nigh sky lighting standards (COP Volume 2, Section 8.2.2.2; Mayflower Wind 2022).

Cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism. The Proposed Action would require export cables that would be 1,179 statute miles (1,897 kilometers) long and interarray cables that would be 497 statute miles (800 kilometers) long (Appendix D, Table D2-1). Cable installation would require a maximum of eight vessels (three cable lay barges and five cable transport and lay vessels) (COP Volume 1, Section 3.3.14.1, Table 3-21; Mayflower Wind 2022). Recreational vessels traveling near the offshore export cable routes would need to navigate around vessels and access-restricted areas associated with the offshore export cable installation. The proposed Falmouth and Brayton Point offshore export cable routes intersect and pass adjacent to several popular offshore fishing areas, including the Owl and Mutton Shoal (COP Volume 2, Figure 11-22, Mayflower Wind 2022). Mayflower Wind has committed to developing a communication plan to inform recreational fishers, among others, of construction and maintenance activities and vessel movements, which would minimize potential adverse impacts associated with cable emplacement and maintenance activity (COP Volume 2, Section 10.3.2.2.2; Mayflower Wind 2022). The localized, temporary need for changes in navigation routes due to Proposed Action construction would constitute a minor impact.

Cable installation could also affect fish and marine mammals of interest for recreational fishing and sightseeing through dredging and turbulence, although species would recover upon completion (Section 3.5.7, *Sea Turtles*, and Section 3.5.6, *Marine Mammals*), resulting in localized, short-term, minor impacts on recreation and tourism. Cable emplacement and maintenance that occur near beaches, fishing sites, or nearshore recreational activities could contribute to recreational impacts due to temporary water quality impacts during construction and maintenance.

Noise: Noise from onshore cable installation, O&M, pile driving and trenching, and vessels could result in impacts on recreation and tourism. Temporary impacts on recreation and tourism would result from impacts in the Wind Farm Area and along the offshore export cable route on species important to recreational fishing and marine sightseeing. The temporary disruptions to or changes in offshore fish, shellfish, and whale populations (Sections 3.5.5 and 3.5.6) would have a minor impact on recreational fishing or marine sightseeing.

In addition to the temporary disruption to fish and shellfish, noise generated by offshore construction and onshore cable installation would have impacts on the recreational enjoyment of the marine and coastal environments, with minor impacts on recreation and tourism. Offshore construction noise would occur from vessels, pile driving, and other installation activities along the offshore export cable route and in the Wind Farm Area. As the Proposed Action would be built 20 nautical miles (48 kilometers) offshore, noise effects from offshore construction noise on onshore recreational activities would be temporary and negligible. Recreational boaters in the vicinity of the WTG and offshore cable installation may experience increased noise from construction, which would temporarily inconvenience recreational boaters.

Mayflower Wind conducted noise modeling for onshore construction activities (e.g., HDD) and onshore substation and converter station operations to assess the impact on sensitive receptors and conformance with acoustic regulatory thresholds (COP Volume 2, Section 9; Mayflower Wind 2022). The analysis determined that noise from construction and operations would comply with applicable thresholds assuming implementation of applicant-proposed measures, such as installing sound barriers (refer to COP Volume 2, Section 9.1.5 for a description of the proposed measures [Mayflower Wind 2022]). While temporary noise increases could affect the enjoyment of some recreators in the vicinity of construction activity, the effects would be localized, short-term and minor. Because the proposed onshore substations and converter station would be located on sand and gravel quarries and a former power plant where no recreational use occurs, and Mayflower Wind would implement applicant-proposed measures to minimize noise levels, the effects of operational noise on recreation would be long-term but negligible.

Overall, construction noise from the Proposed Action alone would have localized, short-term, minor impacts on recreation and tourism. Offshore operational noise from the WTGs would be similar to the noise described for other projects under the No Action Alternative and would, therefore, have continuous, long-term, negligible impacts.

Port utilization: In the geographic analysis area, the Proposed Action would use facilities primarily off the coast of Massachusetts and Rhode Island for construction and O&M (COP Volume 1, Section 3.3.13; Mayflower Wind 2022). No port upgrades are proposed as part of the Proposed Action upgrades. Vessel traffic in the port areas may result in short-term delays and crowding during construction, which could temporarily affect recreational vessel use. The Proposed Action would have a short-term, negligible impact on recreation and tourism due to port utilization in the geographic analysis area.

Presence of structures: The Proposed Action's 149 WTGs and five OSPs would affect recreation and tourism through increased navigational complexity; attraction of recreational vessels to offshore wind structures for fishing and sightseeing; the adjustment of vessel routes for recreational fishing; the risk of fishing gear loss or damage by entanglement due to scour or cable protection; difficulties in anchoring over scour or cable protection; and visual impacts.

Construction and installation, expected to begin in 2024, would affect recreational boaters. Risk of allision with anchored vessels would increase incrementally during construction, as more anchored vessels would be in the recreation and tourism geographic analysis area. Mayflower Wind has committed to developing a communication plan to inform the public of construction and maintenance activities and vessel movements, which would minimize potential adverse impacts associated with structure construction activities (COP Volume 2, Section 10.3.2.2.2; Mayflower Wind 2022). Most recreational boating takes place within 3 nautical miles (5.5 kilometers) of the shore and within state waters (COP Volume 2, Section 10.3.1.2.1; Mayflower Wind 2022). Boating routes with the highest density in Nantucket Sound were located in the channel between Falmouth and Martha's Vineyard and north of the Nantucket Boat Basin. Recreational boating activity in the Wind Farm Area is much less frequent than in areas closer to the coast. Mayflower Wind proposes to minimize impacts through the navigation-related AMMs listed in the COP Volume 2 Table 16-1.

During O&M of the Proposed Action, the permanent presence of WTGs would create obstacles for recreational vessels. At their lowest point, WTG blade tips would be 53.8 feet (16.4 meters) above the highest astronomical tide (COP Volume 1, Section 3.3.2; Mayflower Wind 2022). At this height, larger sailboats would need to navigate around the Wind Farm Area, while smaller vessels could navigate unobstructed (except for the WTG monopiles).

There are several popular offshore fishing areas in the geographic analysis area as shown in the COP Volume 2 Figure 11-22, but none of these areas overlap the Lease Area (Mayflower Wind 2022). As noted in Section 3.6.1, *Commercial Fisheries and For Hire Recreational Fishing*, navigational hazards and scour/cable protection due to the presence of structures from ongoing and planned activities, including the Proposed Action, would result in substantial adverse impacts on commercial fisheries and for-hire recreational fishing. In addition, private recreational anglers may avoid fishing in the Wind Farm Area due to concerns about their ability to safely fish in or navigate through the area. Kirkpatrick et al. (2017) analyzed recreational fishing exposure from offshore wind development by quantifying the total recreational fishing activity that may be affected by offshore wind development in a given area if anglers opt to no longer fish in this area and cannot go to a different location. For the Massachusetts wind energy area, recreational fishing was considered "exposed" to potential impact if at least part of the trip occurred within 1 nm (1.9 kilometers) of the Massachusetts wind energy area during the study period (2007–2012). Angler trips from Fall River, Massachusetts, and New Bedford, Massachusetts, are most exposed to the Massachusetts wind energy area, with 4,133 private angler trips, or 10.0 percent of total angler trips, originating from Fall River that would be exposed, and 4,067 private angler trips, or 9.6 percent of total angler trips, originating from New Bedford that would be exposed (Kirkpatrick et al. 2017). See Section 3.6.1 for more discussion on private and for-hire fishing. Some beneficial impacts on recreational fishing due to the artificial reef effect are expected. Evidence from Block Island Wind Farm indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). However, the magnitude of benefits to recreational fishermen resulting from the Project may be reduced due to the greater distance of these structures from the shore (Starbuck and Lipsky 2013). BOEM does not anticipate that habitat conversion and fish aggregation due to the presence of structures would result in considerable changes in fish distributions across the geographic analysis area. Overall, the impacts on recreational fishing, boating, and sailing generally would be negligible, while the impacts on for-hire fishing would be minor because these enterprises are more likely to be materially affected by displacement.

As it relates to visual impacts of presence of structures, the Proposed Action’s WTGs would also affect recreation and tourism through visual impacts. During construction, viewers on Martha’s Vineyard and Nantucket would see the upper portions of tall equipment, such as mobile cranes. These cranes would move from turbine to turbine as construction progresses and, thus, would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a temporary, negligible impact on recreation and tourism.

The WTGs would be in open ocean approximately 20 nautical miles (37 kilometers) east from the coast. The maximum-case WTGs would have a hub height of 605.1 feet (184.4 meters) above mean lower low water (COP Volume 1, Section 3.3, Table 3-1; Mayflower Wind 2022), a navigation light at the top of the nacelle, and a mid-tower light. At maximum vertical extension, the blade tips of the WTGs would be theoretically visible to a viewer at a 5-foot (1.5-meter) eye level above the ocean surface or beach shoreline elevation at distances up to 42.8 miles (68.9 kilometers) with clear-day conditions. Between 33.6 (54.1 kilometers) and 42.8 miles (68.9 kilometers), only the WTG blades would be potentially visible above the horizon from the perspective of a beach-elevation viewer. The blades, navigation light, nacelle, hub, tower, and mid-tower light would be theoretically visible to viewers on the ocean surface or beach shoreline at distances between 24.2 (38.9 kilometers) and 42.8 miles (68.9 kilometers). Mayflower Wind has voluntarily committed to use ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint colors to reduce impacts (COP Appendix T, Section 5.4; Mayflower Wind 2022).

The visual impact of future offshore wind structures could affect recreation and tourism. The visual contrast created by the WTGs could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer’s orientation, activity, and purpose for visiting the area. For example, beaches with views of WTGs could gain trips from the estimated 2.5 percent of beach visitors for whom viewing the WTGs would be a positive result, offsetting some lost trips from visitors who consider views of WTGs to be negative (Parsons and Firestone 2018). BOEM expects the impact of visible WTGs on the use and enjoyment of recreation and tourist facilities and activities during O&M of the Proposed Action to be long term, continuous, and minor.

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk, primarily during Project construction and decommissioning, along routes between ports and the offshore construction areas. Construction of the Proposed Action would generate between 15 and 35 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time (COP Volume 1, Section 3.3.14.1; Mayflower Wind 2022). Recreational vessels may experience delays in the ports serving construction, but most recreational boaters in the geographic analysis area would experience only minor inconvenience from construction-related vessel traffic. Vessel travel requiring a specific route that crosses or approaches the offshore export cable routes could potentially experience minor impacts. Operation of the Proposed Action would have localized, long-term, intermittent, minor impacts on recreational vessel traffic near ports and in open waters. Impacts during decommissioning would be similar to the impacts during construction and installation.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities. The cumulative impacts from vessels anchoring would be short-term and minor and would be most pronounced when multiple offshore wind projects are under construction at one time. The Proposed Action would incrementally contribute to land disturbance impacts from ongoing and planned activities that disrupt recreational access or enjoyment. Because most land disturbance impacts would be temporary, and overlapping construction activity from the Proposed Action and other projects is anticipated to be minimal, cumulative impacts would be short-term and minor.

The Proposed Action would add to the combined lighting impacts from ongoing and planned activities including offshore wind. The Proposed Action, in combination with other ongoing and planned offshore wind projects, would cause aviation hazard lighting to be potentially visible from 1,048 total WTGs. ADLS would reduce the nighttime impact significance on recreation and tourism to negligible due to substantially limited hours of lighting (COP Appendix T, Section 5.1.3; Mayflower Wind 2022).

The cumulative impacts of the Proposed Action related to cable emplacement would have minor impacts on recreation and tourism, due to the localized and temporary nature of the impacts and ability of displaced users to use alternate nearby locations during construction and installation, O&M, and decommissioning of offshore export cables. Similarly, noise created as a result of the Proposed Action in combination with other ongoing and planned activities would have minor impacts on recreation and tourism, as construction noise would be temporary and users could avoid elevated noise levels by using alternative locations. Impacts of noise on recreation and tourism during operations would be negligible and long term. The Proposed Action would incrementally contribute to increased port utilization that, combined with other ongoing and planned activities, would have negligible impacts on recreation and tourism because any delays at ports would be short in duration and temporary.

The Proposed Action would contribute incrementally to the combined impacts on recreational boating, fishing, and other marine recreational activity from ongoing and planned activities associated with the presence of structures. The geographic extent of impacts would increase as additional offshore wind projects are constructed, resulting in negligible to minor adverse impacts on recreational fishing, recreational sailing and boating, and for-hire recreational fishing, as well as minor beneficial impacts associated with the artificial reef effect.

Portions of 1,048 WTGs from the Proposed Action combined with future offshore wind projects could be visible from coastal and elevated locations in the geographic analysis area and contribute to impacts on recreation and tourism. The Proposed Action WTGs would contribute the most from the closest locations, including Wasque Point on the southeastern end of Chappaquiddick Island in Martha's Vineyard and Ladies Beach on the southern edge of Nantucket (COP Appendix T, Section 5.3.1, Tables 5-8 and 5-9; Mayflower Wind 2022). Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP Appendix T, Section 5.1.3; Mayflower Wind 2022). The combined visual impacts on recreation and tourism from ongoing and planned activities including offshore wind would be long term, continuous, and minor in the overall geographic area, with moderate impacts on shoreline areas with views of WTGs.

Overlapping construction schedules of the Proposed Action and other offshore wind projects in the geographic analysis area would increase traffic between ports and work areas, requiring increased alertness on the part of recreational or tourist-related vessels, and possibly resulting in a greater number of minor delays or route adjustments. The likelihood of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. Modest levels of vessel traffic are anticipated from offshore wind operations. In context of reasonably foreseeable environmental trends, incremental impacts contributed by the Proposed Action to the combined vessel traffic impacts on recreation and tourism from ongoing and planned activities would be localized, short term, and minor.

Conclusions

Impacts of the Proposed Action: The impacts of the Proposed Action would be **minor** and **minor beneficial**. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs, as well as the long-term presence of cable hardcover and structures in the Wind Farm Area during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures.

Cumulative Impacts of the Proposed Action: In context of other reasonably foreseeable environmental trends, the combination of the Proposed Action and other ongoing and planned activities would result in **moderate** impacts with **minor beneficial** impacts. The main drivers for this impact rating are the visual impacts associated with the presence of structures and lighting; impacts on fishing and other recreational activity from noise, vessel traffic, and cable emplacement during construction; and beneficial impacts on fishing from the reef effect.

3.6.8.6 Impacts of Alternative C on Recreation and Tourism

Impacts of Alternative C: Alternative C would result in similar but slightly greater impacts on recreation and tourism compared to the Proposed Action, but the overall impact magnitudes would be the same. To avoid sensitive fish habitat in the Sakonnet River, the export cable route to Brayton Point under Alternative C-1 and Alternative C-2 would be rerouted onshore. The onshore export cables would be installed in trenches within existing road ROWs where feasible, including road shoulders and medians, but could require pathways on private properties. The Alternative C-1 onshore export cable route would be installed primarily along Route 138, on Aquidneck Island, increasing the total length of the onshore cable route by approximately 9 miles. The Alternative C-2 onshore export cable route would be installed primarily along Routes 77 and 177, in Little Compton and Tiverton, increasing the total length of the onshore cable route by approximately 13 miles. Similar to the Proposed Action, onshore construction and installation of the export cables would affect recreation and tourism where construction activity interferes with access to recreational sites and from increases in traffic, noise, or temporary emissions that degrade the recreational experience. Construction impacts would have intermittent and short-term impacts on recreation.

