VINEYARD MID-ATLANTIC

CONSTRUCTION AND OPERATIONS PLAN
VOLUME II

JANUARY 2025

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SUBMITTED BY:

VINEYARD MID-ATLANTIC LLC

VINEYARD
MID-ATLANTIC

VINEYARD OFFSHORE

PUBLIC VERSION

Vineyard Mid-Atlantic COP

Volume II

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Prepared for:
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January 2025

Revision	Date	Description
0	January 2024	Initial submission.
1	September 2024	Updated to address Bureau of Ocean Energy Management Round 1 Comments and to incorporate revisions to the Project Design Envelope.
2	November 2024	Updated to address Bureau of Ocean Energy Management Round 2 Comments and to incorporate revisions to the Project Design Envelope.
2	January 2025	Resubmitted without revisions.

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List of Acronyms

AC	alternating current
ACS	American Community Survey
ADLS	Aircraft Detection Lighting System
AEP	auditory evoked potential
AFB	Air Force Base
AGL	above ground level
AIS	Automatic Identification System
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMCS	Atlantic Marine Conservation Society
AMSL	above mean sea level
ANSI	American National Standards Institute
APE	Area of Potential Effects
AQRV	air quality related values
ARSR	air route surveillance radar
ASLFs	Ancient Submerged Landform Features
ASMFC	Atlantic States Marine Fisheries Commission
ASR	airport surveillance radar
ATON	Federal Aids to Navigation
BA	Biological Assessment
BACT	Best Available Control Technology
BCC	Bird of Conservation Concern
BIA	Biologically Important Area
BMP	best management practices
BOEM	Bureau of Ocean Energy Management
BRI	Biodiversity Research Institute
BSB	below seabed
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CBRA	Cable Burial Risk Assessment
CEA	Critical Environmental Area
CEQ	Council on Environmental Quality
CeTAP	Cetacean and Turtle Assessment Program
CGS	Connecticut General Statutes
CH_4	methane
CITES	Convention of International Trade in Endangered Species
CL	carapace length
CL	Chain Length
CLCPA	Climate Leadership and Community Protection Act
cm	centimeter
CMECS	Coastal and Marine Ecological Classification Standard
CMP	Construction Management Plan

List of Acronyms (Continued)

CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	Corresponding Onshore Area
CO-OPS	Center for Operational Oceanographic Products and Services
COP	Construction and Operations Plan
CPT	cone penetration tests
CSIRO	Commonwealth Scientific and Industrial Research Organization
CSNA	Climate Solutions Now Act
CT DEEP	Connecticut Department of Energy and Environmental Protection
CTV	crew transfer vessel
CVA	Certified Verification Agent
CVOW	Coastal Virginia Offshore Wind
CWIS	cooling water intake structure
DAC	Disadvantaged Community
DAS	distributed acoustic sensing
DASR	Digital Airport Surveillance Radar
DC	direct current
DECD	Department of Economic and Community Development
DEIS	Draft Environmental Impact Statement
DFO	Department of Fisheries and Oceans
DHEC	Department of Health and Environmental Control
DHS	Department of Homeland Security
DMA	Dynamic Management Area
DMM	discarded military munition
DMON	Digital acoustic monitoring
DP	dynamic positioning
DPS	distinct population segment
DTS	distributed temperature sensing
EBS	Ecological Baseline Studies
EC	East Coast
EDR	Environmental Design & Research
EEA	Executive Office of Energy and Environmental Affairs
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
eGRID	Emissions & Generation Resource Integrated Database
EJ	Environmental Justice
EJMAP	Environment Justice Mapping, Assessment, and Protection
EMF	electromagnetic field
EO	Executive Order
EPA	Environmental Protection Agency

List of Acronyms (Continued)

EPRI	Electric Power Research Institute
ERM	environmental resource mapper
ESA	Endangered Species Act
ESF	Environmental Science and Forestry
ESP	electrical service platform
FAA	Federal Aviation Administration
FCP	fisheries communication plan
FDR	Facility Design Report
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWG	Fisheries Hydroacoustic Working Group
FIR	Fabrication and Installation Report
FL	Fisheries Liaison
FLAG	Fiber-Optic Link Around the Globe
FLM	Federal Land Manager
FMP	Fishery Management Plan
FR	Fisheries Representative
ft	feet
FTE	full-time equivalent
GARFO	Greater Atlantic Regional Fisheries Organization
GDP	gross domestic product
GHG	greenhouse gases
GIS	Geographic Information System
GNSS	global navigation satellite system
GPS	global positioning system
GRAD	gradiometer
GW	gigawatt
GWSA	Global Warming Solutions Act
HAP	hazardous air pollutant
HAT	Highest Astronomical Tide
HC	hydrocarbon
HDD	horizontal directional drilling
HF	high frequency
HLV	heavy lift vessel
hr	hour
HMS	highly migratory species
HPTP	Historic Properties Treatment Plan
HREA	Historic Resources Effects Assessment
HRG	high resolution geophysical
HRVEA	Historic Resources Visual Effects Assessment
HSD	HydroSound Dampers

List of Acronyms (Continued)

HSE	Health, Safety, and Environmental
HVAC	high voltage alternating current
HVDC	high voltage direct current
IFR	instrument flight rule
IMO	International Maritime Organization
in	inch
IOOS	Integrated Ocean Observing System
IPaC	Information for Planning and Consultation
IPF	impact producing factor
IR	infrared
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
IWG	Interagency Working Group
JFK	John F Kennedy International Airport
km	kilometer
km^2	square kilometer
KOP	key observation point
LAER	Lowest Achievable Emission Rate
LATN	low-altitude tactical navigation
LED	light-emitting diode
LF	low frequency
LGA	LaGuardia Airport
LiDAR	Light Detection and Ranging
LID	low-impact development
LIPA	Long Island Power Authority
m	meter
m^2	square meter
m^3	cubic meter
MAB	Mid-Atlantic Bight
MARA	Marine Archaeological Resources Assessment
MARCO	Mid-Atlantic Council on the Ocean
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
MARPOL	International Convention for the Prevention of Pollution from Ships
MA WEA	Massachusetts Wind Energy Area
MBES	multibeam echosounder
MCS	multi-channel seismic
MDAT	Marine-life Data and Analysis Team
MDE	Maryland Department of the Environment
MEA	minimum enroute altitude
MF	magnetic field
MF	mid frequency

List of Acronyms (Continued)

MHz	megahertz
mi	mile
mi^2	square mile
MLLW	Mean Lower Low Water
mm	millimeter
MMIS	Marine Minerals Information System
MMP	Marine Minerals Program
MMPA	Marine Mammal Protection Act
MMT	million metric ton
MOCA	minimum obstruction clearance altitude
mph	miles per hour
MPRSA	Marine Protection, Research, and Sanctuaries Act
MRASS	Mariner Radio Activated Sound Signals
MRIP	Marine Recreational Information Program
MSIR	Marine Site Investigation Report
M-TWG	Maritime Technical Working Group
MV	marine vibrator
MVA	minimum vectoring altitude
MW	megawatt
N/A	not applicable
NAAQS	National Ambient Air Quality Standards
NABat	Bat Monitoring Program
NAICS	North American Industry Classification System
NARW	North Atlantic right whales
NAS	noise abatement system
NCCOS	National Centers for Coastal Ocean Science
NDBC	National Data Buoy Centre
NEAMAP	NorthEast Area Monitoring and Assessment Program
NEAq	New England Aquarium
NEFSC	Northeast Fisheries Science Center
NEODP	Northeast Ocean Data Portal
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NEXRAD	next generation weather radar
NHPA	National Historic Preservation Act
NJ WEA	New Jersey Wind Energy Area
NJDEP	New Jersey Department of Environmental Protection
NJGWS	New Jersey Geologic and Water Survey
NLCD	National Land Cover Base
NM	nautical mile
NMFS	National Marine Fisheries Service

List of Acronyms (Continued)

NMS	Noise Mitigation System
NO_2	nitrogen dioxide
NOAA	National Oceanic Atmospheric Administration
NORM	Navigational and Operational Risk Model
NOS	National Ocean Service
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NROC	Northeast Regional Ocean Council
NSRA	Navigation Safety Risk Assessment
NTIA	National Telecommunications and Information Administration
NTM	Notices to Mariners
NVD	night vision device
NWS	National Weather Service
NYAC	New York Archaeological Council
NYCRR	New York Codes, Rules and Regulations
NYNHP	New York Natural Heritage Program
NYPA	New York Power Authority
NYS	New York State
NYSCJWG	New York State Climate Justice Working Group
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSERDA	New York State Energy Research and Development Authority
NYSHPO	New York State Historic Preservation Office
NYSOPRHP	New York State Office of Parks, Recreation, and Historic Preservation
NY WEA	New York Wind Energy Area
OBIS	Ocean Biodiversity Information System
OCM	Office of Coastal Management
OCS	Outer Continental Shelf
OE/AA	Obstruction Evaluation and Airspace Analysis
OECC	Offshore Export Cable Corridor
OEM	original equipment manufacturer
OFL	Onboard Fisheries Liaison
OLPD	online partial discharge
O&M	operations and maintenance
OSS	Out of Service
OPA	Offshore Planning Area
OPAREA	Operating Areas
OSP	optimal sustainable population
OSRP	Oil Spill Response Plan

List of Acronyms (Continued)

OTR	Ozone Transport Region
PA DEP	Pennsylvania Department of Environmental Protection
PAM	passive acoustic monitoring
PAPE	Preliminary Area of Potential Effects
PATON	Private Aid to Navigation
PBR	Potential Biological Removal
PDE	Project Design Envelope
PK	peak
PM	particulate matter
POI	Point of Interconnection
PSD	Prevention of Significant Deterioration
PSEG	Public Service Enterprise Group
PSO	Protected Species Observer
PTS	permanent threshold shift
QMA	Qualified Marine Archaeologist
RAPCON	Radar Approach Control
RCS	reactive compensation station
ReMOTe	Remote Marine and Onshore Technology
RIDEM	Rhode Island Department of Environmental Management
RI/MA WEA	Rhode Island/Massachusetts Wind Energy Area
ROTV	remotely operated towed vehicles
ROV	remotely operated vehicles
ROW	rights-of-way
RSD	Rippled Scour Depression
RSZ	rotor swept zone
SAR	search and rescue
SASI	Swept Area Seabed Impact
SATV	service accommodation and transfer vessels
SBMT	South Brooklyn Marine Terminal
SBP	sub-bottom profilers
SCADA	supervisory control and data acquisition
SC-GHG	social cost of GHGs
SCL	straight carapace lengths
SCS	Single-channel seismic
SEER	Synthesis of Environmental Effects Research
SEFSC	Southeast Fisheries Science Center
SEL	Sound Exposure Level
SEL_{cum}	cumulative sound exposure level
SF_6	sulfur hexafluoride
SFV	sound field verification
SHPO	State Historic Preservation Officer

List of Acronyms (Continued)

SL	sound level
SLVIA	Seascape, Landscape, and Visual Impact Assessment
SMA	Seasonal Management Areas
SMAST	School of Marine Science and Technology
SNE	southern New England
SO_2	sulfur dioxide
SoMAS	School of Marine and Atmospheric Sciences
SOI	Secretary of the Interior
SOV	service operation vessel
SPCC	Spill Prevention, Control, and Countermeasure
SPL	sound pressure level
SPL_{pk}	peak sound pressure level
SPL_{rms}	root mean square sound pressure level
SSER	South Shore Estuary Reserve
SSS	side scan sonar
STSSN	Sea Turtle Stranding and Salvage Network
SUNY	State University of New York
TARA	Terrestrial Archaeological Resources Assessment
TBD	to be determined
TCP	traditional cultural properties
TDWR	Terminal Doppler Weather Radar
TED	Turtle Excluder Device
THPO	Tribal Historic Preservation Officer
TMP	Traffic Management Plan
TRACON	Terminal Radar Approach Control
TSS	total suspended solids
TSS	traffic separation scheme
TTS	temporary threshold shift
UK	United Kingdom
ULSD	ultra-low sulfur diesel
UME	Unusual Mortality Event
US	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USCS	Unified Soils Classification System
USD	United States Dollar
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UXO	unexploded ordnances
VC	vibracores
VGP	Vessel General Permit

List of Acronyms (Continued)

VHF	very high frequency
VMS	vessel monitoring system
VO	Visual Observer
VOC	volatile organic compounds
VSA	Visual Study Area
VTR	vessel trip reports
WCS	Wildlife Conservation Society
WEA	Wind Energy Area
WFO	Weather Forecast Office
WHOI	Woods Hole Oceanographic Institution
WNS	white-nose syndrome
WOA	World Ocean Atlas
WSR	Weather Surveillance Radar
WTG	wind turbine generator
WTRIM	Wind Turbine Radar Interference
ZLV	Zone of Likely Visibility
ZTV	Zone of Theoretical Visibility

1 Introduction

1.1 Overview of Vineyard Mid-Atlantic

Vineyard Mid-Atlantic LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0544 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Mid-Atlantic".

Vineyard Mid-Atlantic includes 118 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area.[1] One or two of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. In accordance with Proponent's lease stipulations, the WTGs and ESP(s) will be oriented in west-northwest to east-southeast rows and north to south columns with 0.68 nautical mile (NM) (1.3 kilometer [km]) spacing between positions. The WTGs will be supported by monopiles and ESP(s) will be supported by monopiles or piled jacket foundations. The base of the foundations may be surrounded by scour protection. Submarine inter-array cables will transmit power from groups of WTGs to the ESP(s). If two ESPs are used, they may be connected with inter-link cables. Two to six offshore export cables will then transmit the electricity collected at the ESP(s) to shore.

The WTGs, ESP(s), and their foundations as well as the inter-array cables, inter-link cables (if used), and a portion of the offshore export cables will be located in Lease Area OCS-A 0544. The Lease Area is one of six New York Bight Lease Areas identified by BOEM, following a public process and environmental review, as suitable for offshore wind energy development. At its closest point, the 174 square kilometer (km^2) (43,056 acre) Lease Area is approximately 38 km (24 miles [mi]) south of Fire Island, New York.

Between the Lease Area and shore, the offshore export cables will be installed within an Offshore Export Cable Corridor (OECC). Up to six high voltage alternating current (HVAC) cables, two high voltage direct current (HVDC) cable bundles, or a combination of up to four HVAC cables/HVDC cable bundles will be installed within the OECC. The OECC extends from the northern end of the Lease Area, continues west along the boundary of neighboring Lease Area OCS-A 0512, and then proceeds northwest across the Ambrose to Nantucket and Nantucket to Ambrose Traffic Lanes towards the southern shore of Long Island, New York. As the OECC approaches shore, it splits into three variations to connect to three potential landfall sites (of which, up to two will be used): the Rockaway Beach Landfall Site, the Atlantic Beach

1 As further described in Section 2.3 of COP Volume I, six WTG/ESP positions along the northwestern boundary of Lease Area OCS-A 0544 are contingent upon the final layout of the neighboring Empire Wind 2 project. Vineyard Mid-Atlantic will not develop these contingent WTG/ESP positions if the final Empire Wind 2 layout includes WTGs at immediately adjacent positions within Lease Area OCS-A 0512.