Whereas the Proposed Action would make landfall on Aquidneck Island across the road from Island Park Beach, Alternative C-1 would make landfall in the parking lot of Second Beach and Alternative C-2 would make landfall in the parking lot of the Sakonnet Point Marina. Impacts among the landfall locations would be similar, resulting in temporary disruptions to access and increased noise and construction activity that may degrade the recreational experience at these sites during HDD activities. Based on NOAA's Marine Recreational Information Program (NOAA 2022c), shoreside recreational fishing sites may potentially be affected during cable placement activity and maintenance of the Alternative C-1 and Alternative C-2 cable landfalls. Recreational fishing and related sites in proximity to the Alternative C-1 export cable route include Second Beach in Middletown, Rhode Island. Recreational fishing and related sites in proximity to the Alternative C-2 export cable route include the Sakonnet Point Club and Breakwater and Sakonnet Harbor Ramp in Little Compton, Rhode Island, and the Boat House Dock in Tiverton, Rhode Island. Impacts would be temporary during cable installation and use of the sites would not be affected in the long term.

Impacts would be greatest if construction of the landfalls and export cables occurred during the busy summer tourist season. Because the cables are anticipated to be installed largely within existing road ROWs, there would be no permanent impacts on recreational sites, but construction activity could lead to temporarily reduced access to recreational sites and increased traffic, especially on Route 138 in Portsmouth under Alternative C-1, which is a well-traveled four-lane road with year-round tourist traffic. Disruptions in access and increased traffic would occur for a short period at any given location as installation of equipment progresses along the cable routes. The same avoidance measures that Mayflower Wind has proposed for the Proposed Action would apply for Alternative C, including implementing a Traffic Management Plan and a construction schedule to minimize effects to tourism related activities, including coordinating with stakeholders/visitors' bureaus to schedule outside of major events and avoiding construction during the summer tourist season (COP Volume 2, Table 16-1; Mayflower Wind 2022). Because these impacts would be temporary, lasting only during installation activities, and with implementation of the avoidance measures proposed by Mayflower Wind, impacts under Alternative C are anticipated to localized, short-term, minor.

Cumulative Impacts of Alternative C: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative C: While the onshore cable route to Brayton Point would differ under Alternatives C-1 and C-2, the overall impact magnitudes are anticipated to be the same as those of the Proposed Action, which is anticipated to be **minor** adverse and **minor** beneficial on recreation and tourism.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative C would be the same as the Proposed Action—**moderate** and **minor beneficial**.

3.6.8.7 Impacts of Alternative D on Recreation and Tourism

Impacts of Alternative D: Alternative D would involve the installation of up to six fewer WTGs than the Proposed Action, which would reduce the construction impact footprint and installation period. Construction of fewer WTGs would result in a negligible reduction of impacts on visual resources compared to the Proposed Action, unnoticeable to the casual viewer. Alternative D could reduce gear entanglements and loss, as well as allisions, and recreational fishing may slightly decrease due to fewer structures providing reef habitat for targeted species. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area and the risk of collision with marine mammals and sea turtles.

Cumulative Impacts of Alternative D: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative D would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative D: The **minor** impacts and **minor beneficial** impact associated with the Proposed Action would not change substantially under Alternative D. The impacts associated with Alternative D would be slight improvements over the Proposed Action's impacts, but the impact level would not change.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternative D would be the same as the Proposed Action—**moderate** and **minor beneficial**.

3.6.8.8 Impacts of Alternatives E and F on Recreation and Tourism

Impacts of Alternatives E and F: Alternative E, which would involve installing a range of foundation types (piled foundations under Alternative E-1; suction bucket foundations under Alternative E-2; or GBS under Alternative E-3), and Alternative F, which would allow for up to three HVDC offshore export cables to Falmouth (as opposed to the maximum of 5 as proposed under the Proposed Action), would not have measurable impacts on recreation and tourism that are materially different from the impacts of the Proposed Action.

Cumulative Impacts of Alternatives E and F: In the context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives E and F would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternatives E and F: The impacts of Alternatives E and F on recreation and tourism would be the same as those of the Proposed Action. Impacts would be **minor** impacts and **minor beneficial**.

Cumulative Impacts of Alternatives E and F: In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts of Alternatives E and F would be the same as the Proposed Action—**moderate** and **minor beneficial**.

3.6.8.9 Proposed Mitigation Measures

No measures to mitigate impacts on recreation and tourism have been proposed for analysis.

3.6 Socioeconomic Conditions and Cultural Resources

3.6.9 Scenic and Visual Resources

This section discusses potential impacts on seascape, open ocean, and landscape character and viewers from the proposed Project, alternatives, and ongoing and planned activities in the scenic and visual resources geographic analysis area, as advised in the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States* (BOEM 2021) and the *Guidelines for Landscape and Visual Impact Assessmen*t (3rd Edition) (Landscape Institute and Institute of Environmental Management and Assessment 2016). The geographic analysis area, as shown on Figure 3.6.9-1, includes an earth curvature-based 42.8-mile (68.9-kilometer) buffer around the Lease Area, a 3-mile (4.8-kilometer) buffer around the onshore substation and converter station sites, and a 0.5-mile (0.8-kilometer) buffer around the export cables. The geographic analysis area includes the full extent of the Offshore and Onshore Project areas and the coastlines from western Aquinnah, Martha's Vineyard to eastern Nantucket, the Sakonnet River to Portsmouth, Rhode Island and Somerset, Massachusetts, inland to north Falmouth, Massachusetts, including Upper Cape Cod, and associated smaller islands, including Nomans Land, Esther, Tuckernuck, and Muskeget, as well as the Elizabeth Islands off Cape Cod (COP Appendix T; Mayflower Wind 2022). Appendix H, *Seascape, Landscape, and Visual Impact Assessment*, contains additional analysis of the seascape, open ocean, and landscape character units, and viewer experiences that would be affected by the Proposed Action and alternatives, and visual simulations of the Proposed Action alone and in combination with other planned offshore wind projects.

3.6.9.1 Description of the Affected Environment and Future Baseline Conditions

This section summarizes the seascape, open ocean, landscape, and viewer baseline conditions as described in COP Appendix T, *Visual Impact Assessment* (VIA) (Mayflower Wind 2022). The demarcation line between seascape and open ocean is the U.S. state jurisdictional boundary, 3 nautical miles (3.45 statute miles) (5.5 kilometers) seaward from the coastline (U.S. Congress Submerged Lands Act, 1953). This line coincides with the area of sea visible from the shoreline. The line defining the separation of seascape and landscape is based on the juxtaposition of apparent seacoast and landward landscape elements, including topography, water (bays and estuaries), vegetation, and structures.

The geographic analysis area is classified by broadly defined land and water areas and more specific seascape, open ocean, and landscape character areas. These discrete areas are based on major features and elements that define the physical character, "feel" and "experiential qualities" of the geographic analysis area and include open ocean, shoreline, coast, marsh and bay, and inland areas. Seascape, open ocean, and landscape character areas provide a framework to analyze potential visual effects throughout the geographic analysis area. The character areas identified in this analysis are summarized in Table 3.6.9-1.

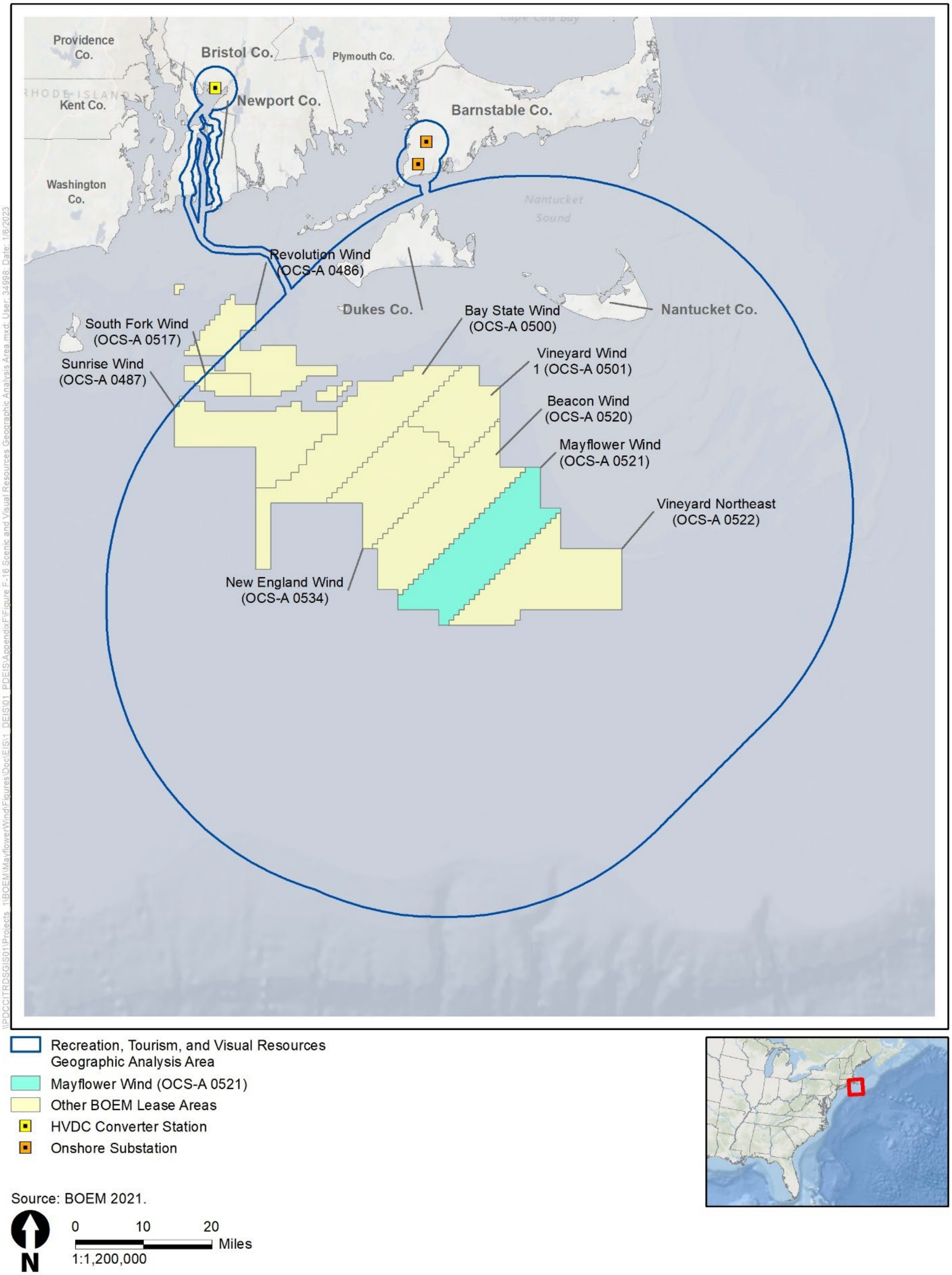

Figure 3.6.9-1. Scenic and visual resources geographic analysis area

Table 3.6.9-1. Seascape, open ocean, and landscape character areas

Areas	Character Areas [a]
Open Ocean	Ocean Character
Seascape Areas	Seascape Character Areas: • Ocean • Sound • Beachfront • Coastal Bluff • Coastal Dune • Boardwalk • Coastal Scrub • Commercial • Forests/Woodlands • Institutional • Park • Preserve • Residential • Salt Pond • Transportation • Village/Town
Landscape Areas	Landscape Character Areas: • Agriculture • Coastal Scrub • Commercial • Estuary • Forests/Woodlands • Institutional • Light Industrial • Marshland • Park • Preserve • Residential • Salt Pond • Pond Shoreline • Transportation • Village/Town

[a] Seascape, Open Ocean, and Landscape Character Areas are consistent with the seascape/landscape and visual impact assessment (SLVIA) and seascape/landscape impact assessment (SLIA) terminology and purpose (BOEM 2021).

Figure 3.6.9-2 provides an overview of seascape and landscape in the geographic analysis area, including the maximum extent of visibility of WTGs and key observation point (KOP) locations. Figure 3.6.9-3 and Figure 3.6.9-4 display existing landscape character, KOPs, and WTG viewshed on Martha's Vineyard and Nantucket. Figure 3.6.9-5 displays the areas in view of the Gay Head Lighthouse. Figure 3.6.9-6 displays the area in view of the Sankaty Head Lighthouse. Figure 3.6.9-7 and Figure 3.6.9-8 show existing landscape character and KOPs around the Brayton Point Onshore Project area and Falmouth Onshore Project area.

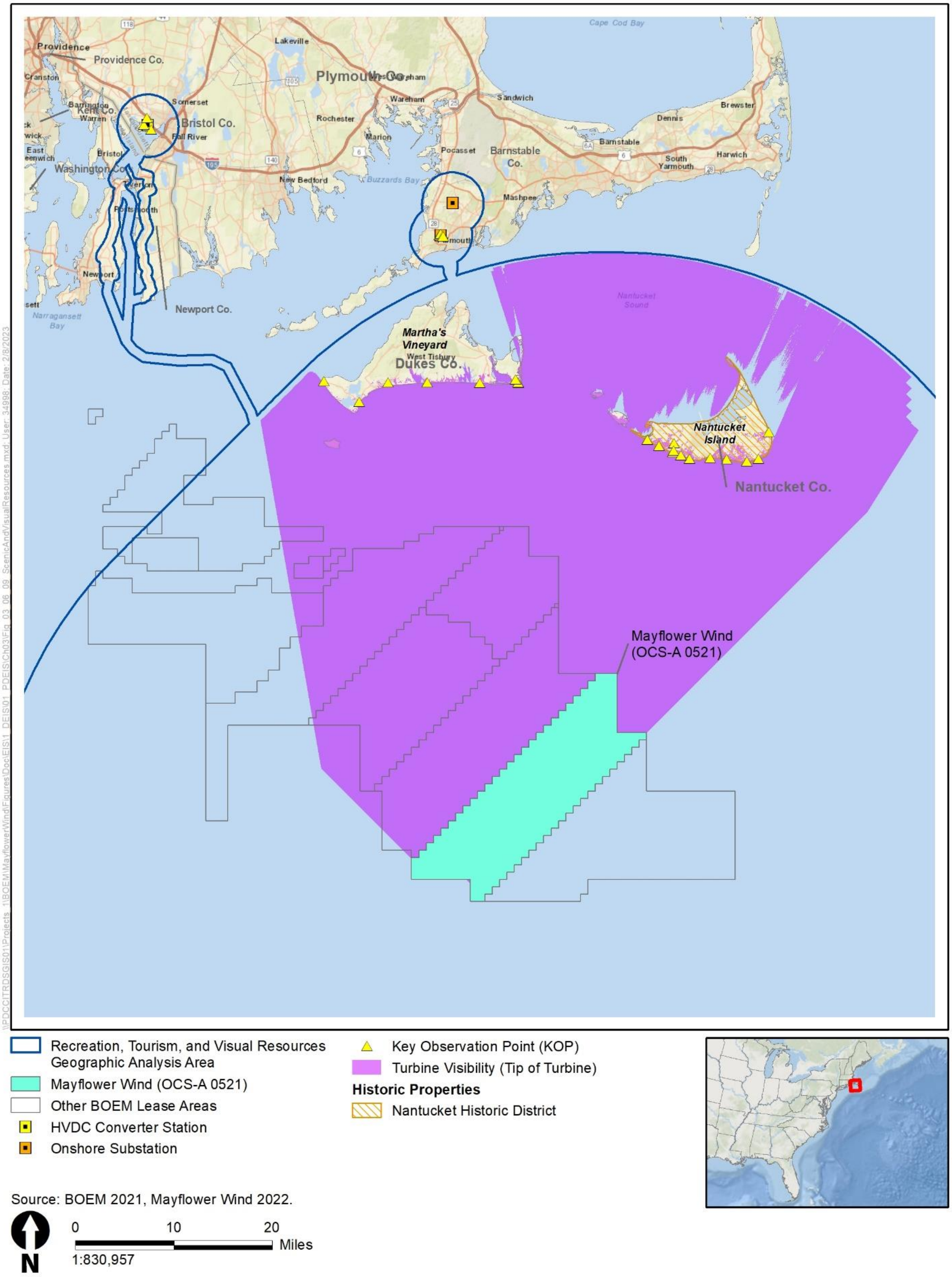

Figure 3.6.9-2. Scenic resources, offshore lease area viewshed, and KOP overview

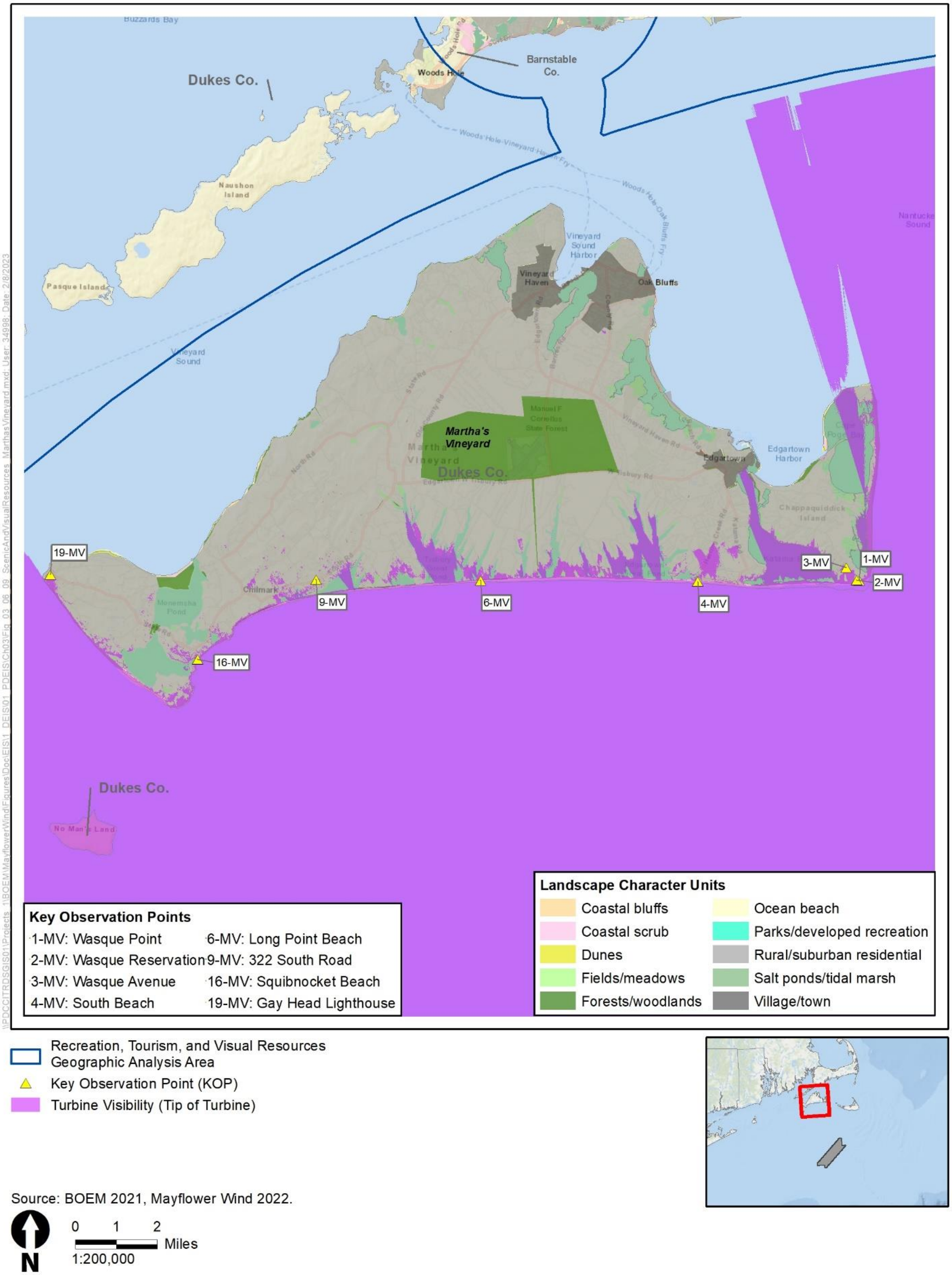

Figure 3.6.9-3. Landscape character, KOPs, and WTG viewshed – Martha's Vineyard

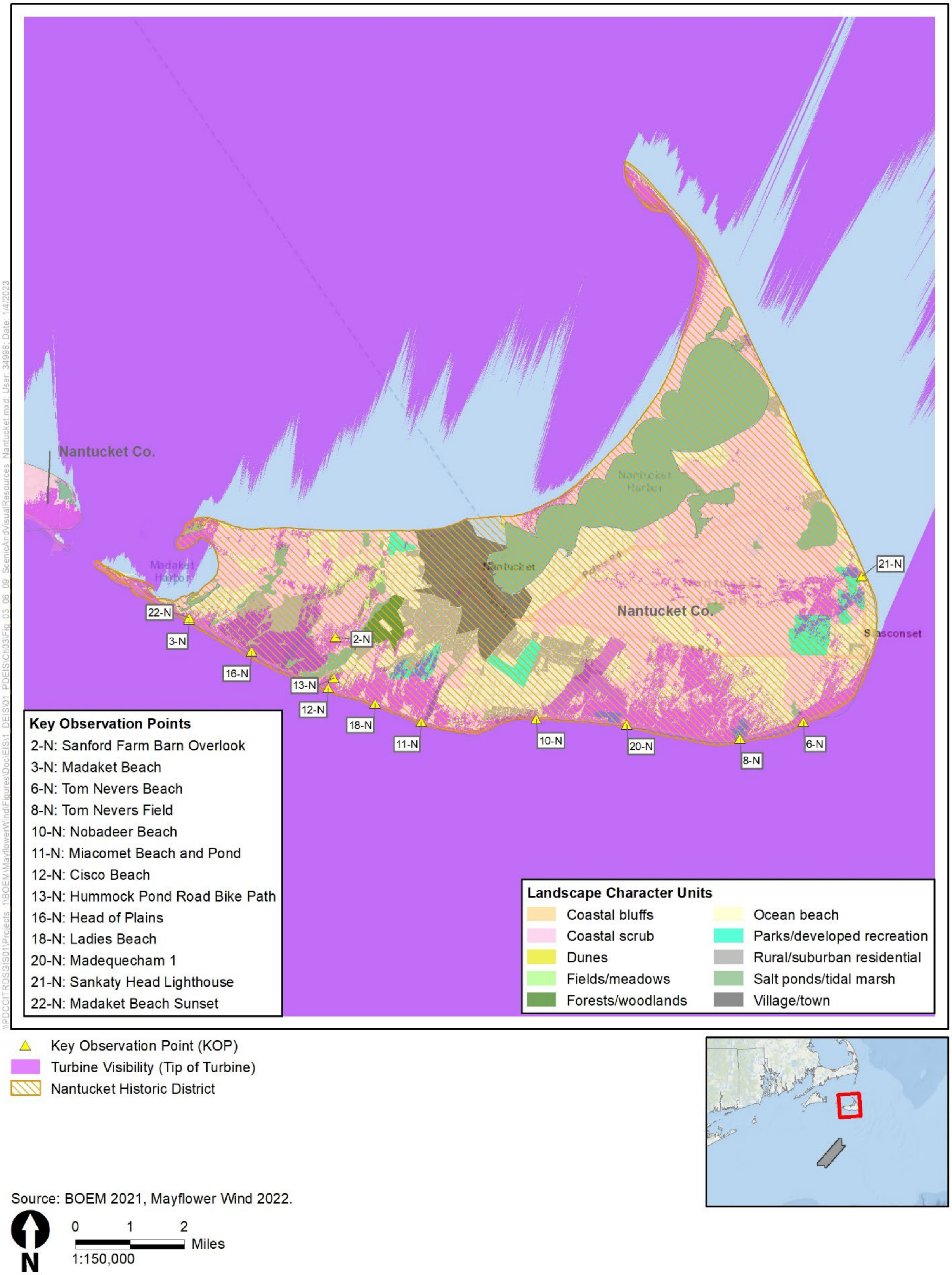

Figure 3.6.9-4. Landscape character, KOPs, and WTG viewshed – Nantucket

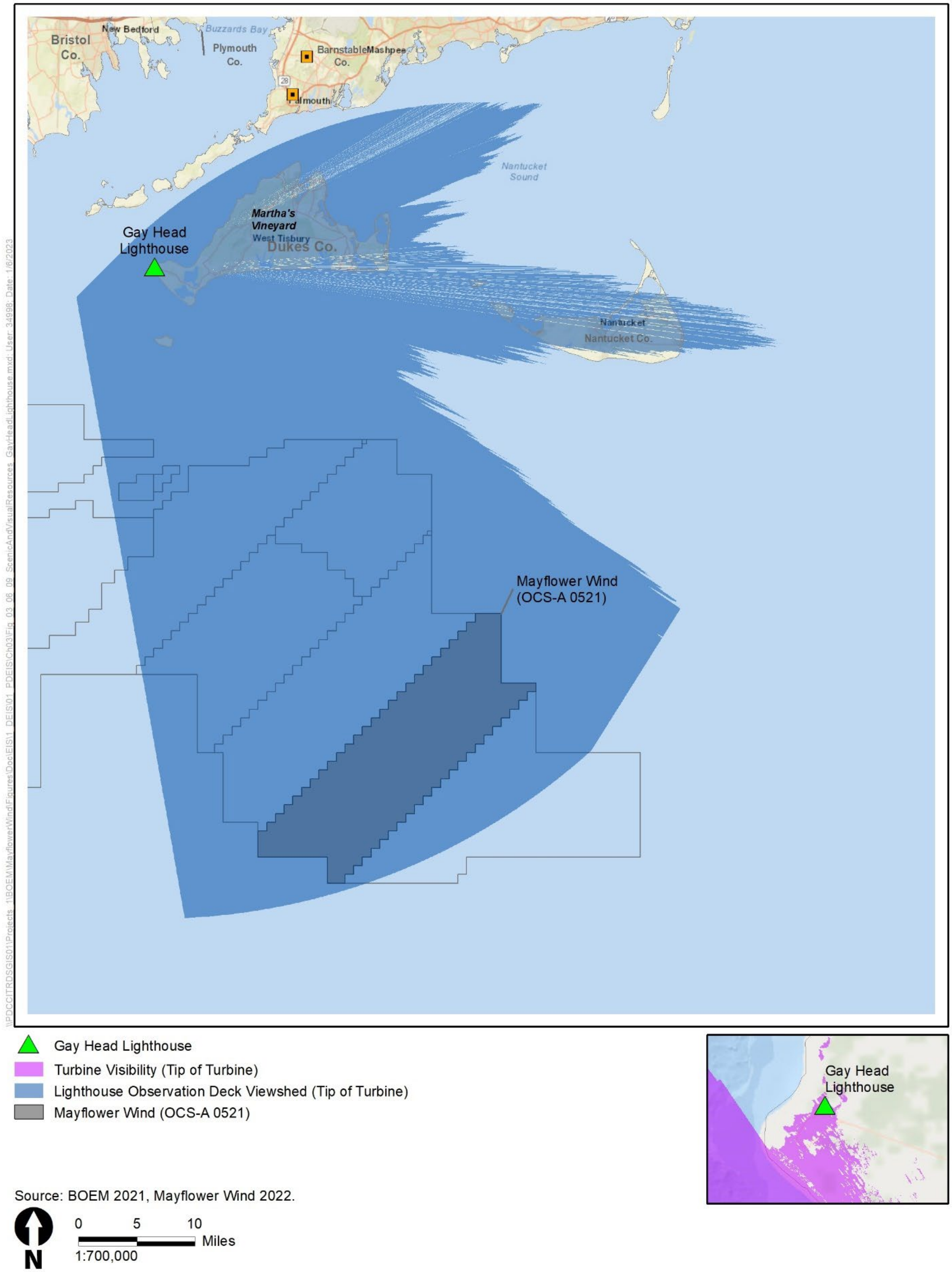

Figure 3.6.9-5. Gay Head Lighthouse viewshed

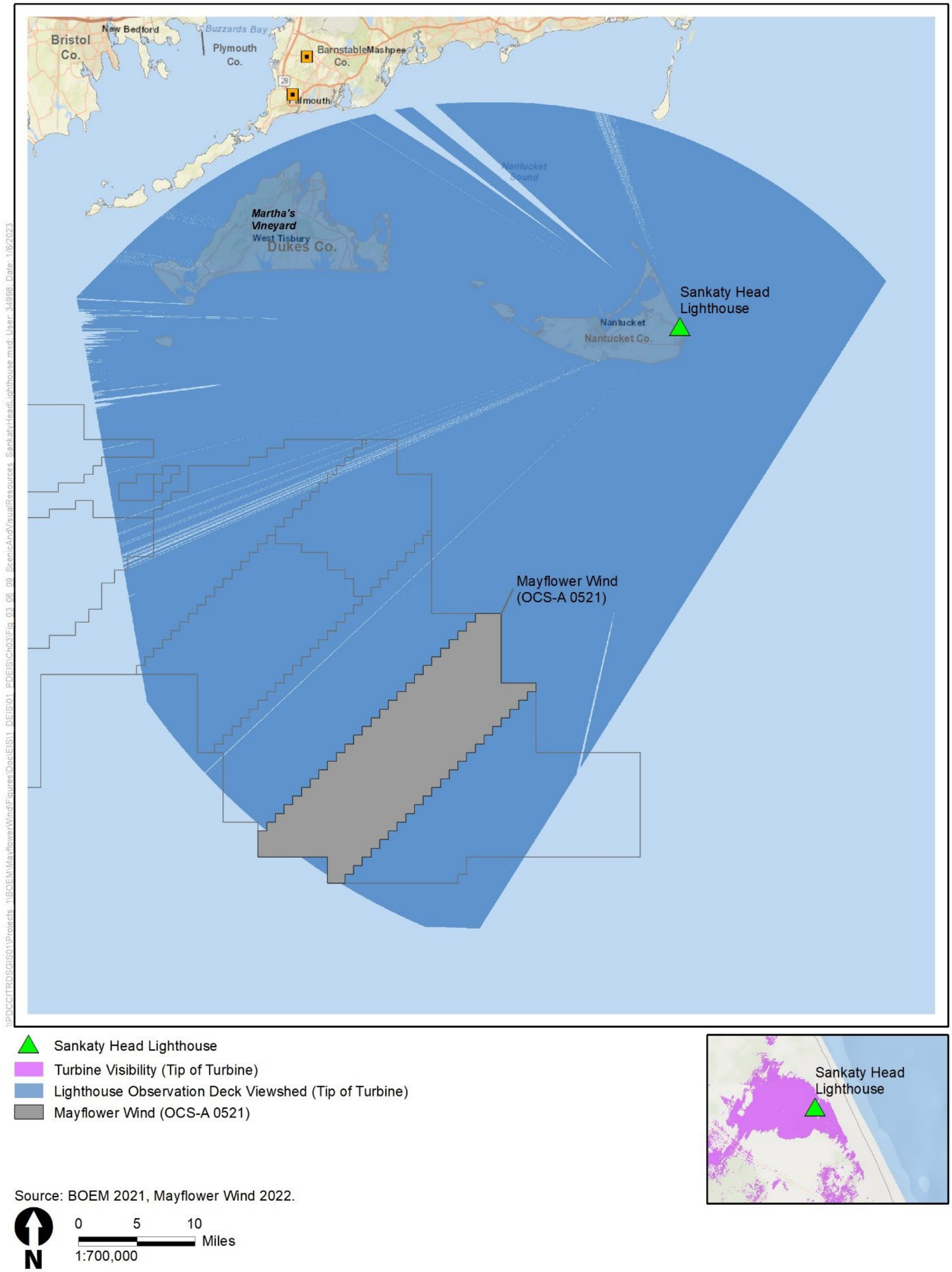

Figure 3.6.9-6. Sankaty Head Lighthouse viewshed

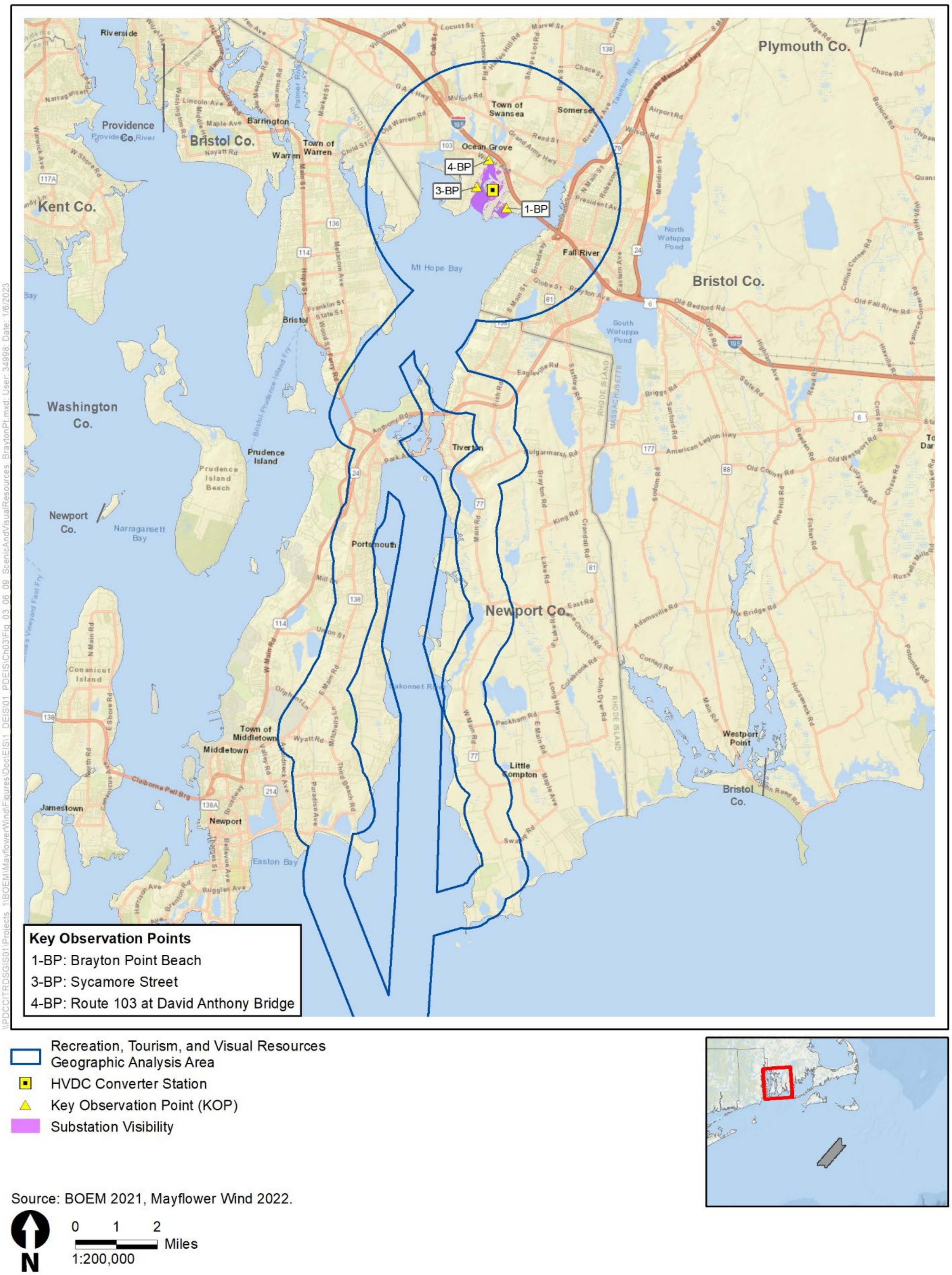

Figure 3.6.9-7. Scenic resources – Brayton Point

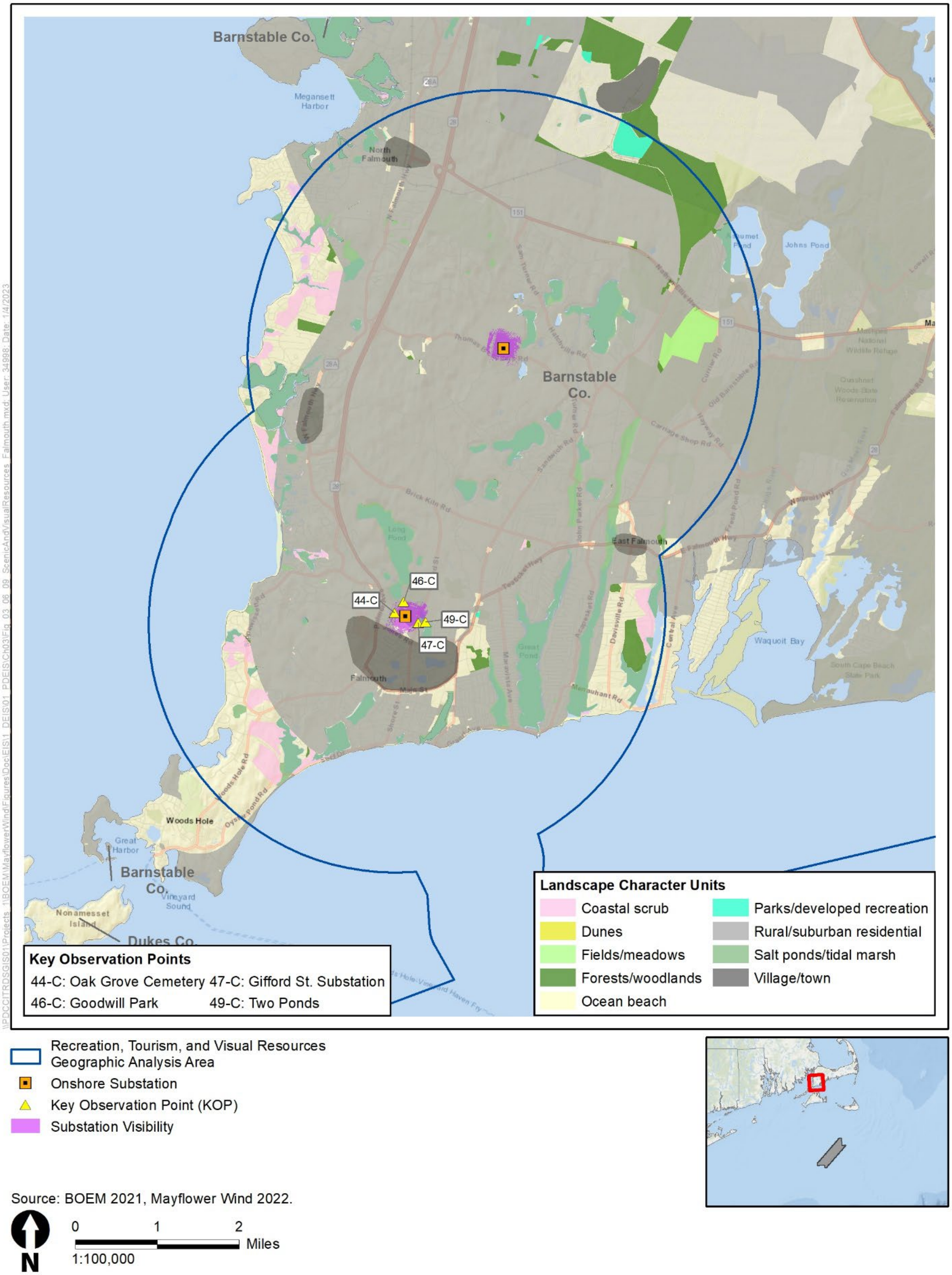

Figure 3.6.9-8. Scenic resources – Falmouth

The geographic analysis area's landforms, water, vegetation, and built environment structures contain common and distinctive landscape features as outlined in Table 3.6.9-2.

Table 3.6.9-2. Landform, water, vegetation, and structures

Category	Landscape Features
Landform	Flat shorelines to gently sloping beaches, cliffs, dunes, islands, and inland topography.
Water	Ocean, estuary, river and stream water patterns.
Vegetation	Tidal salt marshes and estuarine biomes, beach grass, bogs, heaths, meadows, and maritime forests. Vegetation community tree and shrub species include American beach (*Fagus grandifolia*), black oak (*Quercus velutina*), eastern red cedar (*Juniperus virginiana*), Japanese pine (*Pinus thunbergii)*, pitch pine (*Pinus rigida*), and white oak (*Quercus alba*), bayberry (*Morella caroliniensis*), beach plum (*Prunus maritime*), hazelnut (*Corylus americana*), highbush blueberry (*Viburnum trilobum*), huckleberry (*Vaccinium myrtillus*), inkberry (*Ilex glabra*), and wintergreen (*Pyrola minor*).
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, and infrastructure.

The visual characteristics of the seascape, open ocean, and landscape conditions in the geographic analysis area, including surroundings of the Wind Farm Area, landfall sites, offshore and onshore export cable corridors, and onshore substation and converter station areas, contain both locally common and regionally distinctive physical features, characters, and experiential views (Table 3.6.9-3).

Table 3.6.9-3. Seascape, open ocean, and landscape conditions

Category	Seascape, Open Ocean, and Landscape Conditions
Seascape	Intervisibility by pedestrians and boaters within coastal and adjacent marine areas (3.45 miles [5.5 kilometers]) in the geographic analysis area.
Seascape Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, and whitecaps.
Seascape Character	Experiential characteristics stem from built and natural landscape forms, lines, colors, and textures to the foreground water's tranquil, mirrored, and flat; active, rolling, and angular; vibrant, churning, and precipitous. Forms range from horizontal planar to vertical structures', landscapes', and water's slopes; lines range from continuous to fragmented and angular; colors of structures, landscape, and the water's foam, and spray reflect the changing colors of the daytime and nighttime, built environment, land cover, sky, clouds, fog, and haze; and textures range from mirrored smooth to disjointed coarse.
Open Ocean	Intervisibility within the open ocean (beyond the 3.45-mile [5.5-kilometer] seascape area) in the geographic analysis area from seagoing vessels, including recreational cruising, fishing, sailing vessels, commercial "cruise ship" routes, commercial fishing activities, tankers and cargo vessels and air traffic over and near the WTG array and cable routes.
Open Ocean Features	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, and whitecaps.

Category	Seascape, Open Ocean, and Landscape Conditions