Landfall Site, and the Jones Beach Landfall Site. The Proponent has also identified a "Western Landfall Sites OECC Variant" that may be used for routing offshore export cables to the Rockaway Beach and Atlantic Beach Landfall Sites.

Onshore export cables will connect up to two of the three potential landfall sites to two new onshore substations in Nassau County and/or Suffolk County, New York. If HVAC cables are used, depending upon numerous technical considerations, an onshore reactive compensation station (RCS) may be located along each onshore export cable route to manage the export cables' reactive power (unusable electricity), increase the transmission system's operational efficiency, reduce conduction losses, and minimize excess heating. Grid interconnection cables will connect the new onshore substations to the existing East Garden City Substation (Uniondale) Point of Interconnection (POI) in Uniondale, New York, the Ruland Road Substation POI in Melville, New York, or the proposed Eastern Queens Substation POI in Queens, New York.

Vineyard Mid-Atlantic is being developed and permitted using a Project Design Envelope (PDE) based on expected commercial and technological advancements. The PDE outlines a reasonable range of project design parameters (e.g., multiple foundation types) and installation techniques (e.g., use of various cable installation tools). The Proponent has developed the PDE and sited Vineyard Mid-Atlantic's facilities in consultation with multiple stakeholders. For example, the Proponent modified and refined the OECC through numerous consultations with federal and state agencies as well as fishermen and, based on their feedback, consolidated the OECC with Empire Wind 2's proposed submarine export cable route to the extent feasible. Key elements of Vineyard Mid-Atlantic's PDE are summarized in Table 1.1-1.

Table 1.1-1 Summary of the Project Design Envelope

Parameter	Project Design Envelope
Maximum number of WTG/ESP positions	118
Wind Turbine Generators	
Maximum number of WTGs	117
Maximum rotor diameter	320 meters (m) (1,050 feet [ft])
Maximum tip height	355 m (1,165 ft)
Minimum tip clearance	27 m (89 ft)
Electrical Service Platform(s)	
Number of ESPs	1 or 2
Maximum topside height above Mean Lower Low Water[1]	70 m (230 ft)
Foundations and Scour Protection	
Maximum pile diameter	Monopiles (WTGs and ESPs): 13 m (43 ft) Piled jackets (ESPs): 4.25 m (14 ft)
Maximum area of scour protection	WTG monopiles: 7,238-11,660 square meters (m^2) (1.8-2.9 acres)[2] ESP monopiles: 7,238-11,660 m^2 (1.8-2.9 acers)[2] ESP piled jackets: 32,577 m^2 (8.1 acres)

Table 1.1-1 Summary of the Project Design Envelope (Continued)

Parameter	Project Design Envelope
Offshore Cables	
Maximum total inter-array cable length	296 km (160 NM)
Maximum total inter-link cable length	83 km (45 NM)
Number of offshore export cables	2–6 total cables (up to 6 HVAC cables, 2 HVDC cable bundles, or a combination of up to 4 HVAC cables/HVDC cable bundles)
Maximum total offshore export cable length[3]	594 km (321 NM)
Target burial depth beneath stable seafloor[4]	1.2 m (4 ft) in federal waters 1.8 m (6 ft) in state waters
Onshore Facilities	
Potential landfall site(s)	Up to two of the following potential landfall site(s) will be used: Rockaway Beach Landfall Site, Atlantic Beach Landfall Site, or Jones Beach Landfall Site
Potential POIs	East Garden City Substation (Uniondale) POI Ruland Road Substation POI Eastern Queens Substation POI
Maximum onshore cable route length	Routes to the Uniondale POI: 29 km (18 mi) Routes to the Ruland Road Substation POI: 35 km (22 mi) Routes to the Eastern Queens Substation POI: 28 km (18 mi)
Onshore substation site envelopes[5]	Two onshore substations will be located within up to two of the following onshore substation site envelopes: Onshore Substation Site Envelope A, Onshore Substation Site Envelope B, Onshore Substation Site Envelope C, or Onshore Substation Site Envelope D
Maximum number of onshore RCSs	2

Notes:

1. Height includes helipad (if present), but may not include antennae and other appurtenances.
2. A range of the maximum area of scour protection is provided as detailed engineering of the foundations is ongoing. Feedback from New York Bight recreational fishermen indicates they are supportive of extending scour protection around foundations because it provides additional structured habitat for fish.
3. Includes the length of the offshore export cables within the Lease Area.
4. Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.
5. Since the Proponent has not yet secured site control for the onshore substation sites, the Proponent has identified several potential "onshore substation site envelopes."

1.2 Construction

Construction of Vineyard Mid-Atlantic will likely start with the onshore facilities (e.g., onshore cables and onshore substations). The onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas)[2] via open trenching. Trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies). The onshore cables may be installed in a duct bank (i.e., an array of plastic conduits encased in concrete) or within directly buried conduit(s). Construction of the onshore substations and onshore RCSs is expected to involve site preparation (e.g., land clearing and grading), installation of the equipment and cables, commissioning, and site clean-up and restoration.

Offshore construction will likely begin with offshore export cable installation and/or foundation installation (including scour protection installation). Once the foundations are in place, the WTGs and ESP topside(s) can be installed. Inter-array cables may be installed before or after the WTGs are installed on their foundations. WTG commissioning is expected to take place after the inter-array cables are installed.

Prior to offshore cable installation, the cable alignments may require boulder clearance and minimal to no sand bedform leveling. Following those activities, pre-lay surveys and pre-lay grapnel runs will be performed to confirm that the cable alignments are suitable for installation. The offshore cables will then be buried beneath the stable seafloor at a target depth of 1.2 meters (m) (4 feet [ft]) in federal waters and 1.8 m (6 ft) in state waters[3] likely using jetting techniques or a mechanical plow. While every effort will be made to achieve sufficient burial, a limited portion of the offshore cables may require cable protection if a sufficient burial depth cannot be achieved. At the landfall site(s), the offshore export cables are expected to transition onshore using horizontal directional drilling (HDD) to avoid or minimize impacts to the beach, intertidal zone, and nearshore areas. The offshore export cables will connect to the onshore export cables in underground transition vaults at the landfall site(s).

The foundations, WTGs, and ESP topside(s) may be staged at United States (US) or Canadian port(s) or delivered directly to the Lease Area. The Proponent has identified several ports in New York, New Jersey, Connecticut, Rhode Island, Massachusetts, Maryland, South Carolina, and Canada that may be used during construction (see Section 3.10.1 of COP Volume I). The foundations, WTGs, and ESP topside(s) will be installed by jack-up vessels or heavy lift vessels (HLVs) using dynamic positioning (DP) or anchors along with necessary support vessels (e.g.,

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[2] In limited areas, the onshore cable routes may follow utility rights-of-way (ROWs) or depart from public roadway layouts, particularly at complex crossings.

[3] Unless the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

tugboats). Seabed preparation may be required prior to foundation installation. Scour protection, which would likely consist of loose rock material placed around the foundation, will likely be needed for monopiles, but may or may not be needed for the smaller diameter jacket pin piles. Once set onto the seabed by the crane of the main installation vessel(s), monopiles or jacket pin piles will be installed using impact pile driving,[4] which will begin with a soft-start (i.e., the impact hammer energy level will be gradually increased). Noise mitigation systems are expected to be applied during pile driving. If monopile foundations are used, a transition piece will be installed on top of the monopile using a vessel's crane (unless an extended monopile concept is employed). Once the foundations are installed, the WTGs and ESP topside(s) will be lifted and secured onto their foundations. Then, the WTGs and ESP(s) will be commissioned to confirm that they are functioning correctly and ready for energy production. To aid safe navigation, the WTGs, ESP(s), and their foundations will be equipped with marine navigation and aviation lighting, marking, and signaling in accordance with BOEM, United States Coast Guard (USCG), and Federal Aviation Administration (FAA) guidance.

1.3 Operations and Maintenance

Vineyard Mid-Atlantic's facilities are expected to operate for a minimum of approximately 30 years.[5] During operations, the offshore and onshore facilities will be continuously remotely monitored from one or more control center(s) located at the Proponent's operations and maintenance (O&M) facilities and/or a third party's facilities.

The WTGs and ESP(s) will be designed to operate autonomously and will not be manned. The offshore facilities will be equipped with a supervisory control and data acquisition (SCADA) system. The SCADA system will notify operators of alarms or warnings and enable the operators to remotely interact with and control devices (e.g., sensors, valves, motors), override automatic functions, reset systems, and shut down equipment for maintenance or at the request of grid operators or agencies. The Proponent anticipates that the offshore cables will include a monitoring system, such as distributed temperature sensing (DTS), online partial discharge (OLPD) monitoring, and/or distributed acoustic sensing (DAS), to continuously monitor the cables' status.

The Proponent will regularly conduct inspections and preventative maintenance, including foundation and scour protection inspections, offshore cable surveys, safety inspections and tests, electrical component service, and replacement of consumables, among other activities.

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4 Prior to impact pile driving, a vibratory hammer or other tool could be used to slowly lower the pile through the top layers of the seabed in a controlled fashion to avoid the potential for a "pile run" (see Section 3.3 of COP Volume I)

5 Lease OCS-A 0544 provides for an Operations Term of 33 years, which begins on the date that BOEM approves the COP (and includes the construction period); the operations period of the Lease may be amended in accordance with 30 CFR § 585.235 and/or the Proponent may request a renewal of the operations period.

Offshore, most scheduled maintenance activities will be performed using service operation vessels (SOVs), service accommodation and transfer vessels (SATVs), crew transfer vessels (CTVs), and/or helicopters. Unscheduled repairs or component replacement may also be necessary, which may require jack-up vessels or other larger vessels similar to those used during construction. The Proponent expects to use one or more onshore O&M facilities to support offshore operations. The O&M facilities, which could be located at or near any of the ports identified in Section 4.4.1 of COP Volume I, would likely be used for dispatching technicians and crew exchange, bunkering, and loading supplies and spare parts onto vessels. The Proponent may also lease space at an airport hangar for aircraft (e.g., helicopters) used to support operations. Onshore maintenance and repair activities are expected to require minimal use of worker vehicles and construction equipment.

1.4 Decommissioning

Decommissioning of the offshore and onshore facilities at the end of their operational life is essentially the reverse of the construction process. The WTGs and ESP(s) will be disconnected from the offshore cables, disassembled, and removed from their foundations. The foundations will be cut and removed to a depth of 4.5 m (15 ft) below the mudline, unless otherwise authorized by the Bureau of Safety and Environmental Enforcement (BSEE). The removed WTG, ESP, and foundation components will be shipped to shore and properly disposed of or recycled. The offshore cables may be removed or retired in place (if authorized by BOEM and other appropriate agencies). Any scour protection or cable protection may be removed or left in place, depending on input from federal and state agencies and relevant stakeholders. The onshore facilities could be retired in place or retained for future use, subject to discussions with local agencies.

1.5 Summary of the Maximum Design Scenario for Resource Assessments

The benefits and potential impacts of Vineyard Mid-Atlantic to physical, biological, socioeconomic, visual, and cultural resources, which are discussed in the following sections, are based on the “maximum design scenario” for each resource. The maximum design scenario, which is based on the PDE described in Sections 3.2 through 3.10 of COP Volume I, allows analysis of the maximum impacts that could occur from Vineyard Mid-Atlantic:

- For the offshore facilities, the maximum design scenario is the full buildout of all 118 WTG/ESP positions within the Lease Area. One or two of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. Each WTG will be supported by a monopile foundation. Each ESP could be supported by a monopile or a piled jacket foundation. As a result, Vineyard Mid-Atlantic could include

    - 116-118 monopiles and 0 to 2 piled jackets, as well as associated scour protection. The maximum design scenario also includes six offshore export cables (with a maximum total length of 594 km [321 NM]), up to 296 km (160 NM) of inter-array cables, up to 83 km (45 NM) of inter-link cables, and associated cable protection.[6]

- For the onshore facilities, the maximum design scenario is the construction of two landfall sites, two onshore cable routes, two onshore RCSs, and two new onshore substations in Nassau County and/or Suffolk County on Long Island, New York.

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6 The length of the offshore export cables includes the length of the cables within the Lease Area.

2 Summary of Vineyard Mid-Atlantic's Benefits

Vineyard Mid-Atlantic will generate clean, renewable electricity by 2030 to assist New York State and/or other offtake users in achieving their renewable energy and carbon emission reduction goals. The electricity generated by the wind turbine generators (WTGs) will displace electricity from fossil fuel power plants, resulting in a significant net reduction in air emissions from New York State's electric grid. Vineyard Mid-Atlantic is expected to reduce carbon dioxide equivalent (CO_2e) emissions from the electric grid by approximately 4.7 million tons per year (tpy), or the equivalent of taking approximately 930,000 cars off the road.[7,8] This reduction in greenhouse gas emissions will help mitigate additional effects of ongoing climate change (e.g., sea level rise and increased flooding, ocean acidification, changes in agricultural productivity, shifts in species' distributions, and increases in energy system costs) that are impacting the environment and public health. Vineyard Mid-Atlantic will also reduce regional emissions of air contaminants such as nitrogen oxides (NOx) and sulfur dioxide (SO_2), which contribute to acid rain and ground level ozone/smog and are linked to increased rates of early death, heart attacks, stroke, and respiratory disorders. Vineyard Mid-Atlantic will also help further diversify New York's electricity supply and increase the reliability of the electric grid.

Vineyard Mid-Atlantic offers several other environmental benefits. The Proponent expects to support (e.g., through funding, provision of resources, collecting and analyzing data) environmental research and conservation, community/climate change resilience measures, and coastal and benthic habitat improvement initiatives. The Proponent also expects to conduct or contribute to additional resource studies and monitoring programs pre- and post-construction, including providing scientific, technical, and financial support for regional environmental and fisheries studies. Additionally, as described in Sections 4.6 and 5.4, the foundations may function as fish aggregating devices, resulting in increases in biodiversity and abundance of fish and thereby improving the recreational fishing experience within the Lease Area (Riefolo et al. 2016; Raoux et al. 2017; BOEM 2021; The Nature Conservancy and INSPIRE Environmental 2021).

Beyond these important environmental, public health, and energy reliability benefits, Vineyard Mid-Atlantic is expected to result in significant long-term economic benefits. Vineyard Mid-Atlantic is expected to provide steady, well-paying jobs that will have direct positive and stabilizing impacts on the workforce within the Onshore Development Area and will result in significant growth in sectors servicing the offshore wind industry. The Proponent is committed to supply chain and workforce development and expects to work cooperatively with educational institutions and others to further develop training and educational opportunities

7 Assuming the minimum nameplate capacity of Vineyard Mid-Atlantic.

8 As further described in Section 3.1, the avoided emissions analysis is based on the approximate nameplate capacity for the entire Lease Area and 2021 air emissions data for Long Island from EPA's (2023) Emissions & Generation Resource Integrated Database (eGRID2021).

for students and residents of the Onshore Development Area. Vineyard Mid-Atlantic intends to prioritize host communities and environmental justice communities for recruitment, training, and hiring.