Open Ocean Character	Experiential characteristics range from tranquil, mirrored, and flat; to active, rolling, and angular; to vibrant, churning, and precipitous. Forms range from horizontal planar to vertical slopes; lines range from continuous and horizontal to fragmented and angular; colors of water, foam, and spray reflect the changing colors of sky, clouds, fog, haze, and the daytime and nighttime, built environment and land cover; and textures range from mirrored smooth to disjointed coarse.
Landscape	Intervisibility within the adjacent inland areas, seascape, and open ocean; nighttime views diminished by ambient light levels of commercial, recreational, and residential development; open, modulated, and closed views of water, landscape, and built environment; and pedestrian, bike, and vehicular traffic throughout the region.
Landscape Features	Natural elements: landward areas of islands, bays, marshlands, shorelines, vegetation, flat to moderately inclined topography, and natural areas. Built elements: boardwalks, bridges, buildings, gardens, landscapes, life-saving stations, umbrellas, lighthouses, parks, piers, roads, seawalls, skylines, trails, single-family residences, commercial corridors, village centers, mid-rise motels, and low to moderate -density residences.
Landscape Character	Tranquil and pristine natural, to vibrant and ordered, to chaotic and disordered.
Designated National, State, and Local Parks, Preserves, and Parkways	Adams Lookout Cemetery, Cape Pogue Wildlife Refuge, Chilmark Cemetery, Coatue Wildlife Refuge, Correllus State Forest, Coskata-Coatue Wildlife Refuge, Felix Neck Wildlife Sanctuary, Francis Newhall Woods Nature and Wildlife Preserve, Gay Head Lighthouse, Holdgate Trails, Lily Pond Park, Long Point Wildlife Refuge, Main Street and Fair Street Park, Miacomet Pond Trail, Mill Hill Cemetery, Mill Hill Park, Mill Square Park, Moshup Trail, Municipal Cemetery, Nantucket National Historic District, Nantucket State Forest, Nashawena Park, Naushon Park, New North Cemetery, New Westside Cemetery, Newtown Cemetery, Niantic Park, Nomans Land Island National Wildlife Refuge, Ocean Park, Old North Cemetery, Penacook Park, Plymouth Park, Prospect Hill Cemetery, Sankaty Head Lighthouse, Saratoga Park, Sea View Hill Cemetery, Sesachacha Heathlands Wildlife Sanctuary, Shawkemo Hills Trail, Siasconset Park, South Beach State Park, Saint Mary Catholic Cemetery, Summerfield Park, Tower Hill Cemetery, Trinity Park, Veira Park, Waban Park, Washing Pond, Washington Park, Wesleyan Park, Westside Cemetery, and Winter Park.

The sensitivity of the geographic analysis area's seascape character is defined by its innate features, elements, and value to residents and visitors. Seascape sensitivity ratings include the following.

- **High**: Seascape character is highly distinctive and highly valued by residents and visitors.
- **Medium**: Seascape character is moderately distinctive and moderately valued by residents and visitors.
- **Low**: Seascape character is common, and unimportant to residents and visitors.

The sensitivity of the open ocean is defined by the activities of viewers, innate character, and susceptibility to the type of change proposed by the Project. Open ocean sensitivity ratings include the following.

- **High**: Open ocean characteristics are pristine, highly distinctive, and highly valued by residents and visitors.

- **Medium**: Open ocean characteristics are moderately distinctive and moderately valued by residents and visitors.
- **Low**: Open ocean characteristics are common or with minimal scenic value.

The sensitivity of the geographic analysis area's landscape character is defined by its innate features, elements, and value to residents and visitors. Landscape sensitivity ratings include the following.

- **High**: Landscape characteristics are highly distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape.
- **Medium**: Landscape characteristics are moderately distinctive and moderately valued by residents and visitors.
- **Low**: Landscape characteristics are common or within a landscape of minimal scenic value.

Table 3.6.9-4 summarizes the conditions within seascape, open ocean, and landscape settings with high, medium, and low innate sensitivity.

Table 3.6.9-4. Seascape, open ocean, and landscape sensitivity

Settings	Conditions
High-Sensitivity Seascape	Ocean shoreline, beach, and dune areas, and ocean areas within 3.45 statute miles (5.5 kilometers) of the shoreline Seascapes with national, state, or local designations: Gay Head Lighthouse, Sankaty Head Lighthouse, and Tom Nevers Field Beaches, boardwalks, and piers
High-Sensitivity Open Ocean	Ocean areas in the geographic analysis area
High-Sensitivity Landscape	Scenic and medium to high resident and visitor use volume coastal areas and bays, islands, sounds, and adjoining estuaries. Cemeteries, churches, historic sites, lighthouses, scenic overlooks, schools, town halls, and residential areas in the geographic analysis area Landscapes with national, state, or local designations: Adams Lookout Cemetery, Cape Pogue Wildlife Refuge, Chilmark Cemetery, Coatue Wildlife Refuge, Correllus State Forest, Coskata-Coatue Wildlife Refuge, Felix Neck Wildlife Sanctuary, Francis Newhall Woods Nature and Wildlife Preserve, Gay Head Lighthouse, Holdgate Trails, Lily Pond Park, Long Point Wildlife Refuge, Main Street and Fair Street Park, Miacomet Pond Trail, Mill Hill Cemetery, Mill Hill Park, Mill Square Park, Moshup Trail, Municipal Cemetery, Nantucket National Historic District, Nantucket State Forest, Nashawena Park, Naushon Park, New North Cemetery, New Westside Cemetery, Newtown Cemetery, Niantic Park, Nomans Land Island National Wildlife Refuge, Ocean Park, Old North Cemetery, Penacook Park, Plymouth Park, Prospect Hill Cemetery, Sankaty Head Lighthouse, Saratoga Park, Sea View Hill Cemetery, Sesachacha Heathlands Wildlife Sanctuary, Shawkemo Hills Trail, Siasconset Park; South Beach State Park, Saint Mary Catholic Cemetery, Summerfield Park, Tower Hill Cemetery, Trinity Park, Veira Park, Waban Park, Washing Pond, Washington Park, Wesleyan Park, Westside Cemetery, and Winter Park (including 517 private and public reserves [Appendix H])
Medium-Sensitivity Landscape	Moderately distinctive areas of medium scenic value and/or low resident or visitor use volume beaches, coastal areas and bays, sounds, adjoining estuaries, and inland areas
Low-Sensitivity Landscape	Indistinctive areas with low scenic value and limited to absent resident or visitor use volume

The susceptibility of the geographic analysis area's seascape character is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Seascape susceptibility rating criteria include the following.

- **High**: Seascape character is highly vulnerable to the type of change proposed, distinctive, and highly valued by residents and visitors.
- **Medium**: Seascape character is reasonably resilient to the type of change proposed, moderately distinctive, and moderately valued by residents and visitors.
- **Low**: Seascape character is unlikely to be affected by the type of change proposed, common, and unimportant to residents and visitors.

The susceptibility of the geographic analysis area's seascape, open ocean, and landscape character is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Open ocean susceptibility rating criteria include the following.

- **High**: The character is highly vulnerable to the type of change proposed, distinctive, and highly valued by residents and visitors.
- **Medium**: The character is reasonably resilient to the type of change proposed, moderately distinctive, and moderately valued by residents and visitors.
- **Low**: The character is unlikely to be affected by the type of change proposed, common, and unimportant to residents and visitors.

Table 3.6.9-5 summarizes the conditions in seascape, open ocean, and landscape settings with high, medium, and low susceptibility.

Table 3.6.9-5. Seascape, open ocean, and landscape susceptibility

Susceptibility	Settings
High-Susceptibility Seascape	Ocean shoreline portion of the seascape and ocean within the 3.45-mile (kilometer) seascape area (Table 3.6.9-1). Seascapes with national, state, or local designations: Cisco Beach, Dionis Beach, Eel Point, Jackson Point, Jetties Beach Recreation Area, Low Beach, Madaket Beach, Madaquecham Beach, Nobadeer Beach, Siasconset Beach, Surfside Beach, and Tom Nevers Beach.
High-Susceptibility Open Ocean	Ocean areas in the geographic analysis area.

Susceptibility	Settings
High-Susceptibility Landscape	Landscapes with scenic or historic designations: Adams Lookout Cemetery, Alter Rock, Brant Point CA, Capsum Pond CA, Cato Lane CA, Chilmark Cemetery, Cliff Road Nantucket Conservation Foundation, Fishers Landing, Gay Head Lighthouse, Goose Pond CA, Gosnold Road CA, Grove Lane CA, Head of Hummock Pond CA, Head of the Plains CA, Hither Creek CA, Holdgate Trails, Hummock Pond CA, Hydrangea Way CA, Indian Burial Ground, Kings Way CA, Larsen Sanford Center, Laurel Brooke Farm CA, Lily Pond CA, Little Neck, Long Pond, Madaket, Madaket CA, Maddequet CA, Maddequet Road CA, Madequecham Valley, Massasoit Bridge Road CA, Maxcy Pond, Miacomet Moors, Miacomet Park, Miacomet Pond Trail, Miacomet Road CA, Middle Moors, Mill Hill Cemetery, Mill Hill Park, Monomoy Creek CA, Moors End Farm, Nantucket Municipal Cemetery, Municipal Cemetery, Nantucket National Historic District, New North Cemetery, New Westside Cemetery, Newtown Cemetery, New South Road CA, Newtown Cemetery, No Bottom Pond CA, Nobadeer Farm, North Beach Street CA, Old North Cemetery, Pesthouse Pond, Phillips Run, Pilot Whale Drive CA, Prospect Hill Cemetery, Ram Pasture, Ruddick Commons, Sanford Farm, Sankaty Head Lighthouse, Sesachacha Headlands Wildlife Sanctuary, Shawkemo, Shawkemo Hills Trail, Shimmo CA, Smooth Hummocks Coastal Preserve, South Pasture CA, South Pasture Road CA, Saint Mary Cemetery, Station Street CA, Sturgis Pines, Surfside CA, The Creeks, The Greenbelt, The Plains CA, Tom Nevers, Tom Nevers CA, Tower Hill Cemetery, Trotts Hills CA, Vesper Lane CA, Veterans of Foreign Wars Post 8608, Warrens Landing Road CA, Washerman's Island CA, West Chester Street CA, Westside Cemetery, Wildlife Sanctuary, Willfeld, and Winter Park.
Medium-Susceptibility Landscape	Landscape of locally valued scenic quality that are reasonably resilient: Backus Lane CA, Beach Avenue CA, Cape Pogue Wildlife Refuge, Coatue Wildlife Refuge, Correllus State Forest, Coskata-Coatue Wildlife Refuge, Felix Neck Wildlife Sanctuary, Francis Newhall Woods Nature and Wildlife Preserve, Holdgate Trails, Lily Pond Park, Long Point Wildlife Refuge, Main Street and Fair Street Park, Miacomet Golf Course, Miacomet Heath Wildlife Management Area, Miacomet Pond Trail, Milestone Cranberry Bog, Mill Hill Park, Mill Square Park, Moshup Trail, Nantucket Elementary School Playground, Nantucket Golf Club, Nantucket High School Fields, Nantucket State Forest, Nantucket Girl Scout Camp, Nashawena Park, Naushon Park, Niantic Park, Nomans Land Island National Wildlife Refuge, Ocean Park, Old North Cemetery, Penacook Park, Plymouth Park, Polpis Road, Radio Monitor Site Recreational Area, Saratoga Park, Sea View Hill Cemetery, Sesachacha Heathlands Wildlife Sanctuary, Shawkemo Hills Trail, Siasconset Park, Siasconset Golf Course, South Beach State Park, Saint Mary Catholic Cemetery, Summerfield Park, Trinity Park, Veira Park, UMass Field Station, Waban Park, Washing Pond, Washington Park, Wesleyan Park, and Winter Park
Low-Susceptibility Landscape	Landscapes in the geographic analysis area that are neither high nor medium susceptibility.

CA = Conservation Area

Geographic analysis area seascape and landscape jurisdictions with ocean views are listed in Table 3.6.9-6. The nearest and most distant beaches, Nantucket shoreline and Chilmark shoreline (Squibnocket Beach), respectively, are portrayed in Figure 3.6.9-9 and Figure 3.6.9-10, respectively.

Table 3.6.9-6. Jurisdictions with ocean views

Ocean View	Jurisdiction
Ocean view from a seascape beach	Aquinnah Chilmark Edgartown Nantucket West Tisbury
Ocean view from an inland landscape	Aquinnah Chilmark Edgartown Nantucket Tisbury West Tisbury

Typical views in the geographic analysis area are represented by photographs presented in Figure 3.6.9-9, Figure 3.6.9-11, Figure 3.6.9-11, and Figure 3.6.9-12. View conditions at the Falmouth substation are represented by photographic Figure 3.6.9-13 and Figure 3.6.9-14 (COP Appendix T; Mayflower Wind 2022). View conditions at the Brayton Point Power Station converter station are represented by photographic Figure 3.6.9-15 (COP Appendix T.1; Mayflower Wind 2022).

Figure 3.6.9-9. Miacomet Beach Seascape, Nantucket

Figure 3.6.9-10. Squibnocket Beach Seascape, Martha's Vineyard

Figure 3.6.9-11. Hummock Pond Road Bike Path Landscape, Nantucket

Figure 3.6.9-12. 322 South Road Landscape, Martha's Vineyard

Figure 3.6.9-13. Falmouth Youth Baseball Fields Landscape, Trotting Park, Falmouth

Figure 3.6.9-14. Oak Grove Cemetery Landscape, Falmouth

Figure 3.6.9-15. Brayton Point Landscape, Somerset

The range of sensitivity of view receptors and people viewing the Projects is determined by their engagement and view expectations. Table 3.6.9-7 lists the sensitivity issues identified for the SLIA and VIA and the indicators and criteria used to assess impacts for the EIS.

Table 3.6.9-7. View receptor sensitivity ranking criteria

Sensitivity	Sensitivity Criteria
High	Residents with views of the proposed Projects from their homes; people with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; people engaged in outdoor recreation whose attention or interest is focused on the seascape, open ocean, and landscape, and on particular views; visitors to historic or culturally important sites, where views of the surroundings are an important contributor to the experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views.
Medium	People engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, and where the seascape and landscape setting is not important to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are dominated by non-scenic developments.
Low	People who regard the visual environment as an unvalued asset.

KOPs represent individuals or groups of people who may be affected by changes in views and visual amenity. Based on higher viewer sensitivity, viewer exposure, and context photography, 24 designated KOPs (Table 3.6.9-8) provide the locational bases for detailed analyses of the geographic analysis area's seascape, open ocean, landscape, and viewer experiences as shown on Figure 3.6.9-2 (COP Appendix T; Mayflower Wind 2022).

Table 3.6.9-8. Representative offshore analysis area view receptor contexts and key observation points

Context	Key Observation Points
Vantage Point	KOP-1-MV [a] Wasque Point KOP-19-MV Gay Head Lighthouse KOP-2-N [b] Nantucket Conservation Foundation Sanford Farm Barn Overlook KOP-17-N Bartlett's Farm KOP-21-N Sankaty Head Lighthouse
Linear Receptor	KOP-3-MV Wasque Avenue KOP-4-MV South Beach KOP-6-MV Long Point Beach KOP-9-MV 322 South Road KOP-16-MV Squibnocket Beach KOP-3-N Madaket Beach KOP-6-N Tom Nevers Beach KOP-8-N Tom Nevers Field KOP-10-N Nobadeer Beach KOP-11-N Miacomet Beach and Pond KOP-12-N Cisco Beach KOP-13-N Hummock Pond Road Bike Path KOP-16-N Head of Plains

Context	Key Observation Points
	KOP-18-N Ladies Beach KOP-20-N Madequecham 1
Scenic Area	KOP-2-MV Wasque Point Reservation KOP-1-O [c] Recreational Fishing, Pleasure, and Tour Boat Area KOP-2-O Commercial and Cruise Ship Shipping Lanes

[a] MV = Martha's Vineyard
[b] N = Nantucket Island
[c] O = Ocean

KOPs selected for viewer analyses in the substation areas include seven locations with existing views of the substations (COP Appendix T, Table 6-3; and Appendix T.1, Table 3-2; Mayflower Wind 2022). The four KOPs in the vicinity of the Falmouth onshore substation and three KOPs in the vicinity of Brayton Point onshore converter station and their viewing contexts are shown in Table 3.6.9-9.

Table 3.6.9-9. Representative onshore analysis area view receptor contexts and key observation points

Context	Key Observation Points
Vantage Point	KOP-1-BP [a] Brayton Point Beach KOP-44-C [b] Oak Grove Cemetery KOP-46-C Goodwill Park KOP-49-C Two Ponds
Linear Receptor	KOP-3-BP Sycamore Street KOP-4-BP Route 103 at Anthony Bridge KOP-47-C Lawrence Lynch Site Road - Gifford Street Substation Road

[a] BP = Brayton Point
[b] C = Cape Cod

The sensitivity of KOP viewers is determined with reference to view location and activity: 1) review of relevant designations and the level of policy importance that they signify (such as landscapes designated at national, state, or local levels); and 2) application of criteria that indicate value (such as scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects, and artistic associations). Judgments regarding seascape, landscape, and KOP sensitivity are informed by the VIA (COP Appendix T; Mayflower Wind 2022). Table 3.6.9-10 lists offshore KOP viewer sensitivity ratings, and Table 3.6.9-11 lists onshore KOP viewer sensitivity ratings.

Table 3.6.9-10. Offshore Project area key observation point viewer sensitivity ratings

Context	Key Observation Points
High	KOP-1-MV [a] Wasque Point KOP-2-MV Wasque Point Reservation KOP-3-MV Wasque Avenue KOP-4-MV South Beach KOP-6-MV Long Point Beach KOP-9-MV 322 South Road KOP-16-MV Squibnocket Beach

Context	Key Observation Points
	KOP-19-MV Gay Head Lighthouse KOP-2-N [b] Nantucket Conservation Foundation Sanford Farm Barn Overlook KOP-3-N Madaket Beach KOP-6-N Tom Nevers Beach KOP-8-N Tom Nevers Field KOP-10-N Nobadeer Beach KOP-11-N Miacomet Beach and Pond KOP-12-N Cisco Beach KOP-13-N Hummock Pond Road Bike Path KOP-16-N Head of Plains KOP-17-N Bartlett's Farm (in the topo viewshed – coastal scrub vegetation) KOP-18-N Ladies Beach KOP-20-N Madequecham 1 KOP-22-N Madaket Beach at Sunset KOP-21-N Sankaty Head Lighthouse KOP-1-O [c] Recreational Fishing, Pleasure, and Tour Boat Area KOP-2-O Commercial and Cruise Ship Shipping Lanes
Medium	None
Low	None

[a] MV = Martha's Vineyard
[b] N = Nantucket Island
[c] O = Ocean

Table 3.6.9-11. Onshore Project area key observation point viewer sensitivity ratings

Context	Key Observation Points
High	KOP-1-BP [a] Brayton Point Beach KOP-3-BP Sycamore Street KOP-4-BP Route 103 at Anthony Bridge KOP-44-C [b] Oak Grove Cemetery KOP-46-C Goodwill Park KOP-49-C Two Ponds
Medium	KOP-47-C Lawrence Lynch Site Road
Low	None

[a] BP = Brayton Point
[b] C = Cape Cod

Offshore viewing receptors include the fishing boats, pleasure craft, and cruise ships that represent marine traffic in the area. Daytime and nighttime views range from immediate foreground (0-mile) (0-kilometer) to 42.8-mile (68.9-kilometer) distances.