Based on an assessment of the expected minimum economic impacts associated with the buildout of Vineyard Mid-Atlantic (see Section 5.1 and Appendix II-S), Vineyard Mid-Atlantic is expected to support approximately 8,363 direct, indirect, and induced full-time equivalent (FTE) job-years[9] during pre-construction and construction. Construction of Vineyard Mid-Atlantic is estimated to generate approximately $866 million in total labor income, approximately $1.28 billion in value added, and approximately $2.49 billion in total economic output.[10,11] The operation of Vineyard Mid-Atlantic is projected to generate approximately 9,459 FTE job-years assuming a 30-year operational life (equivalent to 315 direct, indirect, and induced FTEs annually), as well as approximately $670 million in total annual labor income, $1.79 billion in value added, and approximately $2.89 billion in total output.

Lastly, each of the following sections contains a summary of avoidance, minimization, and mitigation measures, many of which provide benefits to the human or natural environment.

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9 One FTE job-year is the equivalent of one person working full time for one year (2,080 hours).

10 The economic impacts do not capture the additional benefits associated with the various supply chain localization and facility investments that would likely be included in future Vineyard Mid-Atlantic offtake awards.

11 Output is the estimated value of all goods and services sold (i.e., expenditures other than payroll).

3 Physical Resources

3.1 Air Quality

This section addresses the potential impacts and benefits of Vineyard Mid-Atlantic on air quality in the Offshore Development Area and Onshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to air quality during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

The clean, renewable offshore wind energy produced by Vineyard Mid-Atlantic will displace electricity from fossil fuel power plants, resulting in a significant net reduction in air emissions from the regional electric grid. Vineyard Mid-Atlantic is expected to reduce carbon dioxide equivalents (CO_2e) emissions from the electric grid by approximately 4.7 million tons per year (tpy), or the equivalent of taking approximately 930,000 cars off the road. Vineyard Mid-Atlantic is also expected to reduce regional emissions of nitrogen oxides (NOx) by 3,198 tpy and sulfur dioxide (SO_2) by 1,160 tpy (see Section 3.1.2.2 for additional details).

However, there will be air emissions from vessels, equipment, aircraft, and vehicles used during the construction, operations and maintenance (O&M), and decommissioning of Vineyard Mid-Atlantic. The Bureau of Ocean Energy Management (BOEM) only regulates air emissions from facilities located on the Outer Continental Shelf (OCS) in the Gulf of Mexico west of 87°30'W longitude and areas offshore Alaska's North Slope Borough. The Environmental Protection Agency (EPA) regulates air quality in all other portions of the OCS. Therefore, emissions from Vineyard Mid-Atlantic on the OCS are regulated through EPA's OCS Air Permit process under the OCS Air Regulations (40 CFR Part 55). Per BOEM's (2020) Construction and Operations Plan (COP) guidelines, the Proponent will provide a copy of Vineyard Mid-Atlantic's OCS Air Permit application(s) to BOEM when submitted to EPA.

Although BOEM does not have jurisdiction to regulate air emissions in the Offshore Development Area or Onshore Development Area, BOEM will assess Vineyard Mid-Atlantic's potential benefits and impacts to air quality as part of the National Environmental Policy Act (NEPA) process. This section provides an analysis of all potential air emissions from Vineyard Mid-Atlantic (both emissions regulated and not regulated by the OCS Air Regulations) within the United States (US) to support BOEM's assessment. The air quality information presented in this section is supplemented by Appendix II-A, which contains a preliminary inventory of Vineyard Mid-Atlantic's anticipated emission sources and describes the methodology used to estimate emissions generated during the construction and operation of Vineyard Mid-Atlantic. Appendix II-A also describes the method used to quantify emissions from fossil fuel power plants that are expected to be avoided as a result of Vineyard Mid-Atlantic's clean, renewable energy.

3.1.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities. For the purposes of assessing effects to air quality, the Offshore Development Area includes all federal and state waters within the US Exclusive Economic Zone (out to ~200 nautical miles [NM] [~370 kilometers {km}] from shore) where Vineyard Mid-Atlantic-related vessels, equipment, and aircraft may operate. This includes emissions from vessels traveling to and at the ports that may be used for Vineyard Mid-Atlantic (see Sections 3.10.1 and 4.4.1 of COP Volume I).

The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities. With respect to air quality, the Onshore Development Area includes the communities surrounding Vineyard Mid-Atlantic's onshore facilities, O&M facilities, construction staging areas, and port facilities.

In general, air pollutants within the Offshore Development Area and Onshore Development Area derive from both naturally occurring (biogenic) and human-made (anthropogenic) sources. Vessels are the predominant anthropogenic sources of air emissions in state and federal waters. Onshore, anthropogenic emission sources include cars and trucks, fossil fuel power plants, factories, office buildings, and homes, among many other sources.

To monitor the impacts of these emission sources on ambient air quality, air quality within a region is measured against National Ambient Air Quality Standards (NAAQS), which EPA has established to protect public health and welfare.[12] EPA has set NAAQS for six criteria air pollutants that are considered harmful to public health and the environment: SO_2, two types of particulate matter (PM) (10 microns and smaller as PM_{10} and 2.5 microns and smaller as $PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), lead (Pb),[13] and ozone (O_3). Typically, ozone is not emitted directly into the air; instead, ground-level ozone primarily forms from the reaction of volatile organic compounds (VOCs) and NOx in sunlight. VOCs and NOx, which are often emitted directly into the air, are commonly referred to as ozone precursors. Therefore, emissions of the precursors to ozone are quantified instead of ozone.

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[12] Several states (e.g., New York, New Jersey, Massachusetts) have also established ambient air quality standards that are similar or identical to the NAAQS.

[13] Pb is regulated as both a criteria pollutant and a hazardous air pollutant (discussed further below). The removal of Pb from motor vehicle gasoline and other regulatory restrictions on Pb emissions have resulted in a 98% reduction in ambient concentrations of Pb between 1980 and 2014 (EPA 2022). Because of this, Pb is now generally not addressed as a criteria pollutant but continues to be addressed as a component of HAP emissions.

NAAQS have been developed for various durations of exposure and consist of primary and secondary standards. Primary standards are intended to protect human health. Secondary standards are intended to protect public welfare from known or anticipated adverse effects associated with the presence of air pollutants, such as damage to property or vegetation. The NAAQS are summarized in Table 3.1-1 below.

Table 3.1-1 National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS[1]	
		Primary	Secondary
NO_2	Annual[2]	53 ppb	Same
	1-hour[3]	100 ppb	None
SO_2	3-hour[4]	None	0.5 ppm
	1-hour[5]	75 ppb	None
$PM_{2.5}$	Annual[6]	9 μg/m^3	15 μg/m^3
	24-hour[7]	35 μg/m^3	Same
PM_{10}	24-hour[8]	150 μg/m^3	Same
CO	8-hour[4]	9 ppm	None
	1-hour[4]	35 ppm	None
Ozone	8-hour[9]	0.070 ppm	Same
Pb	3-month[10]	0.15 μg/m^3	Same

Notes:

1. Source: EPA 2024b. ppb = parts per billion by volume. μg/m3 = micrograms per cubic meter of air. ppm = parts per million by volume.
2. Annual mean.
3. 98th percentile of 1-hour daily maximum concentrations, averaged over three years.
4. Not to be exceeded more than once per year.
5. 99th percentile of 1-hour daily maximum concentrations, averaged over three years.
6. Annual mean, averaged over three years.
7. 98th percentile, averaged over three years.
8. Not to be exceeded more than once per year on average over three years.
9. Annual fourth-highest daily maximum 8-hour concentration, averaged over three years.
10. Not to be exceeded.

To assess compliance with the NAAQS, the concentrations of criteria pollutants in ambient (outdoor) air are measured by a network of onshore monitoring stations. EPA uses this air quality data to classify all areas of the country as in *attainment*, *nonattainment*, or *unclassified* with the NAAQS. When the monitored pollutant levels in an area exceed the NAAQS for any pollutant, the area is classified as in "nonattainment" for that pollutant. For some standards, nonattainment areas are categorized by the severity of the pollution. These classifications, in order of increasing severity, are: marginal, moderate, serious, severe, and extreme. An attainment area is defined as an area that meets or is cleaner than the NAAQS. An unclassified area is defined as an area that cannot be classified as meeting or not meeting the NAAQS based on available information and is treated as an attainment area. Note that an area can be in attainment/unclassified for some pollutants and in nonattainment for others. Additionally, an area that was previously in nonattainment but is currently in attainment or unclassified may be designated as a maintenance area (EPA 2010). An area's attainment status can be found in Designation of Areas for Air Quality Planning Purposes (40 CFR Part 81).

Although there are no monitoring stations offshore, for coastal areas, the nonattainment or maintenance area boundary extends to the state's seaward boundary, which is 3 NM (~5.6 km) for most states (EPA 2010). The EPA does not designate attainment statuses for federal waters. However, the attainment designations described below effectively characterize air quality throughout the Offshore Development Area.

Attainment designations for all US counties where Vineyard Mid-Atlantic air emissions may occur (due to onshore construction, offshore construction, vessel transits, and port usage) are summarized in Table 3.1-2. When EPA designates a new NAAQS, older standards are not automatically revoked. As a result, there are two 8-hour ozone standards (the 2008 and 2015 standards), three $PM_{2.5}$ standards (the 1997, 2006, and 2012 standards), two SO_2 standards (the 1971 and 2010 standards), and two Pb standards (the 1978 and 2008 standards). All counties where Vineyard Mid-Atlantic emissions may occur are in attainment with the NAAQS for Pb, NO_2, and the 1971 SO_2 standards, which are not included in the following table.

Although several counties in the Offshore Development Area and Onshore Development Area are in nonattainment with the various NAAQS (see Table 3.1-2),[14] in general, air quality along the East Coast has been improving over the last two decades (EPA 2023c). This trend is illustrated in Figure 3.1-1, which shows the ambient air concentrations of key criteria pollutants measured at several monitoring stations closest to the Lease Area and OECC since 2008.[15]

14 The General Conformity regulations (40 CFR Part 93, Subpart B and 40 CFR Part 51, Subpart W) ensure that federal actions do not interfere with states' or Native American tribes' plans to attain and maintain the NAAQS in areas that are or have been classified as nonattainment for those standards. The activities for which BOEM has authority are outside of any nonattainment or maintenance area; therefore, BOEM has determined that it is not required to demonstrate conformity.

15 Based on ambient air quality data from EPA (2021).

Table 3.1-2 Air Quality Designations for Areas Where Vineyard Mid-Atlantic Emissions May Occur

County	Potential Vineyard Mid-Atlantic Activities	Attainment Status[1]	Criteria Pollutants (Year of Standard)[2,3]						
			O_3 (2008)	O_3 (2015)	$PM_{2.5}$ (1997 & 2006)[4]	$PM_{2.5}$ (2012)	PM_{10} (1987)	CO (1971)	SO_2 (2010)
New York									
Nassau, Queens	Onshore construction, offshore construction, and vessel transits	Nonattainment	SV	MD					
		Maintenance			x			x	
		Attainment				x	x		x
Suffolk	Onshore construction, port usage, and vessel transits	Nonattainment	SV	MD					
		Maintenance			x				
		Attainment				x	x	x	x
Bronx, Kings, Richmond, Westchester	Port usage and/or vessel transits	Nonattainment	SV	MD					
		Maintenance			x			x	
		Attainment				x	x		x
Rockland	Port usage and vessel transits	Nonattainment	SV	MD					
		Maintenance			x				
		Attainment				x	x	x	x
New York	Vessel transits	Nonattainment	SV	MD			MD		
		Maintenance			x			x	
		Attainment				x			x
Orange	Vessel transits	Nonattainment							
		Maintenance			x				
		Attainment	x	x		x	x	x	x
Albany, Rensselaer, Putnam, Dutchess, Columbia, Ulster, Greene	Port usage and/or vessel transits	Nonattainment							
		Maintenance							
		Attainment	x	x	x	x	x	x	x
New Jersey									
Bergen, Essex, Hudson, Middlesex, Monmouth, Union	Port usage and/or vessel transits	Nonattainment	SV	MD					
		Maintenance			x			x	
		Attainment				x	x		x
Cape May, Cumberland	Vessel transits	Nonattainment	MG	MD					
		Maintenance							
		Attainment			x	x	x	x	x

Table 3.1-2 Air Quality Designations for Areas Where Vineyard Mid-Atlantic Emissions May Occur (Continued)

County	Potential Vineyard Mid-Atlantic Activities	Attainment Status[1]	Criteria Pollutants (Year of Standard)[2,3]						
			O_3 (2008)	O_3 (2015)	$PM_{2.5}$ (1997 & 2006)[4]	$PM_{2.5}$ (2012)	PM_{10} (1987)	CO (1971)	SO_2 (2010)
New Jersey (Continued)									
Salem	Port usage and vessel transits	Nonattainment	MG	MD					
		Maintenance						x	
		Attainment			x	x	x		x
Gloucester	Port usage and vessel transits	Nonattainment	MG	MD					
		Maintenance			x				
		Attainment				x	x	x	x
Connecticut									
Fairfield, New Haven	Port usage and/or vessel transits	Nonattainment	SV	MD					
		Maintenance			x			x	
		Attainment				x	x		x
Middlesex	Vessel transits	Nonattainment	SV	MD					
		Maintenance						x	
		Attainment			x	x	x		x
New London	Port usage and vessel transits	Nonattainment	S	MD					
		Maintenance							
		Attainment			x	x	x	x	x
Rhode Island									
All Rhode Island Counties	Port usage and/or vessel transits	Nonattainment							
		Maintenance							
		Attainment	x	x	x	x	x	x	x

Table 3.1-2 Air Quality Designations for Areas Where Vineyard Mid-Atlantic Emissions May Occur (Continued)

County	Potential Vineyard Mid-Atlantic Activities	Attainment Status[1]	Criteria Pollutants (Year of Standard)[2,3]						
			O_3 (2008)	O_3 (2015)	$PM_{2.5}$ (1997 & 2006)[4]	$PM_{2.5}$ (2012)	PM_{10} (1987)	CO (1971)	SO_2 (2010)
Massachusetts									
Bristol	Port usage and vessel transits	Nonattainment							
		Maintenance							
		Attainment	x	x	x	x	x	x	x
Dukes	Vessel transits	Nonattainment	MG						
		Maintenance							
		Attainment		x	x	x	x	x	x
Essex	Port usage and vessel transits	Nonattainment							
		Maintenance							
		Attainment	x	x	x	x	x	x	x
Pennsylvania									
Delaware	Vessel transits	Nonattainment	MG	MD					
		Maintenance			x	x			
		Attainment					x	x	x
Delaware									
Kent	Vessel transits	Nonattainment							
		Maintenance							
		Attainment	x	x	x	x	x	x	x
Sussex	Vessel transits	Nonattainment	MG						
		Maintenance							
		Attainment		x	x	x	x	x	x
New Castle	Vessel transits	Nonattainment	MG	MD					
		Maintenance			x				
		Attainment				x	x	x	x

Table 3.1-2 Air Quality Designations for Areas Where Vineyard Mid-Atlantic Emissions May Occur (Continued)

County	Potential Vineyard Mid-Atlantic Activities	Attainment Status[1]	Criteria Pollutants (Year of Standard)[2,3]						
			O_3 (2008)	O_3 (2015)	$PM_{2.5}$ (1997 & 2006)[4]	$PM_{2.5}$ (2012)	PM_{10} (1987)	CO (1971)	SO_2 (2010)
Maryland									
Anne Arundel, Baltimore	Port usage and/or vessel transits Vessel transits	Nonattainment	MD	MD					N
		Maintenance							
		Attainment			x	x	x	x	
Calvert	Vessel transits	Nonattainment		MD					
		Maintenance	x						
		Attainment			x	x	x	x	x
Dorchester, Kent, Queen Anne's, Somerset, St. Mary's, Talbot	Vessel transits	Nonattainment							
		Maintenance							
		Attainment	x	x	x	x	x	x	x
Virginia									
Accomack, Hampton, Lancaster, Matthews, Middlesex, Norfolk, Northampton, Northumberland, Poquoson, Virginia Beach, York	Vessel transits	x	x	x	x	x	x	x	x
South Carolina									
Berkeley, Charleston	Port usage and vessel transits	Nonattainment							
		Maintenance							
		Attainment	x	x	x	x	x	x	x

Notes:

1. Counties depicted as in attainment may be in attainment or unclassified.
2. MG = marginal nonattainment; MD = moderate nonattainment, S = serious nonattainment, SV = severe nonattainment, N = not specified, and X = maintenance, attainment, or unclassified.
3. Source: EPA 2023d.
4. The $PM_{2.5}$ (1997) standard is revoked for attainment and maintenance areas.