Daytime and nighttime aircraft receptors, arriving and departing Martha's Vineyard Airport and Nantucket Memorial Airport flights, and en-route airport flights traversing the coast, range from foreground to background viewing situations. Aircraft receptors are more frequently affected by view-limiting atmospheric conditions than are land and water receptors.

Typical meteorological and atmospheric conditions limit visibility of the Wind Farm Area from the islands and their beaches on 50 percent of daylight hours on 78 percent of days and provide clear visibility on 50 percent of daylight hours on 22 percent of days (1 of every 4 to 5 days). The tables in COP Appendix T, Table 5-2, Table 5-3, and Table 5-4 (Mayflower Wind 2022) list conditions at greater than 10 nautical miles (11.5 statute miles) and greater than 20 nautical miles (23.0 statute miles). The nearest Wind Farm Area WTG is offshore 20.2 nautical miles (23.3 statute miles [37.5 kilometers]) from the Nantucket shoreline.

Views from nearer the shoreline are more limited by atmospheric conditions than views from interior island areas. Many viewers, particularly recreational users, are more likely to be present on beaches on clearer days, when viewing conditions are better than on rainy, hazy, or foggy days. Therefore, affected environment and visual impact assessments of the Project are based on clear-day and clear-night visibility. Elevated walks and walls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and interior island areas may be diminished by ambient light levels and glare of developments.

The new Falmouth onshore substation at the Lawrence Lynch Site and Brayton Point converter station would occupy portions of previously developed industrial facilities.

3.6.9.2 Impact Level Definitions for Scenic and Visual Resources

Definitions of impact levels are provided in Table 3.6.9-12. There are no beneficial impacts on scenic and visual resources.

Table 3.6.9-12. Impact level definitions for scenic and visual resources

Impact Level	Impact Type	Definition
Negligible	Adverse	SLIA: Very little or no effect on seascape/landscape unit character, features, elements, or key qualities either because unit lacks distinctive character, features, elements, or key qualities; values for these are low; or Project visibility would be minimal. VIA: Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or Project visibility would be minimal.
Minor	Adverse	SLIA: The Project would introduce features that may have low to medium levels of visual prominence in the geographic area of an ocean/seascape/landscape character unit. The Project features may introduce a visual character that is slightly inconsistent with the character of the unit, which may have minor to medium negative effects on the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Project would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. If the value, susceptibility, and viewer concern for change is medium or high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change, but has a high level

Impact Level	Impact Type	Definition
		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 in the geographic area of an ocean/seascape/landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect on the unit's features, elements, or the key qualities. In areas affected by large magnitudes of change, the unit's features, elements or key qualities have low susceptibility and/or value. VIA: The visibility of the Project would introduce a moderate to large level of change to the view's character; may have a moderate to large levels of visual prominence that attracts and holds, but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change; or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, then evaluate the nature of the sensitivity 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 in the geographic area of an ocean/seascape/landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect on the unit's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the character unit is high. VIA: The visibility of the Project would introduce a major level of character change to the view; will attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. If the magnitude of change to the view's character is medium, but the susceptibility or value at the KOP is high, and, then evaluate the nature of the sensitivity 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, then evaluate the nature of the sensitivity to determine if lowering the impact to moderate is justified.

3.6.9.3 Impacts of Alternative A – No Action on Scenic and Visual Resources

When analyzing the impacts of the No Action Alternative on scenic and visual resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for scenic and visual resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Planned Activities Scenario*.

Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for seascape, open ocean, landscape, and viewers described in Section 3.6.9.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on seascape, open ocean, landscape, and viewers primarily involves onshore development and construction activities and offshore vessel traffic. Ongoing activities have the potential to affect seascape character, open ocean character, landscape character, and viewer experience through new structures, traffic congestion, and nighttime light impacts.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on scenic and visual resources include ongoing construction of the Vineyard Wind 1 project (62 WTGs and 1 OSP) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSP) in OCS-A 0517. Ongoing construction of the Vineyard Wind 1 and South Fork projects would have the same type of impacts on scenic and visual resources that are described in *Cumulative Impacts of the No Action Alternative* for ongoing and planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities in the geographic analysis area that contribute to impacts on seascape, open ocean, landscape, and viewers include activities related to development of undersea transmission lines, gas pipelines, and submarine cables; dredging and port improvements; marine minerals extraction; military use; marine transportation; and onshore development activities (see Appendix D for a description of planned activities in the geographic analysis area). Planned activities have the potential to affect seascape character, open ocean character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape.

BOEM expects other offshore wind development activities to affect seascape character, open ocean character, landscape character, and viewer experience through the following primary IPFs. Appendix H Tables H-13 to H-16 consider effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on scenic and visual resources during construction, O&M, and decommissioning of the projects. Offshore wind projects other than the Proposed Action that contribute to impacts on scenic and visual resources include projects within all or portions of the following lease areas: OCS-A-0486 (Revolution Wind), OCS-A-0487 (Sunrise Wind), OCS-A-0500 (Bay State Wind), OCS-A 0501 (Vineyard Wind 1), OCS-A 0517 (South Fork Wind), OCS-A-0520 (Beacon Wind), OCS-A 0522 (Vineyard Wind Northeast), and OCS-A

0534 (New England Wind) (Table D2-1, Appendix D). These projects are estimated to collectively install 901 WTGs in the geographic analysis area between 2023 and 2030 (Appendix D, Table D2-1).

Presence of structures: The placement of 901 WTGs from other offshore wind projects in the geographic analysis area would contribute to adverse impacts on scenic and visual resources. Appendix H provides simulations of offshore wind development without the Proposed Action from eight KOPs with views to the south, southwest, and west. In the geographic analysis area, all lease areas would have the potential to be seen within the same viewshed as the Project from ground-level coastal KOPs. The total number of WTGs that would be visible from any single KOP would be less than the 901 WTGs considered under the planned activities scenario. For example, 335 WTGs would be theoretically visible from KOP-16-MV Squibnocket Beach in Martha's Vineyard, and 577 WTGs would be theoretically visible from KOP-12-N Cisco Beach in Nantucket. The presence of structures associated with offshore wind development would affect seascape character, open ocean character, landscape character, and viewer experience, as simulated from sensitive onshore receptors (Appendix H). The seascape character and open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030 and would result in major impacts.

Lighting: Construction-related nighttime vessel lighting would be used if offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for up to 901 WTGs within the geographic analysis area (excluding the Proposed Action). The impact of vessel lighting on scenic and visual resources during construction would be localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M of planned offshore wind facilities and the impact on seascape character, open ocean character, nighttime viewer experience, and valued scenery from vessel lighting would be intermittent and long term.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines in the geographic analysis area and would have major impacts on scenic and visual resources. FAA hazard lighting systems would be in use for the duration of O&M. The cumulative effect of these WTGs and associated synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle in the offshore wind lease areas would have long-term minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the aviation warning lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night compared to the standard continuous, medium-intensity red strobe FAA warning system due to the reduced duration of activation. Assuming ADLS for other offshore wind projects would be similar to the

Proposed Action, ADLS would be activated for less than 5 hours per year, or 0.1 percent of nighttime hours, compared to standard continuous FAA hazard lighting (COP Appendix T, Section 5.1.3; Mayflower Wind 2022). It is anticipated that the FAA hazard lighting, when activated, would have major impacts on viewers.

Traffic (vessel): Other offshore wind project construction and decommissioning and, to a lesser extent, O&M would generate increased vessel traffic that could contribute to adverse moderate to major impacts on scenic and visual resources in the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the offshore wind construction areas. Assuming vessel traffic of other projects is similar to that of the Proposed Action, each project would generate between 15 and 35 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time during the construction phase. Stationary and moving construction vessels would change the daytime and nighttime seascape and open ocean character from open ocean to active waterway.

Onshore and offshore visual impacts would continue from visible vessel activity related to O&M of offshore wind facilities. Based on the estimates for the Proposed Action, each of the offshore wind projects in the geographic analysis area would generate an average of 1 to 3 vessel trips per day. During O&M of offshore wind projects (excluding the Proposed Action), vessel traffic would result in long-term, intermittent contrasts to seascape and open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during decommissioning at the end of the assumed 35-year operating period of each project, with impacts similar to those described for construction.

Land disturbance: Other offshore wind development would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electric grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of project infrastructure for offshore wind energy projects; however, BOEM anticipates these projects would generally have localized, short-term negligible to minor impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases: Accidental releases during construction, O&M, and decommissioning of offshore wind projects (excluding the Proposed Action) could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean area, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning of offshore wind projects, and would be lower but continuous during O&M. Accidental releases would cause short-term negligible to minor impacts.

Conclusions

Impacts of the No Action Alternative: Ongoing activities would have continuing short- and long-term impacts on seascape, open ocean, landscape, and viewer experience, primarily through the daytime and nighttime presence of structures, lighting, and vessel traffic. The character of the coastal landscape would change in the short term and long term through natural processes and ongoing activities that would continue to shape onshore features, character, and viewer experience. Ongoing activities in the geographic analysis area that contribute to visual impacts include offshore wind and non-offshore wind construction activities and vessel traffic, which lead to increased nighttime lighting, visible congestion, and the introduction of new structures. The primary impacts would be related to the ongoing construction of the Vineyard Wind 1 and South Fork projects, which would add new offshore structures to the ocean where none previously existed. BOEM anticipates that the potential impacts of ongoing activities would be **negligible** to **major**.

Cumulative Impacts of the No Action Alternative: Installation of planned offshore wind projects in combination with ongoing offshore wind projects in the geographic analysis area would change the surrounding marine environment from undeveloped ocean to wind farm character environment. Offshore wind projects other than the Proposed Action would lead to the construction of approximately 901 WTGs in areas where no offshore structures currently exist, leading to **negligible to major** impacts on seascape and landscape scenic and visual resources. The No Action Alternative (ongoing activities) combined with all other planned activities would result in **major** impacts on open ocean areas in the geographic analysis area due to the addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.

3.6.9.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the following sections. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of change (BOEM 2021) of the impacts on scenic and visual resources.

- The Project layout, including the number, size, and placement of the WTGs and OSPs, and the design of lighting systems for structures.
- The number and type of vessels involved in construction, O&M, and decommissioning, and time of day that construction, O&M, and decommissioning would occur.
- Onshore cable export route options and the size and location of onshore substations.

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

- **WTG number, size, location, and lighting:** More WTGs and larger turbine sizes closer to shore would increase visual impacts from onshore KOPs. The design and type of WTG lighting would affect nighttime visibility of WTGs from shore. Implementation of ADLS technology would reduce visual impacts.

- **Vessel lighting:** Nighttime construction, O&M, and decommissioning activities that involve nighttime lighting would increase visibility at night.
- L**ocation and scale of onshore Project components:** Installation of larger-scale onshore Project components in closer proximity to sensitive receptors would have greater impacts.

Mayflower Wind has committed to measures to minimize impacts on scenic and visual resources, which include, but are not limited to, proposing to design the substation and converter station to minimize visual effects to the extent feasible, including height, location, and color; working with the Towns of Falmouth, Somerset, and Portsmouth to ensure the lighting scheme complies with town requirements; and ensuring the lighting on the onshore substation and converter station will be kept to a minimum (COP Volume 2, Table 16-1; Mayflower Wind 2022).

3.6.9.5 Impacts of Alternative B – Proposed Action on Scenic and Visual Resources

This section addresses the impacts associated with construction, O&M, and decommissioning of the Proposed Action on seascape character, open ocean character, landscape character, and viewer experience in the geographic analysis area. The impact level is judged with reference to the sensitivity of the view receptor and the magnitude of change, which considers the noticeable features; distance and FOV effects; view framing and intervening foregrounds; and the form, line, color, and texture contrasts; scale of change; and prominence in the characteristic seascape, open ocean, and landscape. The degree of adverse effects is determined by the following criteria.

- The Proposed Action's characteristics, contrasts, scale of change, prominence, and spatial interactions with the special qualities and extents of the baseline seascape, open ocean, and landscape characters.
- Intervisibility between viewer locations and the Proposed Action's features.
- The sensitivities of viewers.

Viewers or visual receptors in the Proposed Action's zone of theoretical visibility include the following.

- Residents living in coastal communities or individual residences.
- Tourists visiting, staying in, or traveling through the area.
- Recreational users of the seascape, including those using ocean beaches and tidal areas.
- Recreational users of the open ocean, including those involved in yachting, fishing, boating, and passage on ships.
- Recreational users of the landscape, including those using landward beaches, golf courses, cycle routes, and footpaths.
- Tourists, workers, visitors, or local people using transport routes.

- People working in the countryside, commerce, or dwellings.
- People working in the marine environment, such as those on fishing vessels and crews of ships.

Onshore to offshore view distances to the Wind Farm Area range from 23.3 miles (37.5 kilometers) to 42.8 miles (68.9 kilometers). At the 23.3 miles (37.5 kilometers) distance, the Project would occupy 22.8° (18 percent) of the typical human's 124° horizontal field of view (FOV) and 0.4° (0.7 percent) of the typical 55° vertical FOV (measured from eye level). This vertical measure also indicates the perceived proportional size and relative height of a wind farm. At 42.8 miles (68.9 kilometers) distance to the southwest, the Project may appear 0.03° above the horizon and 34.4° (29.4 miles [47.3 kilometers]) along the horizon, 0.05 percent and 28 percent of the human vertical and horizontal FOV, respectively. WTG and OSP visibility would be variable throughout the day depending on specific factors. View angle, sun angle, atmospheric conditions, and distance would affect the visibility and noticeability. Visual contrast of WTGs and OSP would vary throughout daylight hours depending on whether the WTGs and OSPs are backlit, side-lit, or front-lit and based on the visual character of the horizon's backdrop. These variations through the course of the day may result in periods of moderate visual effects, while at other times of day would have minor or negligible effects.

Atmospheric refraction of light rays causes fluctuations in the extents and appearances of offshore and onshore facilities. It results from the bending of light rays between viewers and objects due to current air temperature, water vapor, and barometric pressure (Bislins 2022). Based on the average sea level refraction calculation coefficient of 0.17 (Bislins 2022) applied to the turbine blade tip viewshed distance of 42.8 miles (68.9 kilometers), the 1,066.3-foot (325.0-meter) turbines may be projected upward to increased visibility from 0.0 feet (0.0 meters) to 192 feet (58.5 meters) above the horizon. The nearest beach viewers, located at 23.3 miles (37.5 kilometers) from the Lease Area, may see increased visibility of the 1,066.3-foot (325.0-meter) turbines from 790 feet (240.8 meters) to 844 feet (257.3 meters) above the horizon. Daytime and nighttime atmospheric refraction-based visibility varies with sea level's continuous increases and decreases in temperature, water vapor, and barometric pressure.

At distances of 12 miles or closer (boats and cruise ships), 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.

Presence of structures: The Proposed Action would install up to 147 WTGs extending up to 1,066.3 feet (325.0 meters) above MLLW and up to 5 OSPs extending up to 344.5 feet (105 meters) above MLLW in the Lease Area, for a maximum of 149 offshore structures. The WTGs would be painted white or light gray, no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey. RAL 7035 Light Grey would help reduce potential visibility against the horizon. The presence of structures within the geographic analysis area under the Proposed Action would affect seascape character, open ocean character, landscape character, and viewer experience. The magnitude of WTG and OSP impact is defined by the contrast, scale of the change, prominence, FOV, viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. COP Appendix T, Attachment 3, *Offshore Visual Analysis Forms and Photo Simulations for Martha's Vineyard* *and Nantucket* (Mayflower Wind 2022) presents WTG and OSP visual simulations from onshore KOPs considered in this analysis. The effects analyses involved consideration of those COP VIA clear-day simulations of similar distance, variability of viewer location within KOP vicinity, variability of sun angles throughout the day, and nighttime variability of cloud cover, ocean reflections, and moonlight.

Appendix H provides an assessment of the Proposed Action's noticeable elements, distance effects, FOV effects, foreground elements and influence, scale effects, prominence effects, and contrast rating effects by seashore character unit, open ocean character unit, landscape character unit, and offshore and onshore KOP. The seascape character units, open ocean character unit, landscape character units, and viewer experiences would be affected by the Proposed Action's noticeable elements (Appendix H, Table H-7), applicable distances (Appendix H, Table H-8), and FOV extents (Appendix H, Table H-9), open views versus view framing or intervening foregrounds (Appendix H, Table H-10), and form, line, color, and texture contrasts in the characteristic seascape, open ocean, and landscape (Appendix H, Table H-11). Higher impact significance stems from unique, extensive, and long-term appearance of strongly contrasting vertical structures in the otherwise horizontal open ocean environment, where structures are an unexpected element and viewer experience includes formerly open views of high-sensitivity seascape, open ocean, and landscape, and from high-sensitivity view receptors. Table 3.6.9-13 considers the totality of the Proposed Action's level of impact by seascape character unit, open ocean character unit, and landscape character unit.

Table 3.6.9-13. Proposed Action impact on seascape character, open ocean character, and landscape character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, and Landscape Character Units
Major	SLIA: Open Ocean Character Unit
Moderate	SLIA: Seascape Character Units Ocean, Sound, Beachfront, Coastal Bluff, Coastal Dune, Boardwalk, Coastal Scrub, Commercial, Forests/Woodlands, Institutional, Park, Preserve, Residential, Salt Pond, Transportation, and Village/Town Landscape Character Units Agriculture, Coastal Scrub, Estuary, Forests/Woodlands, Institutional, Marshland, Park, Preserve, Residential, Salt Pond, and Shoreline
Minor	SLIA: Landscape Character Units Agriculture, Coastal Scrub, Commercial, Estuary, Forests/Woodlands, Institutional, Light Industrial, Marshland, Park, Preserve, Residential, Salt Pond, Shoreline, Transportation, and Village/Town
Negligible	SLIA: Landscape Character Units Agriculture, Commercial, Forests/Woodlands, Institutional, Light Industrial, Marshland, Park, Preserve, Residential, Salt Pond, Shoreline, Transportation, and Village/Town

Table 3.6.9-14 considers the totality of the Proposed Action's level of impact (the Sensitivity Level and Magnitude of Change, BOEM 2021) by offshore and onshore KOPs. All KOPs in the geographic analysis area are rated high sensitivity (COP Appendix T and T.1, Mayflower Wind 2022). Appendix H, Table H-6 lists for each KOP the applicable impact level based on specific measures of distance, occupied field of view, noticeable facility elements, visual contrasts, scale of change, and prominence.

The major impact level results from:

1. Wind farm facilities located from 0.0 miles (0.0 kilometers) to 5 miles (8.0 kilometers) of the KOP's viewers and onshore facilities located between 0.1 miles (0.2 kilometers) and 0.2 miles (0.3 kilometers) of the KOP's viewers.
2. Extensive field of view occupied by the facilities.
3. Greater extents of noticeable facility elements in the view.
4. Strong-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, and textures.
5. Large-rated scale of change by facilities.
6. 5- or 6-rated prominence[1] in the view.

The moderate impact level results from:

1. Wind farm facilities located between 23.3 miles (37.5 kilometers) and 26.5 miles (42.6 kilometers) of the KOP's viewers and onshore facilities located at 0.3 mile (0.4 kilometer) of the KOP's viewers.
2. Moderate field of view occupied by the facilities.
3. Moderate extents of noticeable facility elements in the view.
4. Moderate-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, and textures.
5. Medium-rated scale of change by facilities.
6. 3- or 4-rated prominence in the view.

The minor impact level results from:

1. Wind farm facilities located between 29.4 miles (kilometers) and 41.2 miles (kilometers) of the KOP's viewers.
2. Minor field of view occupied by the facilities.
3. Minor extents of noticeable facility elements in the view.
4. Weak-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, and textures.
5. Small-rated scale of change by facilities.
6. 1- or 2-rated prominence in the view.

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[1] WTGs and OSP prominence: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer, but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (NAEP 2012)

Table 3.6.9-14. Proposed Action impact on viewer experience

Level of Impact	Offshore and Onshore Key Observation Points
Major	KOP-1-O [a] Recreational Fishing, Pleasure, and Tour Boat Area KOP-2-O Commercial and Cruise Ship Shipping Lanes KOP-8-N [b] Tom Nevers Field-Nighttime [c] KOP-12-N Cisco Beach-Nighttime [c] KOP-44-C [d] Oak Grove Cemetery KOP-46-C Goodwill Park KOP-47-C Lawrence Lynch Site Road
Moderate	KOP-8-N Tom Nevers Field-Daytime KOP-10-N Nobadeer Beach KOP-11-N Miacomet Beach and Pond KOP-12-N Cisco Beach-Daytime KOP-13-N Hummock Pond Road Bike Path KOP-16-N Head of Plains KOP-17-N Bartlett's Farm KOP-18-N Ladies Beach KOP-20-N Madequecham 1 KOP-22-N Madaket Beach at Sunset KOP-49-C Two Ponds
Minor	KOP-1-MV [e] Wasque Point KOP-2-MV Wasque Point Reservation KOP-3-MV Wasque Avenue KOP-4-MV South Beach KOP-6-MV Long Point Beach KOP-9-MV 322 South Road KOP-16-MV Squibnocket Beach KOP-19-MV Gay Head Lighthouse KOP-2-N Nantucket Conservation Foundation Sanford Farm Barn Overlook KOP-3-N Madaket Beach KOP-6-N Tom Nevers Beach KOP-21-N Sankaty Head Lighthouse
Negligible	KOP-8-N [b] Tom Nevers Field-Nighttime [f] KOP-12-N Cisco Beach-Nighttime [f] KOP-1-BP [g] Brayton Point Beach KOP-3-BP Sycamore Street KOP-4-BP Route 103 at Anthony Bridge

[a] O = Ocean
[b] N = Nantucket Island
[c] Major impact when ADLS is activated.
[d] C = Cape Cod
[e] MV = Martha's Vineyard
[f] Negligible impact when ADLS is not activated.
[g] BP = Brayton Point

The Proposed Action would also add one onshore converter station and one substation in the vicinity of Brayton Point Power Station, Somerset, Massachusetts and Falmouth, Massachusetts, respectively. COP Appendix T, Attachment 3, and Appendix T.1, *Onshore Visual Impact Assessment for Brayton Point* (Mayflower Wind 2022) presents visual simulations of these onshore Project features. Considering the location of the sites relative to scenic resources and public viewpoints, context of the sites and surrounding land uses, visual contrast between the substation and converter station sites and the surrounding landscape, and ability to screen the substation and converter station sites from public viewpoints, impacts of these Project features on scenic and visual resources would be negligible to major. All landfall export cable infrastructure would be underground and would not contribute to impacts on scenic and visual resources through the presence of structures IPF.

Lighting: Nighttime vessel lighting could result from construction, O&M, and decommissioning of the Proposed Action if these activities are undertaken during nighttime, evening, or early morning hours. Vessel lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore and offshore viewing locations based on viewer distance and atmospheric conditions. The impact of vessel lighting on scenic and visual resources during construction and decommissioning would be moderate to major, localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M but long-term impacts would be less due to the lower number of forecast vessel trips. Nighttime vessel lighting for the Proposed Action in combination with other offshore wind development would affect seascape character, open ocean character, nighttime viewer experience, and valued scenery. This impact would be localized and short-term during construction and decommissioning and intermittent and long-term during O&M.

Permanent aviation warning lighting on WTGs would be visible from beaches and coastlines in the geographic analysis area and would have impacts on scenic and visual resources. Field observations associated with visibility of FAA hazard lighting under clear-sky conditions indicate that FAA hazard lighting may be visible at a distance of 40 miles or more from the viewer. Darker-sky conditions may increase this distance due to increased contrast of the light dome (reflections from the ocean) and cloud reflections caused by the hazard lights.

Mayflower Wind has committed to installing ADLS on WTGs, which activates the hazard lighting system in response to detection of nearby aircraft (COP Volume 2, Table 16-1; Mayflower Wind 2022). The synchronized flashing of the aviation warning lights occurs only when aircraft are present, resulting in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The shorter-duration synchronized flashing of ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. ADLS hazard lighting would be in use for the duration of O&M of the Proposed Action and would have intermittent and long-term effects on sensitive onshore and offshore viewing locations based on viewer distance and angle of view, and assuming no obstructions.

Based on estimates from Mayflower Wind, ADLS-controlled obstruction lights would be activated for less than 5 hours per year (COP Appendix T, Section 5.1.3; Mayflower Wind 2022). It is estimated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The OSPs would be lit and marked in accordance with Occupational Safety and Health Administration lighting standards to provide safe working conditions when O&M personnel are present. The OSPs would have nighttime lighting up to 344.5 feet (105 meters) above sea level. Due to EC, from eye levels of 5 feet (1.5 meters), these lights would become invisible above the ocean surface beyond approximately 25.5 miles (41.0 kilometers). Lights of the OSP, when lit for maintenance, potentially would be visible from beaches and adjoining areas during hours of darkness. The nighttime sky light dome and cloud lighting caused by reflections from the water surface may be seen from distances beyond the 42.8-mile (68.9-kilometer) geographic analysis area, depending on variable ocean surface, cloud, and atmospheric reflectivity.

Traffic (vessel): Construction and installation, O&M, and decommissioning of the Proposed Action would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources in the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the offshore wind construction areas. Construction and installation of the Proposed Action is projected to generate on average 15 to 35 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time. O&M activities for the Proposed Action are anticipated to generate between 1 and 3 vessel trips per day between a port and the Wind Farm Area. Vessel traffic during O&M would result in long-term, intermittent contrasts to open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during decommissioning at the end of the operating period, with impacts similar to those described for construction. Maintenance activities would cause minor effects on seascape character and open ocean character due to increased O&M vessel traffic to and from the Lease Area. Impacts from the Proposed Action related to vessel traffic would be minor to moderate.

Land disturbance: The Proposed Action would require installation of onshore export cables, an onshore substation, converter station, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. Impacts from the Proposed Action related to land disturbance would be negligible to minor.

Accidental releases: Accidental during construction, O&M, and decommissioning of the Proposed Action could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning and would be lower but continuous during O&M, resulting in overall negligible to minor impacts.

Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities. Appendix H provides cumulative effects simulations of the Proposed Action from eight KOPs with views to the south, southeast, and southwest (Appendix H, Attachment H-1).

The Proposed Action would contribute up to 147 of a combined total of 1,048 WTGs that would be installed in the geographic analysis area between 2023 and 2030, which accounts for approximately 14 percent of offshore wind development planned for the geographic analysis area. The total number of WTGs that would be visible from any single KOP would be substantially fewer than the 1,048 WTGs considered under the planned activities scenario in combination with the Proposed Action. For example, 425 WTGs would be theoretically visible from KOP-16-MV Squibnocket Beach in Martha's Vineyard and 707 WTGs would be theoretically visible from KOP-12-N Cisco Beach in Nantucket (Appendix H, Attachment H-1). The presence of structures associated with offshore wind development in combination with the Proposed Action would have major seascape character, open ocean character, landscape character, and viewer experience impacts, as simulated from sensitive onshore receptors (Appendix H).

The open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030 and result in major impacts. Mayflower Wind's contribution to cumulative seascape character and landscape character impacts would range from 86 of 679 total WTGs visible on Martha's Vineyard, 13 percent of the total, to 142 of 771 total WTGs visible on Nantucket, 18 percent of the total (Mayflower Wind 2022). The seascape, open ocean, and landscape are highly valued scenery and rated high susceptibility.

Mayflower Wind's WTG contribution to cumulative impacts from KOPs are as follows (Mayflower Wind 2022):

- KOP-1-MV Wasque Point – 86 of 679 total WTGs visible, 13 percent of the total;
- KOP-2-N Sanford Barn Overlook – 142 of 771 total WTGs visible, 18 percent of the total;
- KOP-22-N Madaket Beach at Sunset – 129 of 743 total WTGs visible, 17 percent of the total;
- KOP-6-N Tom Nevers Beach – 92 of 457 total WTGs visible, 20 percent of the total;
- KOP-12-N Cisco Beach – 130 of 707 total WTGs visible, 18 percent of the total;
- KOP-16-MV Squibnocket Beach – 90 of 425 total WTGs visible, 21 percent of the total; and
- KOP-16-N Head of Plains – 132 of 746 total WTGs visible, 18 percent of the total.

Lighting from the Proposed Action in combination with other offshore wind projects would have minor to major long-term cumulative impacts on scenic and visual resources. This range in impacts from lighting is due to variable distances from visually sensitive viewing locations and potential use of ADLS. The recreational and commercial fishing, pleasure, and tour boating community would experience major adverse effects in foreground views. Impacts from lighting would be reduced if ADLS is implemented across all offshore wind projects in the geographic analysis area and would be more adverse if other projects do not commit to using ADLS.

Planned offshore wind project construction, O&M, and decommissioning would increase vessel traffic in the geographic analysis area beyond what the Proposed Action would generate in isolation. As described in Section 3.6.6, *Navigation and Vessel Traffic*, during periods of overlapping constructing in 2024–2025, offshore wind projects would generate between 165 and 385 vessel trips daily from Atlantic Coast ports to worksites in the geographic analysis area. During O&M, the Proposed Action and other offshore wind projects would generate up to 39 vessel trips per day in the geographic analysis area. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean characters from open ocean to active waterway. Increases in these vessel movements would be noticeable to onshore and offshore viewers, but are unlikely to have a significant effect.

Planned offshore wind development including the Proposed Action would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of Project infrastructure for planned offshore wind energy projects; however, the Proposed Action in combination with other planned offshore wind development would generally have localized, short-term negligible to minor impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases during construction, O&M, and decommissioning of planned offshore wind projects including the Proposed Action could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning of offshore wind projects, and would be lower but continuous during O&M. The combined accidental release impacts from the Proposed Action and other ongoing and planned activities would be negligible to minor.

Conclusions

Impacts of the Proposed Action: Proposed Action effects on high- and moderate-sensitivity seascape character units, open ocean character units, and landscape character units would be **minor** to **major**, due to view distances (see effects ranges discussion in Appendix H), minor to moderate FOVs, strong, moderate, and weak visual contrasts, clear-day conditions, and nighttime ADLS activation. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected during construction, O&M, and decommissioning by the Project's features, applicable distances, horizontal and vertical FOV extents, view framing or intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence. These assessments are documented in

Appendix H. Project decommissioning effects would be similar to construction effects. Due to distance, extensive FOVs, strong contrasts, large scale of change, and level of prominence, and heretofore undeveloped ocean views, the Proposed Action would have major impacts (the magnitude of change per BOEM 2021) on the open ocean character unit and viewer boating and cruise ship experiences. The daytime presence of offshore WTGs and OSPs, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSPs. In clear weather, the WTGs and OSPs would be an unavoidable presence in views from the coastline, with **minor** to **moderate** effects on seascape character and landscape character and **major** effects on open ocean character.