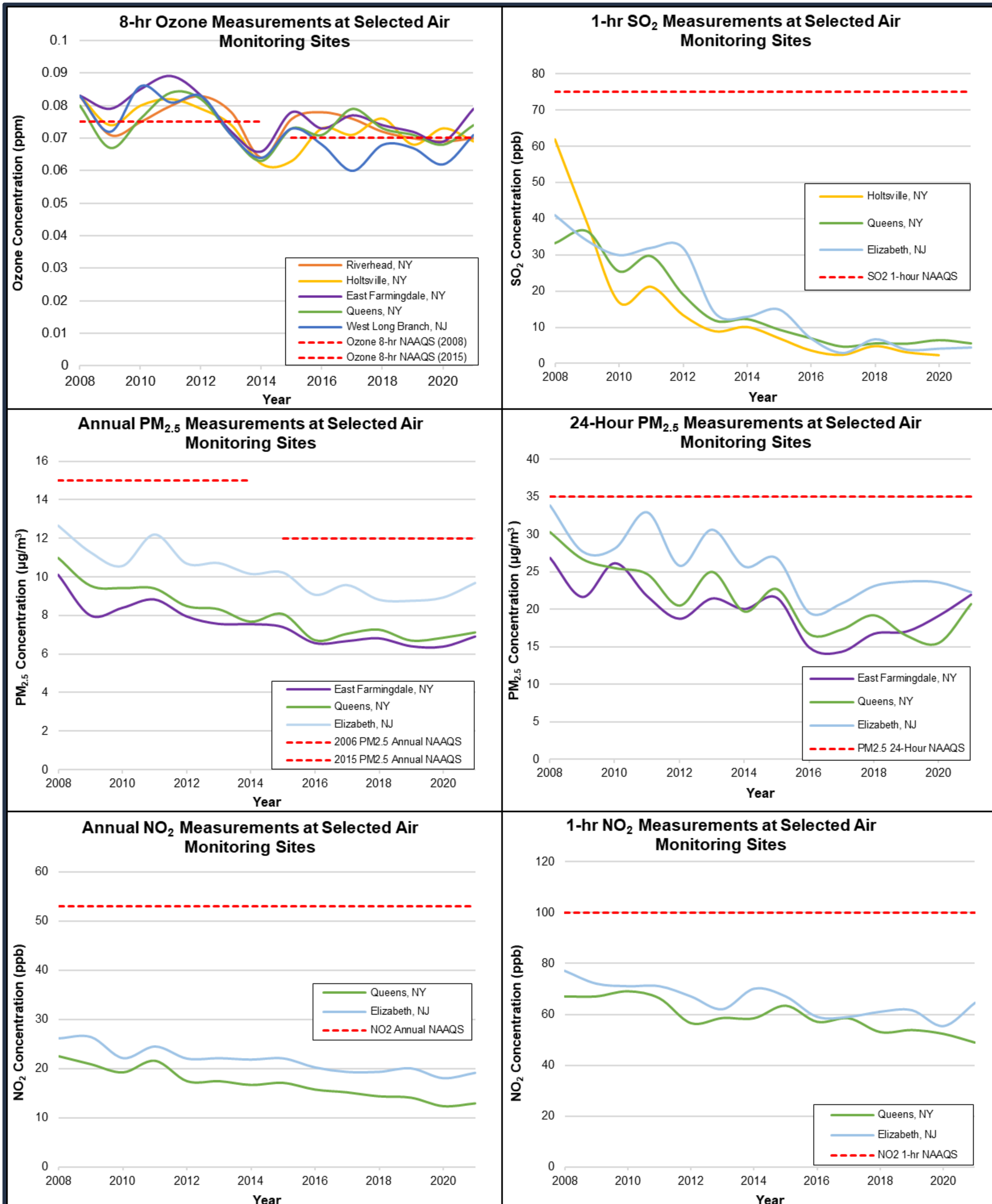

Figure 3.1-1
Ambient Air Quality Near the Offshore Development Area

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

In addition to the attainment designations provided in Table 3.1-2, New York, New Jersey, Connecticut, Rhode Island, Massachusetts, Pennsylvania, Delaware, Maryland, and portions of Virginia are part of the Ozone Transport Region (OTR). The OTR was established in Section 184(a) of the Clean Air Act (CAA) to address ozone formation and pollution due to interstate transport of air pollutants from upwind states to downwind states. All counties or areas within the OTR are treated, at a minimum, as moderate nonattainment areas for ozone (see CAA § 184(b)(2)).

Under the CAA, new major sources of air pollutants (or major modifications at existing sources) within nonattainment areas are subject to Nonattainment New Source Review, whereas new major sources or major modifications in attainment areas are subject to the Prevention of Significant Deterioration (PSD) Program.

Under the PSD Program, areas that are in attainment with the NAAQS are classified as either "Class I," "Class II," or "Class III" areas, which determines the level of air quality deterioration allowed in these areas (EPA 2024a). Class I areas, which include certain national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres, are afforded the greatest level of air quality and visibility protection (NPS 2023). The Class I areas nearest to the Lease Area are shown in Figure 3.1-2. The distances to the nearest Class I areas from the Lease Area centroid are approximately as follows: 128 km (80 miles [mi]) from the Brigantine Wilderness; 312 km (194 mi) from the Lye Brook Wilderness Area; and 450 km (280 mi) from the Presidential Range – Dry River Wilderness. All other areas that attain the NAAQS are initially designated as Class II areas; in these areas, a moderate amount of air quality deterioration is permitted (NPS 2023; EPA 2024a). Class II areas comprise most of the US. There are currently no Class III areas.

Under the CAA, the Federal Land Manager (FLM) and the Federal official with direct responsibility for management of Federal Class I parks and wilderness areas are responsible for protecting the air quality related values (AQRVs) of such lands and must consider whether a proposed major emitting facility will have an adverse impact on such values (NPS 2010). An AQRV is defined as "a resource, as identified by the FLM for one or more Federal areas that may be adversely affected by a change in air quality. The resource may include visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource identified by the FLM for a particular area" (NPS 2010). As part of the OCS Air Permit process, the Proponent will evaluate the potential impacts of Vineyard Mid-Atlantic's air emissions on Class I areas of interest and their related AQRVs as well as Class II areas.

In addition to criteria air pollutants, the assessment of potential air quality impacts from Vineyard Mid-Atlantic addresses hazardous air pollutants (HAPs) and greenhouse gases (GHGs). Although there are no NAAQS for HAPs and GHGs, emissions of these pollutants are regulated through state and federal emission standards (e.g., National Emission Standards for Hazardous Air Pollutants [NESHAPS]) and permit requirements.

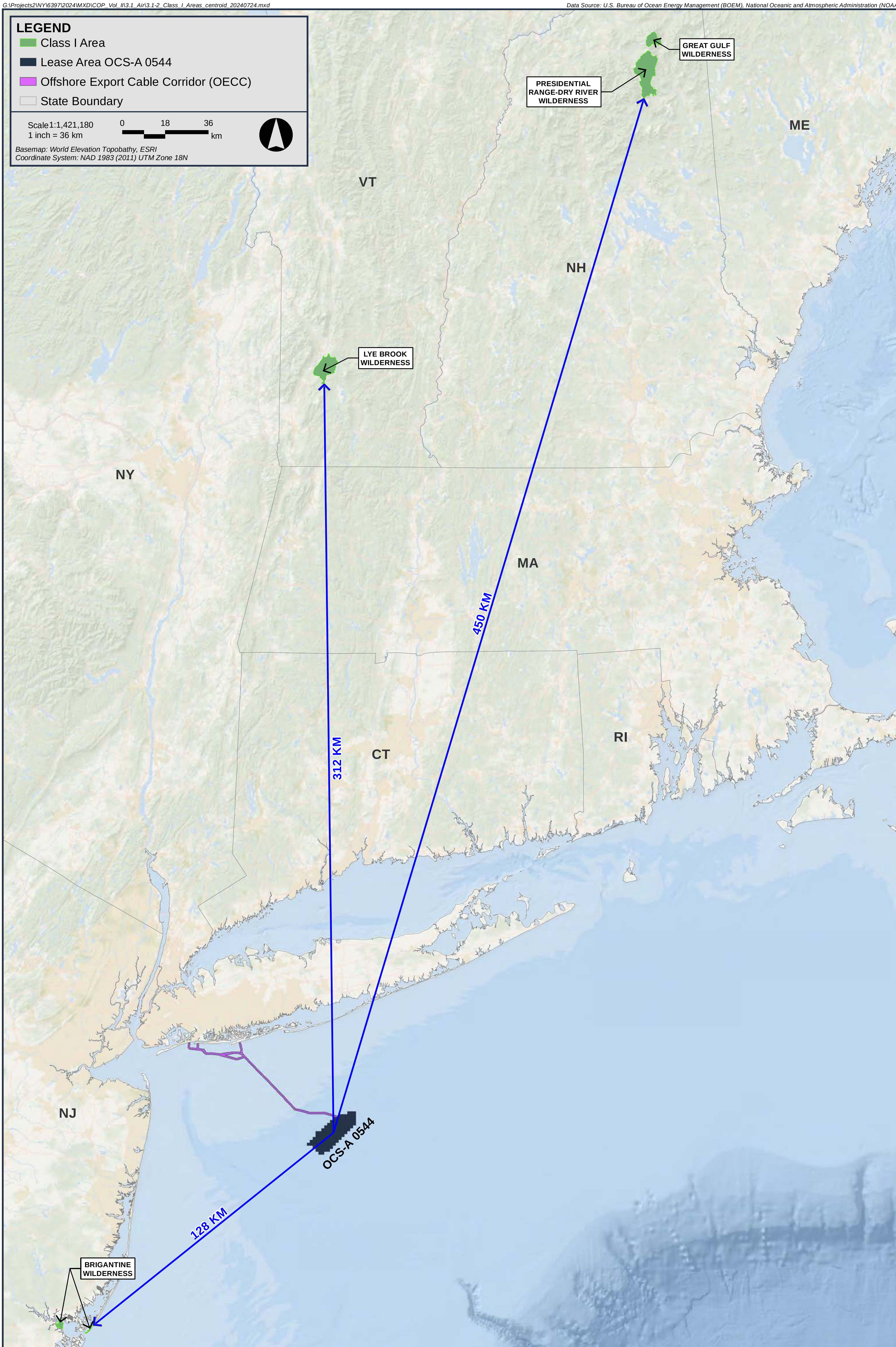

Figure 3.1-2
Class I Areas Nearest to Lease Area OCS-A 0544 Centroid

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

EPA has developed a list of 188 HAPs, also known as toxic air pollutants or air toxics, that are known or suspected to cause cancer or other serious health effects (e.g., reproductive health effects, birth defects, adverse environmental effects, etc.). HAPs are a subset of VOCs and PM. As stated by EPA (2023a), nationwide, "from 1990 to 2017 emissions of air toxics declined by 74 percent, largely driven by federal and state implementation of stationary and mobile source regulations."

GHGs, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and sulfur hexafluoride (SF_6), accumulate in the atmosphere and trap heat that would otherwise escape into space. CO_2, which is a product of combustion, accounts for the majority of anthropogenic GHG emissions in the US (EPA 2023e). Because GHGs have different radiative properties and lifetimes in the atmosphere, GHGs differ in their ability to trap heat in the atmosphere. Therefore, to express their warming influences in a common metric, GHG emissions are calculated as CO_2e.

Excess emissions of GHGs from human activities, especially burning of fossil fuels and deforestation, have caused global warming to rapidly accelerate in recent decades (NYSDEC 2023b). As a result, several East Coast states have established GHG emission reduction targets and renewable energy goals to mitigate the ongoing effects of global warming and climate change, such as sea level rise and increased flooding, ocean acidification, changes in agricultural productivity, shifts in species' distributions, and increases in energy system costs.

- **New York State:** New York State is making modest progress towards the ambitious goals set forth in the State's Climate Leadership and Community Protection Act (CLCPA), which requires statewide GHG emissions to be reduced 40% by 2030 and 85% by 2050 relative to 1990 levels (NYSDEC 2023c). In New York State, GHG emissions increased from 1990 to 2005 and then generally decreased from 2005 to 2021 (NYSDEC 2023a). In 2021, the State's gross GHG emissions were ~368 million metric tons (MMT) of CO_2e, or ~10% lower than the 1990 baseline levels adopted in 6 New York Codes, Rules and Regulations (NYCRR) Part 496.

- **New Jersey:** The New Jersey Global Warming Response Act requires the State to reduce GHG emissions below 1990 levels by 2020, 50% below 2006 levels by 2030, and 80% below 2006 levels by 2050 (NJDEP 2022). Between 1990 and 2006, GHG emissions in New Jersey generally increased from 111.5 to 121.1 MMT CO_2e, then decreased to 98.6 MMT CO_2e in 2019, or ~12% below the 1990 level (NJDEP 2022).[16] Thus, New Jersey attained its 2020 GHG reduction goal ahead of schedule (NJDEP 2022).

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[16] Statewide emissions for 2020 are also described in NJDEP's (2022) *New Jersey Greenhouse Gas Inventory: 2022 Mid-Cycle Update Report* but are not considered representative of current conditions due to the impacts of the COVID-19 pandemic.

- **Connecticut:** Connecticut's 2008 Global Warming Solutions Act (GWSA), Connecticut Public Act 08-98, as amended by Public Act No. 18-82, requires the State to reduce GHG emissions 10% below 1990 levels by 2020, 45% below 2001 levels by 2030, and 80% below 2001 levels by 2050 (CT DEEP 2023). Annual GHG emissions in Connecticut generally increased from 1990 to 2004, reaching a peak of approximately 52.6 MMT CO_2e in 2004, before decreasing to approximately 34.7 MMT CO_2e in 2021, or ~22% below 1990 levels (CT DEEP 2023). Although Connecticut met its statutory target of 10% emissions reductions below 1990 levels as of January 1, 2020, the state will need to significantly accelerate annual GHG emission reductions to meet the 2030 GWSA goal (CT DEEP 2023).

- **Rhode Island:** In Rhode Island, net GHG emissions generally decreased from 11.56 MMT CO_2e in 1990 to 9.87 MMT CO_2e in 2019 and 9.24 MMT CO_2e in 2020 (RIDEM 2023).[17] Therefore, the State achieved the 2021 Act on Climate's mandate to reduce GHG emissions 10% below 1990 levels by 2020 and is progressing towards reaching net-zero emissions by 2050 (RIDEM 2023).

- **Massachusetts:** Between 1990 and 2019, GHG emissions in Massachusetts decreased by 23.4% from 93.5 to 71.6 MMT CO_2e (MassDEP 2022). Accordingly, Massachusetts is close to meeting its target of reducing GHG emissions 25% below the 1990 baseline level by 2020 and is progressing towards reducing GHG emissions 80% below 1990 levels by 2050, as required by the Massachusetts Global Warming Solutions Act (GWSA).

- **Pennsylvania:** In Pennsylvania, net GHG emissions generally decreased from ~288.6 MMT CO_2e in 2005 to ~238.8 MMT CO_2e in 2019 (an ~17% reduction) and 213.9 MMT CO_2e in 2020 (an ~26% reduction from the 2005 baseline (PA DEP 2023). According to Pennsylvania Department of Environmental Protection (PA DEP) (2023), "While Pennsylvania is on track to achieve the 26% by 2025 GHG emissions reduction goal, this achievement is likely fleeting and not durable, as the temporary impacts from the COVID-19 pandemic on the economy appear to be a main driver of the decrease." Even if the emission reductions in 2020 are durable, an additional reduction of approximately 156 MMT CO_2e is needed to reach the State's goal of reducing emissions 80% by 2050 (PA DEP 2023).

[17] According to RIDEM (2023), "the COVID-19 pandemic significantly reduced emissions in 2020 beyond what would be typically expected and the 2020 inventory should not be interpreted as an indicator of future emission reductions."

- **Delaware:** The Delaware Climate Change Solutions Act of 2023 sets a goal of reducing GHG emissions 50% from 2005 levels by 2030 and achieving net-zero emissions by 2050 (DNREC 2023). Delaware has made some progress towards its goals, with an ~27% reduction in gross GHG emissions from ~23.2 to ~16.9 MMT CO_2e between 2005 and 2018 (DNREC 2021). However, according to DNREC (2021), "GHG emission projections show that a declining trend is not expected through 2050."

- **Maryland:** Maryland's Climate Solutions Now Act (CSNA) of 2022 requires the State to reduce statewide GHG emissions 60% from 2006 levels by 2031 and achieve net-zero emissions by 2045 (Maryland Department of the Environment 2023). The State is making progress towards these goals, as statewide GHG emissions have generally decreased since 2006 (Maryland Department of the Environment 2023).

- **Virginia:** In Virginia, statewide GHG emissions are generally decreasing. In 2018, ~141 MMT CO_2e were emitted statewide, a reduction of ~18% from 2005 levels (VA DEQ 2021).

- **South Carolina:** While South Carolina does not have statewide GHG emission reduction targets, the City of Charleston, South Carolina adopted a Climate Action Plan in May 2021 to reduce carbon pollution (Charleston 2021). The plan outlines a goal to reduce GHG emissions 56% below 2018 levels by 2030 and to achieve net-zero by 2050. Since 2002, GHG emissions in Charleston have decreased ~15% to 1.3 MMT CO_2e (Charleston 2020).

3.1.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect air quality during the construction, O&M, and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 3.1-3.

Table 3.1-3 Impact Producing Factors for Air Quality

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Air Emissions	•	•	•
Avoided Air Emissions from Renewable Energy Production		•	

Potential effects to air quality were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore and onshore facilities as described in Section 1.5. To account for the envelope of possible ports used during construction and operations (see Sections 3.10.1 and 4.4.1 of COP Volume I), the emissions estimates generally assume the use of the port with the longest transit distances to and from the Offshore Development Area (within US waters) that is likely to be used for each individual activity, within reason.

3.1.2.1 Air Emissions

Offshore, air emissions will primarily come from the main engines and auxiliary engines on vessels used during the construction, O&M, and decommissioning of Vineyard Mid-Atlantic. Vessel emissions will occur within the Lease Area and OECC, during vessel transits to and from port, and while certain vessels are in port. There may also be emissions from other construction equipment used aboard vessels (e.g., engines used to power pile driving hammers, motion compensation system engines, etc.). Additional offshore emissions are expected to come from diesel generators used to temporarily supply power to the wind turbine generators (WTGs) and electrical service platform(s) (ESP[s]) as well as helicopters. Vessels, offshore equipment, and aircraft used during construction, O&M, and decommissioning are further described in Sections 3.10.4, 4.4.2, and 5.2.5 of COP Volume I, respectively.

Emission sources during onshore construction, O&M, and decommissioning activities will include construction equipment (e.g., cranes, excavators, backhoes, trenchers, drilling tools, forklifts, etc.) and vehicles (e.g., worker vehicles, concrete delivery trucks, dump trucks, etc.). See Sections 3.10.5, 4.4.3, and 5.2.5 of COP Volume I for additional description of onshore equipment and vehicles that may be used for Vineyard Mid-Atlantic activities. There may also be some fugitive emissions (e.g., from incidental solvent release) as well as particulate emissions from construction dust. A comprehensive inventory of Vineyard Mid-Atlantic's potential emission sources, along with assumed engine sizes, hours of operation, load factors, emission factors, and fuel consumption rates, can be found in Appendix II-A.

Air emissions from the construction and operation of Vineyard Mid-Atlantic were estimated by calculating the duration and intensity of emission-generating activities and multiplying those estimates by appropriate emission factors (see Appendix II-A for a description of the calculation methodologies). Table 3.1-4 provides an estimate of emissions within the US (offshore and onshore) from the construction of Vineyard Mid-Atlantic. These construction emissions were conservatively assumed to be distributed over a three-year period.

Table 3.1-4 Estimated Air Emissions from the Construction of Vineyard Mid-Atlantic

	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Offshore Emissions								
Year 1 construction emissions (US tons)	5,220	118	1,173	173	166	38	16	335,602
Year 2 construction emissions (US tons)	6,800	154	1,528	225	216	50	21	437,204
Year 3 construction emissions (US tons)	4,045	92	909	134	129	30	13	260,083

Table 3.1-4 Estimated Air Emissions from the Construction of Vineyard Mid-Atlantic (Continued)

	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Onshore Emissions								
Year 1 construction emissions (US tons)	1	0.1	1	24	24	0.0	0.0	17,243
Year 2 construction emissions (US tons)	103	6	45	54	54	0.2	3	53,484
Year 3 construction emissions (US tons)	74	4	33	30	30	0.2	2	45,788
Total Emissions								
Year 1 construction emissions (US tons)	5,221	118	1,174	197	190	38	16	352,845
Year 2 construction emissions (US tons)	6,903	160	1,573	279	270	50	24	490,688
Year 3 construction emissions (US tons)	4,119	96	941	164	159	30	14	305,872

Table 3.1-5 provides an estimate of potential emissions from the O&M of Vineyard Mid-Atlantic, including an estimate of air emissions for a typical year of operation (for planned, routine O&M activities) as well as an estimate of the maximum annual operational air emissions (assuming several repair activities occur all within the same year).

Table 3.1-5 Estimated Air Emissions from the Operation of Vineyard Mid-Atlantic

	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Offshore Emissions								
Operational emissions, typical year (US tons per year)	453	8	118	15	15	1	1	34,664
Operational emissions, maximum year (US tons per year)	750	13	184	24	23	2	2	53,091
Onshore Emissions								
Operational emissions (US tons per year)	0.1	0.1	0.9	0.0	0.0	0.0	0.0	16,546
Total Emissions								
Operational emissions, typical year (US tons per year)	453	8	118	15	15	1	1	51,210
Operational emissions, maximum year (US tons per year)	750	13	185	24	23	2	2	69,637

Most of the air emissions from the construction and operation of Vineyard Mid-Atlantic will occur offshore within the Lease Area, OECC, and surrounding waters. Only a limited proportion of the emissions reported in Tables 3.1-4 and 3.1-5 will occur at ports. Table 3.1-6 quantifies the subset of emissions that could occur within 5.6 km (3 NM) of the ports used during the construction and operation of Vineyard Mid-Atlantic. Due to the uncertainty regarding the combination of ports that may be used for Vineyard Mid-Atlantic, it is conservatively assumed that these estimated construction and operational emissions could all occur at one port (in a maximum case scenario) or be spread amongst several of the ports identified in Sections 3.10.1 and 4.4.1 of COP Volume I.

Table 3.1-6 Estimated Air Emissions from Activities in Port

	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Total Port Related Emission[1]								
Total port-related construction emissions (US tons)	323	5	80	11	10	0.6	0.8	21,248
Total port-related operational emissions, maximum year (US tpy)	85	1	21	3	3	0.1	0.2	5,492

Note:

1. Includes emissions from onshore equipment and vehicles at a port as well as emissions from vessels hoteling, maneuvering, and transiting within 5.6 km (3 NM) of a port.

Air emissions from decommissioning are not quantified at this time due to the level of uncertainty regarding the types of vessels and equipment that will be available at the time of decommissioning. The Proponent anticipates that technological advances in methods and equipment servicing the offshore industry may result in increased efficiency, and historically, engine emission standards have become increasingly stringent over time. For these reasons, the Proponent anticipates that emissions from decommissioning will be less than during construction.

Prevailing winds are expected to predominantly transport Vineyard Mid-Atlantic's air emissions away from shore, although wind directions may shift and transport emissions toward shore (BOEM 2023). However, given the distance between the Lease Area and shore (~38 km [~24 mi] from Fire Island, New York), emissions within the Lease Area (where the majority of emissions will occur) are unlikely to markedly affect any onshore areas when winds transport emissions toward shore. Furthermore, emissions from Vineyard Mid-Atlantic will be dispersed over a large area, further minimizing ambient air quality impacts.

Vineyard Mid-Atlantic is an air quality impact avoidance measure; the electricity generated by the WTGs will displace electricity produced by fossil fuel power plants and avoid regional emissions resulting from those power plants (see Section 3.1.2.2). Vineyard Mid-Atlantic's construction emissions are temporary and will be quickly offset by these regional net emission reductions during the operational period. Nevertheless, the Proponent will seek to avoid, minimize, and mitigate air emissions wherever feasible.

Most emissions will come from internal combustion engines, including marine engines, diesel engines on construction equipment, and diesel generators. Internal combustion engine manufacturers use minimization and mitigation techniques specific to their engine type to ensure compliance with air quality regulatory standards. Emissions of CO, PM, and VOCs are generally minimized by ensuring complete combustion. NOx emissions are minimized by reducing the combustion temperature and controlling the mixing of fuel and oxygen during combustion to avoid hot spots that generate NOx. Such techniques include water injection and exhaust gas recirculation. Engine manufacturers can also use add-on pollution controls to mitigate air emissions formed during the combustion process. For example, selective catalytic reduction can be used to convert NOx to nitrogen and water in the presence of a catalyst. Oxidation catalysts can also be used to eliminate products of incomplete combustion (e.g., CO, VOCs, and PM) using technology similar to the catalytic converter found in cars. PM emissions can be removed from some engine exhausts using a diesel particulate filter.

The engines used for Vineyard Mid-Atlantic activities will meet or emit less than the applicable on-road, non-road, and marine engine emission standards for NOx, CO, VOCs (as hydrocarbons [HC]), and PM. The Proponent will minimize SO_2 and PM emissions through the use of clean, low-sulfur fuels in compliance with federal and international air pollution requirements. To minimize GHG emissions and other air pollutants, the Proponent will require its contracted vessels to use good combustion practices and operate their engines in the most efficient configuration, in accordance with applicable federal and international requirements. Key marine and non-road engine emission standards and fuel standards include:

- **International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI:** Annex VI of the International Maritime Organization's (IMO's) MARPOL treaty is the main international treaty that addresses air pollution from marine vessels. Annex VI establishes global limits on the sulfur content of marine fuels and NOx emissions limits for engines exceeding 130 kilowatts (~174 horsepower) on vessels built after 2000. The IMO has also adopted legally binding energy efficiency measures as amendments to MARPOL Annex VI. In the US, MARPOL Annex VI is implemented through the Act to Prevent Pollution from Ships (33 U.S.C. §§ 1901-1905) and Control of NOx, SOx, and PM Emissions from Marine Engines and Vessels Subject to the MARPOL Protocol (40 CFR Part 1043). Any vessel used during Vineyard Mid-Atlantic will comply with the Annex VI fuel oil sulfur content limit for the North American Emission Control Area of 1,000 parts per million (ppm).

- **Control of Emissions from New and In-Use Marine Compression-Ignition Engines and Vessels (40 CFR Part 1042):** This US regulation sets emission standards and certification requirements for marine diesel engines. The emission standards are structured as a tiered progression, with each tier of emission standards becoming increasingly stringent. Each tier phased in over several years. These standards are primarily a function of the size, engine displacement, and age of the marine diesel engine.

- **Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines (40 CFR Part 1039):** This US regulation sets emission standards and certification requirements for non-road diesel engines. Like the marine engine standards above, these tiered non-road engine standards are a function of engine size and model year.

- **Regulation of Fuels, Fuel Additives, and Regulated Blendstocks (40 CFR Part 1090):** This US regulation sets fuel sulfur content standards for diesel fuel and certain marine fuels. Applicable engines used during Vineyard Mid-Atlantic will comply with the fuel sulfur content limit of 15 ppm under 40 CFR Part 1090, Subpart D.

Some offshore emissions from Vineyard Mid-Atlantic will also be regulated under the OCS Air Regulations through EPA's OCS Air Permit process. The OCS Air Regulations, which implement Section 328 of the CAA, establish air pollution control requirements for OCS sources located in federal waters. The CAA defines an OCS source as "any equipment, activity, or facility which—(i) emits or has the potential to emit any air pollutant, (ii) is regulated or authorized under the Outer Continental Shelf Lands Act [43 U.S.C. 1331 et seq.], and (iii) is located on the Outer Continental Shelf or in or on waters above the Outer Continental Shelf" (42 U.S.C. § 7627(a)(4)(C)). Pursuant to 40 CFR Part 55, the definition of OCS source only includes vessels when they are permanently or temporarily attached to the seabed, erected thereon, and used for the purpose of exploring, developing, or producing resources therefrom, or are attached to an existing OCS source. However, emissions from all vessels servicing or associated with an OCS source (when within 25 NM [~46 km]) are considered potential emissions from the OCS source. Because the definition of potential emissions under the OCS Air Regulations includes temporary construction emissions and mobile source emissions (unlike in onshore air permitting), the Proponent expects to trigger major source permitting requirements under the PSD program at 40 CFR § 52.21. The PSD regulations would require a demonstration that Vineyard Mid-Atlantic's OCS sources meet Best Available Control Technology (BACT).

Under 40 CFR Part 55, OCS sources located within 25 NM (~46 km) beyond a state's seaward boundary are also required to comply with the state air quality requirements of the Corresponding Onshore Area (COA). The Proponent expects New York (the Nearest Onshore Area to the Lease Area) to be designated as the COA. Assuming New York is designated as the COA, Vineyard Mid-Atlantic's OCS sources would be required to comply with the applicable New York State air quality regulations incorporated by reference into 40 CFR Part 55, Appendix A, including New York's New Source Review permitting program. This program would require a demonstration that Vineyard Mid-Atlantic's OCS sources meet BACT and Lowest Achievable Emission Rate (LAER), as applicable.