Onshore, temporary moderate effects would occur during construction and decommissioning of the landfalls and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be negligible. The context of the onshore substation/converter station sites surrounding industrial elements, strong visual contrast between the sites and the surrounding landscape, and the scale of change would be insubstantial as viewed from the KOPs. While the Project's visibility would be moderately prominent from the KOPs, the value of the view is low, having little or no effect on viewers' quality of visual experience. Impacts of the onshore facilities on scenic and visual resources would be **negligible** to **minor**.

Cumulative Impacts of the Proposed Action: In context of other reasonably foreseeable environmental trends, the cumulative impacts of the Proposed Action in combination with ongoing and planned activities would range from **negligible** to **major**. Cumulative impacts would be **major** for the open ocean character unit and offshore viewer experience and **moderate** for seascape and landscape character units and onshore viewer experience. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.6.9.6 Impacts of Alternative C on Scenic and Visual Resources

Impacts of Alternative C: Installation of longer onshore export cables and infrastructure would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. Landfall export cable infrastructure would be underground and would not contribute to impacts on scenic and visual resources through the presence of structures. The export cable routes would have localized, short-term negligible to minor impacts on scenic and visual resources during construction or O&M due to land disturbance.

Cumulative Impacts of Alternative C: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative C would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative C: The **minor** to **major** impacts of Alternative C on seascape character, open ocean character, landscape character, and viewer experience would be approximately the same as those of the Proposed Action. Temporary **minor** effects would occur during construction and decommissioning of the landfalls and onshore export cables. Effects during O&M would involve temporary vehicular and personnel presence and would be **negligible**.

Cumulative Impacts of Alternative C: In context of other reasonably foreseeable environmental trends in the area, BOEM anticipates the cumulative impacts of Alternative C would be **major**.

3.6.9.7 Impacts of Alternative D on Scenic and Visual Resources

Impacts of Alternative D: Eliminating up to six WTGs in the northeastern portion of the Lease Area would not result in a meaningful difference in impacts on seascape character, open ocean character, and landscape character from the Proposed Action. There is the potential for a slight reduction in impacts, but the number of structures that could be removed would be small and it is unlikely these changes would be noticeable to the casual viewer. Therefore, impacts from Alternative D are anticipated to be approximately the same as the Proposed Action.

Differences between the horizontal and vertical FOV extents for Alternative D (Table 3.6.9-15 and Table 3.6.9-16) and the Proposed Action (Appendix H, Table H-4 and Table H-5) would not be noticeable to the casual viewer at applicable distances to the WTG array.

Table 3.6.9-15. Horizontal FOV occupied by Alternative D

Noticeable Element	Width miles (km)	Distance miles (km)	Horizontal FOV	Human FOV	Percent of FOV
D WTGs	12.3 (19.8)	23.6 (37.9)	26.2°	124°	21%

km = kilometers

Table 3.6.9-16. Vertical FOV occupied by Alternative D

Noticeable Element	Height feet (m) MLLW	Distance miles (km)	Visible Height [a] feet (m)	Vertical FOV	Human FOV
D Rotor Blade Tip	1,066.3 (325.0)	23.6 (37.9)	779 (237)	0.3°	55°

[a] Based on intervening EC and clear-day conditions.
km = kilometers; m = miles

For those shoreline viewers directly north of the wind farm, the distance to the nearest WTG under Alternative D would be 0.3 mile (0.5 kilometer) further than the distance to the Proposed Action, (23.6 miles [37.9 kilometers] compared with 23.3 miles [37.5 kilometers]). The change in character, prominence, and contrasts would be unnoticeable to viewers, particularly because the Proposed Action view would not be built (seen) for comparison.

Cumulative Impacts of Alternative D: In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative D would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative D: The **minor** to **major** impacts of Alternative D on seascape character, open ocean character, landscape character, and viewer experience would be approximately the same as those of the Proposed Action. The impacts from removal of up to six WTGs under Alternative D would be unnoticeable to the casual viewer and would not change the impact ratings.

Cumulative Impacts of Alternative D: In context of other reasonably foreseeable environmental trends in the area, BOEM anticipates the cumulative impacts of Alternative D would be **major**.

3.6.9.8 Impacts of Alternatives E and F on Scenic and Visual Resources

Impacts of Alternatives E and F: Installation of different foundation types under Alternatives E-1, E-2, and E-3 would not change the most prominent visible aspects of WTGs and OSPs (e.g., blade height, hub height) and, therefore, would have no meaningful difference in impacts on seascape, open ocean, and landscape character units and viewer experience compared to the Proposed Action. The reduction in the number of cables installed along the Falmouth offshore export cable route under Alternative F may reduce the number vessel trips required to install the cables, but this slight reduction in vessel activity would have no meaningful difference in impacts compared to the Proposed Action.

Cumulative Impacts of Alternatives E and F: In context of reasonably foreseeable environmental trends, the cumulative impact of Alternatives E and F would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative E and F: The **minor** to **major** impacts of Alternatives E and F on seascape character, open ocean character, landscape character, and viewer experience would be approximately the same as those of the Proposed Action.

Cumulative Impacts of Alternative E and F: In context of other reasonably foreseeable environmental trends in the area, BOEM anticipates the cumulative impacts of Alternatives E and F would be **major**.

3.6.9.9 Proposed Mitigation Measures

No measures to mitigate impacts on scenic and visual resources have been proposed for analysis.

Chapter 4

Other Required Impact Analyses

4.1 Unavoidable Adverse Impacts of the Proposed Action

CEQ's NEPA-implementing regulations (40 CFR 502.16(a)(2)) require that an EIS evaluate the potential unavoidable adverse impacts associated with a Proposed Action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. Table 4.1-1 provides a listing of such impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. Chapter 3 provides additional information on the potential impacts listed below.

All impacts from planned activities are still expected to occur as described in the No Action Alternative analysis in this EIS, regardless of whether the Proposed Action is approved.

Table 4.1-1. Potential Unavoidable Adverse Impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Air Quality	• Air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation
Water Quality	• Increase in suspended sediments due to seafloor disturbance during construction, O&M, and decommissioning
Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic
Benthic Resources	• Suspension and re-settling of sediments due to seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor alterations • Disturbance, displacement, and avoidance behavior due to habitat loss/alteration, equipment activity and noise, and vessel traffic • Individual mortality due to construction activities
Birds	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic
Coastal Habitat and Fauna	• Habitat alteration and removal of vegetation, including trees • Temporary avoidance behavior by fauna during construction activity and noise-producing activities • Individual fauna mortality due to collision with vehicles or equipment during clearing and grading activities, particularly species with limited mobility
Finfish, Invertebrates, and Essential Fish Habitat	• Suspension and re-settling of sediments due to seafloor disturbance • Displacement, disturbance, and avoidance behavior due to construction-related impacts, including noise, vessel traffic, increased turbidity, sediment deposition, and EMF • Individual mortality due to construction activities • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor surface alterations • Conversion of soft-bottom habitat to new hard-bottom habitat

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Marine Mammals	• Increased risk of injury (TTS or PTS) to individuals due to underwater noise from pile-driving activities during construction • Disturbance (behavioral effects) and acoustic masking due to underwater noise from pile-driving, shipping and other vessel traffic, aircraft, geophysical surveys (HRG surveys and geotechnical drilling surveys), WTG operation, cable laying, and dredging during construction and operations • Increased risk of individual injury and mortality due to vessel strikes • Increased risk of individual injury and mortality associated with fisheries gear
Sea Turtles	• Increased risk of individual injury and mortality due to vessel strikes during construction, O&M, and decommissioning • Increased risk of individual injury and mortality associated with fisheries gear • Disturbance, displacement, and avoidance behavior due to habitat disturbance and underwater noise during construction
Wetlands	• Wetland and surface water alterations, including increased sediment deposition and removal of vegetation
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption of access or temporary restriction in harvesting activities due to construction of offshore Project elements • Disruption of harvesting activities during operations of offshore wind facility • Changes in vessel transit and fishing operation patterns • Changes in risk of gear entanglement or availability of target species
Cultural Resources	• Visual impacts on viewsheds of historic properties • Physical impacts on known submerged archaeological resources • Physical impacts on known ancient submerged landforms
Demographics, Employment, and Economics	• Disruption of commercial fishing, for-hire recreational fishing, and marine recreational businesses during offshore construction and cable installation • Hindrances to ocean economy sectors due to the presence of the offshore wind facility, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses
Environmental Justice	• Compounded health issues of local environmental justice communities near ports as a result of air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation • Loss of employment or income due to disruption to commercial fishing, for-hire recreational fishing, or marine recreation businesses • Hindrances to subsistence fishing due to offshore construction and operation of the offshore wind facility
Land Use and Coastal Infrastructure	• Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays • Potential for accidental releases during construction
Navigation and Vessel Traffic	• Congestion in port channels • Increased navigational complexity, vessel congestion, and allision risk within the offshore Wind Farm Area • Potential for disruption to marine radar on smaller vessels operating within or in the vicinity of the Project, increasing navigational complexity • Hindrances to SAR missions within the offshore Wind Farm Area

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Other Uses	• Disruption to offshore scientific research and surveys and species monitoring and assessment • Increased navigational complexity for military or national security vessels operating within the Wind Farm Area • Changes to aviation and air traffic navigational patterns
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access or traffic delays • Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from construction of offshore Project elements • Temporary disruption to the marine environment and marine species important to fishing and sightseeing due to turbidity and noise • Hindrances to some types of recreational fishing, sailing, and boating within the area occupied by WTGs during operation
Scenic and Visual Resources	• Alterations to the ocean, seascape, landscape character units' character, and effects on viewer experience, by the Wind Farm Area, vessel traffic, onshore landing sites, onshore export cable routes, onshore substation and converter station, and electrical connections with the power grid

4.2 Irreversible and Irretrievable Commitment of Resources

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(4)) require that an EIS review the potential impacts on irreversible or irretrievable commitments of resources resulting from implementation of a Proposed Action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts on nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs due to the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

Table 4.2-1 provides a listing of potential irreversible and irretrievable impacts by resource area. Chapter 3, *Affected Environment and Environmental Consequences*, provide additional information on the impacts summarized below.

Table 4.2-1. Irreversible and irretrievable commitment of resources by resource area for the Proposed Action

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Air Quality	No	No	BOEM expects air pollutant emissions to comply with permits regulating compliance with air quality standards. Emissions would be temporary during construction activities and would be limited to the Project lifetime for O&M activities. To the extent that the Proposed Action displaces fossil-fuel energy generation, overall improvement of air quality would be expected.
Water Quality	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands. Turbidity impacts in marine and coastal environments would be temporary.
Bats	Yes	No	Irreversible impacts on bats could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bat displacement from foraging habitat.
Benthic Resources	No	No	Although local mortality of benthic fauna and habitat alteration is likely to occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Birds	Yes	No	Irreversible impacts on birds could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bird displacement from foraging habitat.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Coastal Habitat and Fauna	No	No	Although limited removal of habitat associated with clearing and grading for construction of the onshore landfalls, export cables, substation, and converter station are likely to occur, BOEM does not anticipate population-level impacts on flora or fauna; coastal habitat could recover after construction in some areas, and after decommissioning activities in other areas.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality of finfish and invertebrates and habitat alteration could occur, BOEM does not anticipate population-level impacts on finfish, invertebrates, and essential fish habitat. It is expected that the aquatic habitat for finfish and invertebrates would recover following decommissioning activities.
Marine Mammals	No	Yes	Irreversible impacts on marine mammal populations could occur if one or more individuals of an ESA-listed species were injured or killed or if those populations experienced behavioral effects of high severity. With implementation of mitigation measures, developed in consultation with NMFS (e.g., timing windows, vessel speed restrictions, safety zones), the potential for an ESA-listed species to experience high-severity behavioral effects or be injured or killed would be reduced or eliminated. No irreversible high-severity behavioral effects from Project activities are anticipated; however, due to the uncertainties from lack of information, these effects are still possible. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Project area.
Sea Turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed; however, the implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for impacts on listed species. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of injury or mortality due to vessel strikes or entanglement with fisheries gear caught on the structures, or due to displacement from the Project area.
Wetlands	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands.
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and O&M activities, BOEM does not anticipate irreversible impacts on commercial fisheries. The Project could alter habitat during construction and operations, limit access to fishing areas during construction, or reduce vessel maneuverability during operations. However, the conceptual decommissioning of the Project would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of fishing areas at an individual level.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Cultural Resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of previously unidentified cultural resources onshore and offshore could result in irreversible and irretrievable impacts.
Demographics, Employment, and Economics	No	Yes	Construction activities could temporarily increase contractor needs, housing needs, supply requirements, and demand for local businesses, leading to an irretrievable loss of workers for other projects. These factors could lead to increased housing and supply costs.
Environmental Justice	No	Yes	Impacts on environmental justice communities could occur due to loss of income or employment for low-income workers in marine industries; this could be reversed by Project decommissioning or by other employment, but income lost during Project operations would be irretrievable.
Land Use and Coastal Infrastructure	No	Yes	Land use required for construction and operational activities could result in a temporary impact on use of the land. Construction activities could result in a minor irretrievable impact due to the temporary loss of use of the land for otherwise typical activities. Other land uses could be restored upon Project decommissioning.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and operations, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in transit routes, which could be less efficient during the life of the Project.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during proposed Project construction, operations, and decommissioning activities.
Recreation and Tourism	No	Yes	Construction activities could result in a minor, temporary loss of use of land for recreation and tourism purposes, and temporary disruptions to fishing.
Scenic and Visual Resources	No	Yes	Long-term (until post-decommissioning) alterations to the seascape, open ocean, and landscape character units' character and effects on viewer experience due to construction, O&M, and decommissioning of the wind farm, onshore landing sites, onshore export cable routes, onshore substations, and electrical connections with the power grid would occur.

4.3 Relationship Between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

CEQ's NEPA-implementing regulations (40 CFR 502.16(a)(3)) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action will result in detrimental effects on long-term productivity of the affected areas or resources.

As assessed in EIS Chapter 3, *Affected Environment and Environmental Consequences*, BOEM anticipates that the majority of the potential adverse effects associated with the Proposed Action would occur during construction and installation activities and would be short term in nature and minor to moderate in severity/intensity. These effects would cease after decommissioning activities. In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the long-term benefits of the Proposed Action, which include the following.

- Promotion of clean and safe development of domestic energy sources and clean energy job creation.
- Promotion of renewable energy to help ensure geopolitical security, reduce GHG emissions to combat climate change, and provide electricity that is affordable, reliable, safe, secure, and clean.
- Delivery of power to the Massachusetts (and broader northeast U.S.) energy grid to contribute to the state's renewable energy requirements.
- Increased habitat for certain fish species.

Based on the anticipated potential impacts evaluated in this EIS that could occur during Proposed Action construction and installation, O&M, and decommissioning, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment. Removal or disturbance of habitat associated with onshore activities could create long-term irreversible impacts. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in Table 4.2-1 would be long term. After completion of the Proposed Action's O&M and decommissioning phases, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.