Based on OCS Air Permits issued for offshore wind projects to date, the Proponent expects the following requirements would also apply to Vineyard Mid-Atlantic's OCS sources to meet BACT and potentially LAER, which would minimize Vineyard Mid-Atlantic's emissions:

- **For engines on the WTGs and ESP(s):** Use of engines that are certified to meet or exceed the highest applicable emission limits at 40 CFR Part 1042 and/or 40 CFR Part 1039 and use of ultra-low sulfur diesel (ULSD) with a maximum sulfur content of 15 ppm.

- **For engines on applicable harbor craft (e.g., tugboats, crew transfer vessels [CTVs]), supply vessels, and barges):**[18] Use of vessels with the highest EPA Tier marine engines available (starting with Tier 4 or Tier 3, depending on engine size), and no lower than EPA Tier 2 marine engines.

- **For all other vessels:** Use of vessels with engines meeting EPA's or MARPOL Annex VI's highest applicable marine emission standards, where available, and no lower than EPA Tier 1 or MARPOL Annex VI Tier I marine engines.

The Proponent expects that its OCS Air Permit(s) will also contain, at a minimum, monitoring, testing, and reporting requirements.

PM emissions from onshore construction activities will be minimized through best management practices, such as removing waste in covered trailers, wetting exposed soils, and minimizing the storage of construction waste onsite. The Proponent will require contractors to minimize vehicle idling in accordance with applicable state and local regulations. Any onshore substation equipment containing SF_6 will meet any applicable state regulations that are implemented. For all SF_6-containing equipment, the Proponent will follow manufacturer-recommended maintenance and removal procedures and best industry practices to avoid any potential leakage. The Proponent will also consider alternatives to the use of SF_6 gas in switchgear, only if such alternatives are technically feasible and commercially available.

3.1.2.2 Avoided Air Emissions from Renewable Energy Production

Vineyard Mid-Atlantic will generate clean, renewable energy that will significantly reduce air emissions from the regional electric grid by displacing electricity produced by fossil fuel power plants. Table 3.1-7 quantifies the NOx, SO_2, and GHG (as CO_2e) emissions that are expected to be avoided by using electricity generated from Vineyard Mid-Atlantic. The analysis is based on the approximate nameplate capacity for the entire Lease Area, assuming an annual capacity factor of 43%,[19] and 2021 air emissions data for Long Island from EPA's (2023b) Emissions & Generation Resource Integrated Database (eGRID2021). See Appendix II-A for additional description of the method used to quantify avoided emissions.[20]

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[18] As defined in the EPA-approved 2011 version of the Commercial Harbor Craft Regulation that is incorporated into the California State Implementation Plan (see 83 FR 23232).

[19] Capacity factor refers to the ratio of Vineyard Mid-Atlantic's annual power production to its nameplate production potential.

[20] There are several methodologies that can be used to estimate avoided air emissions from offshore wind projects. The avoided emission estimates presented in Table 3.1-7 are based on an approximate nameplate capacity of 2 gigawatts (GW) and 2021 air emissions data for Long Island's electric grid from eGRID2021, rather than future projections of emissions from the electric grid, in agreement with BOEM.

Table 3.1-7 Avoided Air Emissions Resulting from Vineyard Mid-Atlantic

	NOx	SO_2	CO_2e
Emissions Avoided Annually (US tons/year)	3,198	1,160	4,726,614

Based on air emissions data from eGRID2021, electricity from Vineyard Mid-Atlantic would displace 59% of NOx emissions, 74% of SO_2 emissions, and 65% of GHG emissions produced by Long Island's electric grid annually. This reduction in regional NOx and SO_2 emissions provides a considerable air quality benefit, as these pollutants are known to contribute to acid rain and ground level ozone/smog and are linked to increased rates of early death, heart attacks, stroke, and respiratory disorders.

The reduction in regional GHG emissions, which is roughly equivalent to taking 930,000 cars off the road, will help mitigate additional effects of ongoing climate change that are impacting the environment and public health, such as sea level rise and increased flooding, ocean acidification, changes in agricultural productivity, shifts in species' distributions, and increases in energy system costs. Table 3.1-8 presents the monetary value of estimated climate change damages, known as "the social cost of GHGs" (SC-GHG), that would be avoided by Vineyard Mid-Atlantic (assuming the approximate nameplate capacity for the entire Lease Area). The estimates of avoided social costs differ by the type of GHG (e.g., CO_2, CH_4, and N_2O), the year in which the emissions change occurs, and the discount rate applied (i.e., how future damages are converted into present-day values). The annual estimates of avoided social costs are presented for the years 2030, 2040, and 2050 and for multiple discount rates using SC-GHG estimates from two sources: the Interagency Working Group (IWG) on Social Cost of Greenhouse Gases and EPA. Based on IWG's estimates, the total avoided social costs (for CO_2, CH_4, and N_2O combined) range from $82 million to $498 million annually between 2030 and 2050. Based on EPA's estimates, the total avoided social costs range from $600 million to $2.06 billion annually between 2030 and 2050. While there is considerable variability in the estimates presented below, regardless of the metric used, Vineyard Mid-Atlantic will provide significant societal benefits by avoiding additional climate change damages. See Appendix II-A for additional details regarding the methods used to estimate avoided social costs.

Table 3.1-8 Estimated Social Costs Avoided by Vineyard Mid-Atlantic

Year[2]	Annual Avoided Social Costs (2020 dollars)[1]	
	IWG[3] (Discount Rates of 2.5–5.0%)	EPA[4] (Discount Rates of 1.5-2.5%)
CO_2		
2030	$81,317,000 – $380,906,000	$599,178,000 – $1,626,342,000
2040	$106,996,000 – $440,824,000	$727,574,000 – $1,840,334,000
2050	$136,955,000 – $496,462,000	$855,969,000 – $2,054,326,000

Table 3.1-8 Estimated Social Costs Avoided by Vineyard Mid-Atlantic (Continued)

Year[2]	Annual Avoided Social Costs (2020 dollars)[1]	
	IWG[3] (Discount Rates of 2.5–5.0%)	EPA[4] (Discount Rates of 1.5-2.5%)
CH_4		
2030	$122,000 – $325,000	$247,000 – $416,000
2040	$169,000 – $403,000	$351,000 – $546,000
2050	$221,000 – $494,000	$455,000 – $689,000
N_2O		
2030	$127,000 – $536,000	$731,000 – $1,624,000
2040	$162,000 – $634,000	$893,000 – $1,949,000
2050	$211,000 – $731,000	$1,072,000 – $2,274,000
CO_2e		
2030	$81,566,000 – $381,767,000	$600,156,000 – $1,628,382,000
2040	$107,327,000 – $441,861,000	$728,818,000 – $1,842,829,000
2050	$137,387,000 – $497,687,000	$857,496,000 – $2,057,289,000

Notes:

1. The avoided social costs are calculated from the avoided emission estimates presented in Table 3.1-7. The avoided emission estimates are based on the approximate nameplate capacity of Vineyard Mid-Atlantic and 2021 air emissions data for Long Island's electric grid, not future projections of emissions from the electric grid.
2. A sampling of years during which Vineyard Mid-Atlantic could be operational. Avoided social costs for other years are provided in Appendix II-A.
3. From IWG's (2021) *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* using discount rates of 5% to 2.5%. Avoided social costs using the 95th percentile of estimates based on a 3% discount rate are even greater (see Appendix II-A).
4. From EPA's (2023f) Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances using discount rates of 2.5% to 1.5%.

As described in Section 3.1.1, several East Coast states are not on track to meet their medium-term and long-term GHG emission reduction goals. This underscores the importance of clean energy projects, like Vineyard Mid-Atlantic, in helping states achieve their GHG emission reduction goals.

3.1.2.3 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to air quality during Vineyard Mid-Atlantic are summarized below:

- The engines used for Vineyard Mid-Atlantic activities will meet or emit less than the applicable on-road, non-road, and marine engine emission standards. In addition, emissions from Vineyard Mid-Atlantic's OCS sources will be regulated through the OCS Air Permit(s). The Proponent expects that the OCS Air Permit(s) will require a demonstration that the OCS sources meet BACT and potentially LAER.

- The Proponent will minimize SO_2 and PM emissions through the use of clean, low-sulfur fuels in compliance with federal and international air pollution requirements.

- The Proponent will require its contracted vessels to use good combustion practices and operate their engines in the most efficient configuration, in accordance with applicable federal and international requirements, to minimize GHG emissions.

- The Proponent will use best management practices, such as removing waste in covered trailers, wetting exposed soils, and minimizing the storage of construction waste onsite, to minimize PM emissions.

- The Proponent will require contractors to minimize vehicle idling in accordance with applicable state and local regulations.

- For all SF_6-containing equipment, the Proponent will follow manufacturer-recommended maintenance and removal procedures and best industry practices to avoid any potential leakage. The Proponent will also consider alternatives to the use of SF_6 gas in switchgear, only if such alternatives are technically feasible and commercially available.

3.2 Water Quality

This section addresses the potential impacts of Vineyard Mid-Atlantic on water quality in the Offshore Development Area and Onshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to water quality during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Freshwater resources are also discussed in Section 4.1.

3.2.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The water quality parameters assessed in this section have been collected from available data sources and existing literature for coastal and offshore marine waters in the New York coastal areas and the New York Bight including:

- Northeast Fisheries Science Center Ecosystem Monitoring (EcoMon) Program

- World Ocean Atlas (WOA) climatology dataset

- National Oceanic Atmospheric Administration (NOAA) National Data Buoy Center
- Environmental Protection Agency's (EPA) 2015 National Coastal Condition Assessment

Each available data source provides specific water quality parameters, including temperature, salinity, turbidity, and nutrients. The review of existing literature and available data resulted in the characterization of physical oceanography and water quality conditions of the Lease Area and OECC provided below.

3.2.1.1 Offshore Water Quality

Overall, water quality in the New York Bight is generally classified as 'fair' by the EPA based on analysis of a range of water quality metrics (EPA 2021). A description of available temperature, salinity, total suspended solids (TSS), and nutrient measurements collected in and around the Offshore Development Area is provided below. There is generally a paucity of water quality data available for the New York Bight.

Temperature and Salinity

The NOAA Northeast Fisheries Science Center's EcoMon Program conducts fisheries surveys throughout the northeast that include 102 sampling stations in and within 15 kilometers [km] (8 nautical miles [NM]) of the Lease Area and OECC (Figure 3.2-1). Surface and bottom water temperature and salinity measurements collected from 2000 through 2021 at the EcoMon stations were averaged by season and presented in Table 3-2.1 (NEFSC 2023).

EcoMon survey temperature measurements in and around the Lease Area and OECC revealed average wintertime water temperatures of approximately 5.9 degrees Celsius [°C] (43 degrees Fahrenheit [°F]) with uniform temperature at the top and bottom of the water column. A thermocline was observed to increase from a gradient of more than 5°C (41 °F) between average surface and bottom waters in the spring to a gradient of nearly 10 °C (41 °F) in the summer. In the fall, mixing led to uniform average water temperatures of 15.3 °C (59.5 °F) in surface and bottom waters. Average EcoMon measurements of salinity varied through a relatively small range of 30.8 to 33.0 parts per thousand (ppt). Slightly lower salinity waters were observed during the spring and summer and in surface waters.

Continuous near-surface water temperature measurements were collected at NOAA buoy #44025. Monthly average surface water temperature measurements for the period of 1975 through 2008 are presented in Figure 3-2.2. Average monthly temperatures ranged from 4 °C (39 °F) to 7 °C (44.6 °F) during winter months (January–April) and increased to maximum monthly temperatures of 20 °C (68 °F) to 22°C (71.6 °F) during the summer months (July–September). More recent (2019 through 2022) surface water temperature measurements collected at buoy #44025 were averaged by month and are presented in Table 3-2.2. These more recent temperature measurements follow the same trends and tend to be slightly warmer than the historical monthly averages shown in Figure 3.2-2.

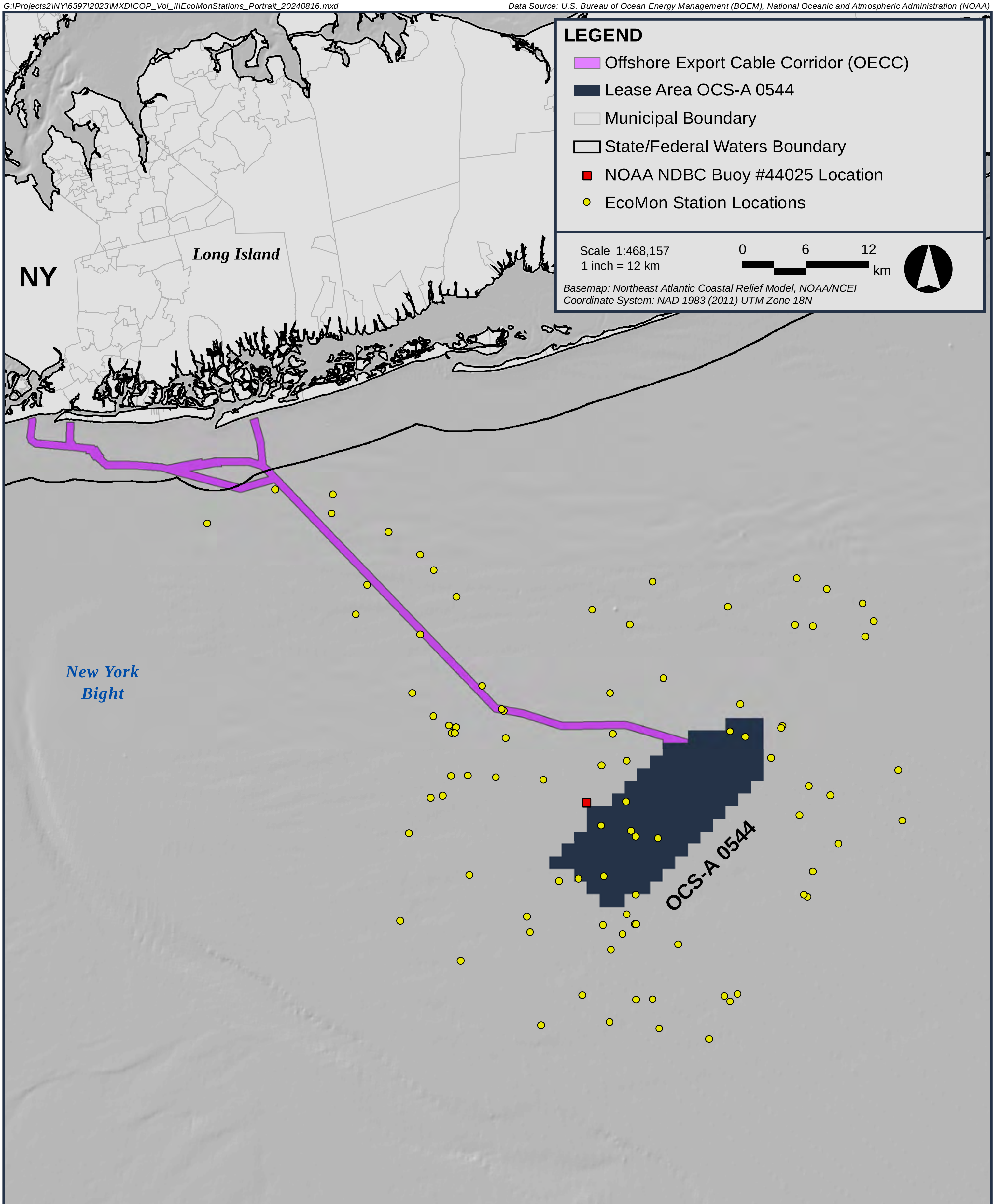

Figure 3.2-1

Water Quality Sampling Stations

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

Table 3.2-1 Average Seasonal Temperature and Salinity Measurements from EcoMon Surveys (2000 – 2021)

Season	Temperature (°C)		Salinity (ppt)	
	Surface	Bottom	Surface	Bottom
Winter (Jan.–March)	5.9	5.8	32.7	33.0
Spring (April–June)	13.7	7.3	31.4	32.5
Summer (July–Sept.)	22.0	11.1	31.3	30.8
Fall (Sept.–Dec.)	15.3	15.3	32.3	32.8

Table 3.2-2 Average Monthly Surface Water Temperature Measurements from NOAA Buoy #44025 from January 2019 through December 2022

Month	Average Surface Water Temperature (°C)				
	2019	2020	2021	2022	2019 - 2022
January	6.1	7.7	8.5	8.3	7.7
February	4.6	6.6	6.0	5.8	5.7
March	4.5	6.6	5.6	5.9	5.6
April	8.0	8.0	8.2	8.2	8.1
May	12.0	15.6	12.7	11.7	13.0
June	17.8	18.0	18.0	18.8	18.1
July	23.1	24.6	22.3	23.4	23.3
August	23.4	23.8	22.9	24.0	23.5
September	20.9	16.6	21.7	22.4	20.4
October	17.8	18.3	19.5	17.7	18.3
November	13.8	13.2	15.3	15.4	14.4
December	9.9	11.6	11.7	10.9	11.1

TSS

In 1999, four TSS measurements were collected in the New York Bight and ranged from 1.8 to 7.9 milligrams per liter (mg/L) (Litten 2003). In 2006, a different survey in the New York Bight resulted in collection of four TSS measurements ranging from 3.2 to 11.4 mg/L (Balthis et al. 2009). In summary, limited available TSS measurements in New York Bight ranged from 1.8 to 11.4 mg/L.

Nutrients

In 2006, four dissolved inorganic nitrogen measurements ranging from 22 to 37 micrograms per liter (µg/L) and four dissolved inorganic phosphorus measurements ranging from 42 to 48 µg/L were obtained in the New York Bight (Balthis et al. 2009). The New York Bight is within a region classified as 'good' for nitrogen and 'fair' for phosphorus (EPA 2012).

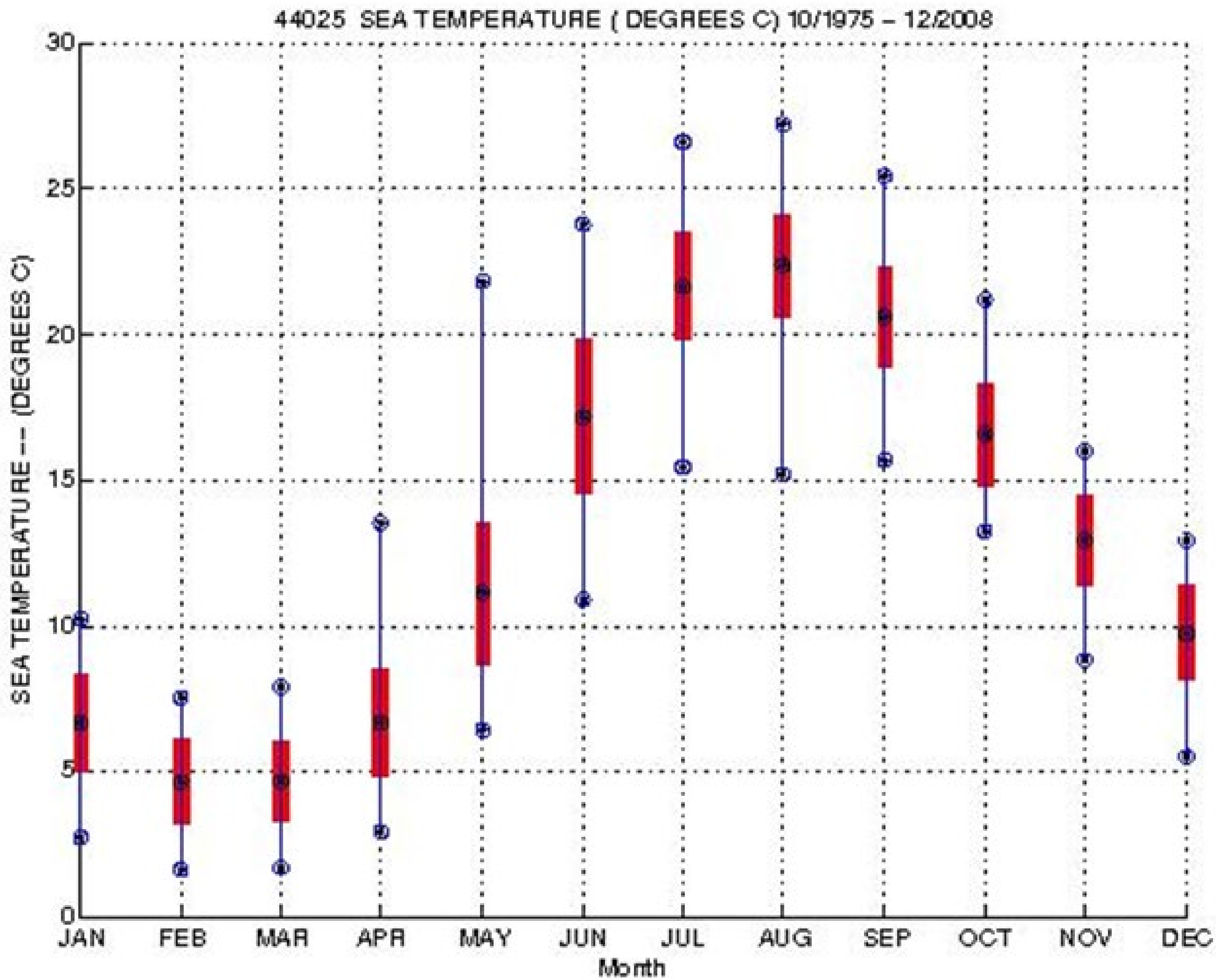

Figure 3.2-2
NOAA Buoy #44025 Monthly Average Surface Water Temperature (1975 – 2008)

3.2.1.2 *Onshore Water Quality*

Mapped water bodies in New York are provided a water quality classification based on existing or expected best usage of each water body or water body segment. Vineyard Mid-Atlantic is located within Long Island, which is a New York State mapped sole source aquifer. As shown in Figure 3.2-3, portions of the onshore cable routes pass waterbodies with Classification SA (marine waters) indicating a best usage for shell fishing for market purposes, swimming and other recreation, and fishing; and Classification SB (marine waters) indicating a best usage for swimming and other recreation, and fishing (NYSDEC 2023a). Additionally, the onshore cable routes do not intersect any mapped Critical Environmental Areas (CEAs) for water protection (NYSDEC 2023b). Further assessment of local and regional onshore water resources will occur during the New York State Article VII permitting process for Vineyard Mid-Atlantic.

3.2.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect water quality during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 3.2-3.

Table 3.2-3 Impact Producing Factors for Water Quality

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Suspended Sediments and Deposition	•	•	•
Ground Disturbance	•	•	•
Discharges	•	•	•
Presence of Structures	•	•	•

Potential effects to water quality were assessed using the maximum design scenario for Vineyard Mid-Atlantic's onshore and offshore facilities as described in Section 1.5.

3.2.2.1 *Suspended Sediments and Deposition*

Temporary increases in suspended sediments and subsequent sediment deposition may occur in the Lease Area and OECC from the installation, maintenance, and decommissioning of export cables, inter-array cables, inter-link cables, foundations, and scour protection. Specifically, sediment is expected to be suspended into the water column during cable pre-installation activities (e.g., pre-lay grapnel run, boulder clearance, etc.), cable installation, seabed preparation prior to foundation installation (if needed), installation of cable protection (where required), the use of other equipment that contacts the seafloor (e.g., jack-up vessels, vessel anchors, or spud legs), and excavation of the temporary horizontal directional drilling (HDD) exit pit.

[redacted]

Most of these activities would occur during construction, with potential for limited seafloor disturbance during operations if cables require repair or maintenance; however, any maintenance impacts would be expected to be far less than those from construction activities. Impacts from suspended sediments and deposition would generally be temporary and confined to a small area close to the location of the installation or maintenance activity.

To assess the impacts of suspended sediments and deposition, sediment transport modeling was completed for export and inter-array cable installation and HDD exit pit construction[21] (see Appendix II-P). Activities were modeled separately within the Lease Area and the OECC. Model results provided the following estimates of the durations and concentrations of suspended sediment during construction:

- **Export and inter-array cable installation:** Above-ambient total suspended solids (TSS) concentrations substantially dissipate within three hours and fully dissipate between six and 12 hours. The modeling analyses predict that suspended sediment concentrations induced by installation of the cables will largely be of short duration, confined to the near-bottom portion of the water column, and will return to ambient conditions within several hours after the installation device has passed. Additionally, if a pre-pass jetting run (using a jet plow or jet trencher) were to be conducted along the route (see Section 3.5.4 of COP Volume I), it is anticipated this would occur with sufficient time for any suspended sediment concentrations to return to ambient conditions prior to cable installation.

- **HDD exit pit construction:** Above-ambient TSS concentrations may be present throughout the entire water column because sediments were released at the water surface but are predicted to return to ambient conditions within six to 12 hours.

Model results also provided estimates of the extent, area, and range of thicknesses of deposited sediment during construction (Appendix II-P). Model results for export cable and inter-array cable installation and HDD exit pit construction provided the following estimates:

- **Export and inter-array cable installation:** In most areas, the model predicted a depositional thickness between 1 mm (0.04 in) and 5 mm (0.2 in); small areas were predicted to have a depositional thickness between 5 mm (0.2 in) and 20 mm (0.8 in).[22]

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[21] As described in Appendix II-P, the modeling for HDD exit pit construction focused on backfilling since it may result in greater water quality effects than excavation under the conservative assumption that dredged material is released at the water surface.

[22] For the maximum jetting scenario in the Lease Area, a small area of deposition was predicted to exceed 20 mm (0.8 in).

- **HDD exit pit construction:** The model predicted a depositional thickness greater than 100 mm (4 in); however, the areas associated with these thicknesses were relatively small (0.01 km^2 [2.5 acres]) and were local to the source.

During operations, localized scour and resuspension of sediments could potentially occur around each foundation. However, due to the low current speeds in the Lease Area, there is low sediment mobility and transport. As further described in Section 2.2 of the Marine Site Investigation Report (see Appendix II-B), the long-term annual flow maintains average velocities of less than 0.2 meters per second (m/s) (0.4 knots [kts]) with current powerful enough to transport sediment typically limited to high-energy events such as winter storms and hurricanes (Duncan et al. 2000). As discussed in Sections 3.3.4 and 3.4.2 of COP Volume I, scour protection may be installed at the base of each foundation as a conservative measure to minimize scour development and ensure the structural integrity of the foundations over their operational life. Given the relatively low current speeds and the expected use of scour protection, significant resuspension of sediments near foundations during operations is not expected.

3.2.2.2 Ground Disturbance

Vineyard Mid-Atlantic will include onshore transmission systems in New York. The onshore transmission systems will include landfall sites, onshore export cable routes, onshore substation sites, potentially onshore RCSs, and grid interconnection cable routes, which may pass through or near mapped water resource areas (see Figures 3.2-3). Localized ground disturbance will occur from construction, O&M, and decommissioning of the landfall sites, onshore cable routes, substations, and potentially onshore RCSs. To minimize disturbance, the Proponent intends to install onshore cables entirely underground primarily within public roadway layouts (or immediately adjacent areas)[23] and onshore substation and onshore RCS sites in industrial/commercial sites that have been previously disturbed. Some onshore substation and onshore RCS sites may require ground disturbance (see Section 3.9.3 of COP Volume I). Ground disturbance associated with Vineyard Mid-Atlantic will be temporary and disturbed areas will be returned to their existing conditions. Construction will be conducted in accordance with soil erosion and sedimentation control plans in order to minimize temporary impacts to water quality.

Impacts to water quality will be minimized or avoided because the onshore cable routes are located primarily within public roadway layouts, and construction involves standard inert materials such as concrete, polyvinyl chloride conduit, and solid dielectric cable. Proper erosion and sedimentation controls will be maintained in accordance with federal, state, and local requirements for Vineyard Mid-Atlantic.

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[23] In limited areas, the onshore cable routes may follow utility rights-of-way (ROW) or depart from public roadway layouts, particularly at complex crossings.

3.2.2.3 Discharges

Potential discharges from vessels, electrical service platforms (ESPs), HDD activities, onshore construction equipment, and onshore substation and RCS sites are discussed below. Accidental discharges and releases are discussed in Section 7.5 and 7.6.

Vessels

The Proponent will require all vessels to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental spills. As described further in Section 7.5, vessel fuel spills are not expected, and, if one occurred, it is likely to be limited in quantity and would dissipate at a rapid pace and evaporate within days of the initial spill. Specifically, all vessels will comply with the United States Coast Guard (USCG) waste and ballast water management regulations (at 33 CFR Part 151 and 46 CFR Part 162), among other applicable federal regulations and International Convention for the Prevention of Pollution from Ships (MARPOL) requirements. Additionally, all Vineyard Mid-Atlantic vessels will meet USCG bilge water regulations in 33 CFR Part 151. Vessels covered under the EPA National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) are also subject to the effluent limits contained in the VGP.

For Vineyard Mid-Atlantic, some routine releases of liquid wastes are allowed to be discharged from vessels to marine waters in both the Lease Area and OECC during construction, O&M, and decommissioning. Conventional and operational wastes from vessels include domestic water, uncontaminated bilge and ballast water, deck drainage, treated grout hose flush water, and uncontaminated fresh or seawater used for vessel air conditioning. These discharges may result in temporary and localized impacts. BOEM (2014) determined the following related to potential water quality impacts from routine vessel discharges: "In the Wind Energy Area (WEA), coastal and oceanic circulation and the large volume of water would disperse, dilute, and biodegrade vessel discharges relatively quickly, and the water quality impact would be minor." Other waste generation such as waste oils, paints, varnishes, cleaners, solvents, and adhesives will be returned to port and properly disposed of or recycled.

ESP(s)

The ESP(s) include several complex mechanical and electrical systems that require oil and chemical products and may include an oil/water separator. See Section 6.3 in COP Volume I for a list of potential oils and chemical products used on the ESP(s). Although the risk of a significant oil spill from the ESPs is very low, an oil spill modeling study was performed to assess the trajectory and weathering of oil following a release of all oil contents from an ESP (see Appendix I-F). In the unlikely event of a spill, the procedures outlined in the Oil Spill Response Plan (OSRP), provided as Appendix I-F, will be followed, including spill prevention measures as well as provisions for communication, coordination, containment, removal, and mitigation of a spill. In addition to the Proponent's efforts to contain and remove an offshore spill, it is anticipated that dispersion, evaporation, and weathering of fuel or oil would occur, all of which would limit the amount and duration of water quality impacts from hydrocarbons (see Section 7.5).

For high voltage direct current (HVDC) ESP(s), the Proponent anticipates that seawater will be withdrawn through pipes that are attached to the foundation and pumped to heat exchangers located in the topside. Before entering the heat exchangers, the seawater will likely be passed through filters. After leaving the heat exchangers, the warmed seawater will be discharged below the water's surface through pipes that are attached to the foundation. See Table 3.4-2 of COP Volume I for the maximum anticipated withdrawal rate and temperature increase of the HVDC cooling water. Any thermal impacts are anticipated to be limited to the immediate area surrounding the discharge, leaving large areas of the surrounding water mass unaffected. In addition to the initial analysis conducted in Appendix II-N, the Proponent will be conducting an impingement and entrainment analysis, as well as an assessment of any potential thermal impacts, as part of the NPDES permitting process for the cooling water intake structure.

Anti-biofouling additives (e.g., sodium hypochlorite) may be injected near the intake of the HVDC ESP seawater cooling system to prevent marine growth within the system. The anti-biofouling additives (if used) may not be completely removed prior to discharge. However, any discharged additives are expected to rapidly dissipate given the large mass of surrounding ocean. The nature of the seawater cooling system discharge will be more fully described and analyzed in the NPDES permit application. Water quality monitoring and controls would be implemented, if deemed necessary, in accordance with the NPDES permit. Similarly, anti-fouling paints and agents may be used on offshore structures; however, anti-fouling paints are widely used on boat hulls and submerged structures, such as piers, aquaculture nets, buoys, and offshore platforms (Voulvoulis et al. 2002; Konstantinou and Albanis 2004; Chambers et al. 2006; Almeida et al. 2007). Any potential impacts to water quality from Vineyard Mid-Atlantic's use of anti-fouling paints or agents will likely be limited in comparison to these ongoing activities.

Alternatively, HVDC ESP(s) could potentially use closed loop water cooling (where no water is withdrawn from or discharged to the sea) if such technology becomes technically and commercially feasible.

HDD Activities

HDD operations will use bentonite or other non-hazardous drilling mud beneath the coastal and nearshore habitats that are seaward of the HDD entry point. The contractor will minimize the amount of bentonite near the exit hole and will have controls near the exit hole to minimize and contain any bentonite. Crews are trained to closely monitor both the position of the drill head and the drilling fluid pressure to reduce the risk of inadvertent releases of pressurized drilling fluid to the surface (i.e., drilling fluid seepage). The Proponent will develop an HDD Inadvertent Release Response Plan, which will describe measures to reduce the risk of an inadvertent release and the immediate corrective actions that will be taken in the unlikely event of an inadvertent release. In the unlikely event of an inadvertent release, turbidity could occur; however, the impacts would be temporary and localized. The temporary receiving pit will be filled back in with the same material once the offshore export cable has been brought to land, thereby restoring the ocean bottom to pre-installation conditions.

<u>Onshore Construction Equipment</u>

Where practicable, onshore vehicle fueling and all major equipment maintenance will be performed offsite at commercial service stations or a contractor's yard. Larger, less mobile equipment (e.g., excavators, paving equipment) will be refueled as necessary onsite. Any such field refueling will be performed in accordance with applicable on-site construction refueling regulations. Procedures for onshore refueling of construction equipment will be finalized during consultations with the appropriate state, regional, and local authorities. The fuel transfer operation will be conducted by a competent person knowledgeable about the equipment, the location, and with the use of the work zone spill kit. Proper spill containment gear and absorption materials will be maintained for immediate use in the event of any inadvertent spills

or leaks thereby minimizing the risk of potential leaks. During construction, equipment shall be inspected for incidental leaks (e.g., hydraulic fluid, diesel fuel, gasoline, anti-freeze, etc.) prior to site access and at the beginning of each work shift. Spill prevention procedures for onshore refueling of construction equipment will be finalized during consultations with the appropriate state, regional, and local authorities.

<u>Onshore Substation and RCS Sites</u>

The onshore substation equipment will be mounted on concrete foundations with secondary oil containment designed in accordance with industry and local utility standards. A stormwater management system at the onshore substation sites will include low-impact development (LID) strategies (e.g., grass water quality swales to capture and convey site runoff, deep sump catch basin(s) to pretreat surface runoff, etc.), which are designed to capture, treat, and recharge stormwater runoff. The Proponent will develop a Spill Prevention, Control, and Countermeasure (SPCC) Plan for each onshore substation site as part of the state permitting process, which will describe onshore spill prevention and response procedures (see Section 6.2 of COP Volume I).

Like the onshore substations, the onshore RCSs would be equipped with a stormwater management system. If the onshore RCSs include equipment containing oil, they would be equipped with secondary oil containment and the Proponent would develop an SPCC Plan for each onshore RCS as part of the state permitting process, if required (see Section 6.2 of COP Volume I).

Marine Trash and Debris

All Vineyard Mid-Atlantic vessel personnel, construction personnel, survey personnel, or other contractors will receive Marine Trash and Debris Prevention training and will follow all BOEM and BSEE guidelines for marine trash and debris prevention (see Sections 7.5 and 7.6). Further, vessel operators will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements. Since all vessels would be required to comply with laws and regulations to properly dispose of marine debris as well as BOEM guidelines, accidental releases of trash and debris are unlikely. Any marine debris accidentally released would be promptly recovered to the extent feasible. Accordingly, impacts to water quality are not expected.

3.2.2.4 Presence of Structures

In addition to the potential for scour formation and resuspension of sediment discussed in Section 3.2.2.1, the presence of offshore wind structures (wind turbine generators [WTGs], ESPs, and their associated foundations [monopiles for WTGs and monopiles or jackets for ESPs]) is expected to alter atmospheric and oceanographic processes to a limited extent. The extraction of energy from the wind creates a downstream wake effect where wind speeds are reduced and there is less wind stress at the sea surface boundary, potentially reducing wind-driven mixing of surface waters (NAS 2024). Additionally, the physical presence of structures may alter local water flow by potentially increasing vertical mixing as water flows around the structure (Segtnan and Christakos 2015; Carpenter et al. 2016; Cazenave et al. 2016; BOEM 2024). When water flows around the structure, turbulence is introduced that influences local current speed and direction. These impacts may be present during construction (as structures are installed), operations, and decommissioning (until all structures are removed).

The presence of scour and cable protection (if used) could potentially alter bottom current patterns, leading to increased movement, suspension, and deposition of sediments (BOEM 2023a; BOEM 2024). Any hydrodynamic effects from scour and cable protection are expected to be extremely localized (i.e., only in the immediate vicinity of the structures themselves), and are not expected to have regional effects on water quality.

While there has been extensive research to characterize and model atmospheric wakes created by WTGs to design the layout of wind facilities and to assess hydrodynamic wake/turbulence related to predicting seabed scour, there have been relatively few studies that analyze the hydrodynamic wakes and the interaction between the sea surface and atmospheric wakes. There have been even fewer studies that analyze the wakes and their impact on regional-scale oceanographic processes (i.e., Mid-Atlantic Cold Pool) and potential secondary effects to primary production and ecosystems. To date, most studies have focused on ocean modeling rather than field measurements (BOEM 2023a; BOEM 2024).

Several of the studies that have been conducted have assessed the local effect of European offshore wind projects on wake, turbidity, stratification, and fisheries impacts (e.g., van Berkel et al. 2020). As noted, most of these studies have involved numerical modeling of the hydrodynamic processes, and only a few studies provide observations or field studies of actual offshore wind projects to validate the numerical models. Only minor influences from the offshore wind projects in comparison with natural processes are shown by several of these European studies, with short-term and localized effects of individual foundations expected in the flow field (Simpson et al. 1982; Floeter et al. 2017). Turbulent hydrodynamic wakes have been observed and modeled at the kilometer scale (Vanhellemont and Ruddick 2014; Cazenave et al. 2016). While impacts on current speed and direction decrease rapidly around monopiles (with peak foundation-induced turbulence occurring within one monopile diameter at the individual foundation scale; Miles et al. [2017]), there is a potential for physical oceanographic effects out to a kilometer from a monopile (Li et al. 2014). Schultz et al. (2020) documented direct observations of the influence of a monopile extended to at least 300 m (984 ft) in the first year of their study; however, they found that changes were indistinguishable from natural variability in a subsequent year.

Some studies have shown contradictory results on topics such as whether an offshore wind project leads to decreases or increases in turbidity (van der Molen et al. 2014; Grashorn and Stanev 2016; Rivier et al. 2016). In their study assessing the impacts of offshore wind structures on turbulence and its mixing of stratification in the German Bight of the southern North Sea, which has a seasonal thermally stratified water column, Schultze et al. (2020) found mixing and stratification buildup time scales to be roughly equivalent suggesting the rate of additional mixing from offshore wind structures was comparable to the rate of stratification formation in that region. However, another study by Floeter et al. (2017) assessing biophysical parameters in two offshore wind farms in the stratified water column of the German Bight of the North Sea, found empirical evidence of enhanced vertical mixing that predicted higher nutrient fluxes to the water surface. The introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017). It should be noted, though, that field observations characterizing the physical impacts of offshore wind farms are rare and it is challenging to distinguish the signal of offshore wind farms from natural variability (Floeter et al. 2017). See Section 4.6, Section 4.7, and Appendix II-D for a further discussion of hydrodynamic and atmospheric wake effects on primary production.

In the United States (US), the effects of offshore wind developments on physical oceanography at a regional scale are still in the research phase due to the early stage of offshore wind development. To assess the potential impacts on water quality from the presence of offshore wind structures, Johnson et al. (2021) conducted a hydrodynamic modeling study for four different foundation build-out scenarios off the offshore Rhode Island and Massachusetts lease area. This study found offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification). However, the changes in currents and mixing would fluctuate seasonally and regionally and could affect water quality parameters (e.g., temperature, dissolved oxygen, and salinity) (BOEM 2024).

The Bureau of Ocean Management (BOEM) has commissioned a study (to be completed in 2024) using hydrodynamic and particle-tracking models to assess how the introduction of commercial scale offshore wind energy facilities may affect local and regional physical oceanographic processes from New York to North Carolina (BOEM 2023b), and the National Academies of Sciences completed a study evaluating hydrodynamic modeling and implications for offshore wind development specific to the area of Nantucket Shoals (NAS 2024). Several of the completed numerical modeling studies and field observations (e.g., Chen et al. 2016; Johnson et al. 2021) have assessed the impacts of offshore wind development areas on the regional oceanographic conditions, and consequently on fish larvae and marine species such as whales; however, most of those studies have focused on different geographic areas, such as the North Sea. At least for the Nantucket Shoals region, where the oceanography and ecology is dynamic and evolving, the National Academies of Sciences (2024) concluded the impacts on ecosystems from development and operation of offshore wind may be difficult to distinguish from natural and other anthropogenic variability (including climate change). A similar analysis has yet to have been conducted for the New York Bight region.

With monopiles placed in waters depths of 39.5 to 47.1 m (130 to 150 ft) where current speeds are relatively low, and the intended burial of offshore export cables to the extent feasible, impacts on water quality would likely be localized and would not degrade water quality in exceedance of water quality standards (BOEM 2024).

3.2.2.5 Summary of Avoidance, Minimization, and Mitigation Measures

For Vineyard Mid-Atlantic, water quality impacts related to suspended sediments from cable installation and other construction activities (such as HDD or placement of scour protection) are expected to be short term and localized. The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to water quality during Vineyard Mid-Atlantic are summarized below:

- Trenchless crossing methods (e.g., HDD) are expected to be used where the onshore cable routes traverse unique features such as wetlands and waterbodies to avoid impacts to those features.
- The Proponent will require all vessels to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental spills.
- Where practicable, onshore vehicle fueling and all major equipment maintenance will be performed offsite at commercial service stations or a contractor's yard. Field refueling shall be performed in accordance with applicable on-site construction refueling regulations. Proper spill containment gear and absorption materials will be maintained for immediate use in the event of any inadvertent spills or leaks.

- Onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas)[24], and construction involves standard inert materials such as concrete and polyvinyl chloride conduit, which will avoid or minimize impacts to any mapped water resource areas along the routes.

- During construction of Vineyard Mid-Atlantic, proper erosion and sedimentation controls will be employed in accordance with federal, state, and local requirements.

- The Proponent will develop a Spill Prevention, Control, and Countermeasure (SPCC) Plan for each onshore substation and RCS site.

- The Proponent has also developed a draft Oil Spill Response Plan for Vineyard Mid-Atlantic, which is included in Appendix I-F.

3.3 Geology

This section addresses the potential impacts of geological site conditions on Vineyard Mid-Atlantic's offshore facilities in the Offshore Development Area. An overview of the affected environment is proved first, followed by a discussion of the impact producing factors (IPFs) and the proposed measures to avoid, minimize, and mitigate potential effects of the geological site conditions on the proposed offshore facilities during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

The Marine Site Investigation Report (MSIR), included as Appendix II-B, provides detailed results of the survey program and geological conditions for Vineyard Mid-Atlantic.

3.3.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the offshore export cable corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic -related activities.

This section summarizes the physical site conditions (primarily seafloor and shallow subsurface geology) within the Lease Area and within and around the OECC and. The analysis and interpretation of the Offshore Development Area is based off the geophysical, geotechnical, and environmental surveys undertaken during 2022 and 2023 in the Lease Area and 2023 in the OECC, including historical supporting datasets and the following resources:

- National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) Hydrographic Surveys and seabed samples in United States (US) coastal waters

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24 In limited areas, the onshore cable routes may follow utility rights-of-way (ROWs) or depart from public roadway layouts, particularly at complex crossings.

- NOAA National Data Buoy Center
- NOAA Center for Operational Oceanographic Products and Services (CO-OPS) Tidal Current Predictions
- NOAA Historical Hurricane Tracks
- NOAA Office for Coastal Management/Bureau of Ocean Energy Management (BOEM) OceanReports
- New York State Energy Research and Development Authority (NYSERDA) Multibeam echosounder and benthic survey data (NYSERDA 2017)
- NYSERDA Hudson North (Subarea A) high-resolution geophysical (HRG) and Geotechnical data (NYSERDA 2021a)
- United States Geological Survey (USGS) East-Coast Sediment Texture Database (USGS 2014)
- USGS and University of Colorado: usSEABED Offshore Surficial-Sediment Database
- USGS Earthquake Hazards Program

3.3.1.1 Lease Area OCS-A 0544

The Lease Area is 174 square kilometers (km^2) (43,056 acres) in size and is located entirely in federal waters. At its closest point, the Lease Area is approximately 38 kilometers (km) (24 miles [mi]) south of Fire Island, New York.[25] Water depths in the Lease Area range from approximately 39.5 to 47.1 meters (m) (130 to 155 feet [ft]) below Mean Low Lower Water (MLLW) (see Figure 3.3-1).

Conditions in the Lease Area have been identified using a combination of marine geophysical, geotechnical, and environmental survey techniques during the 2022 and 2023 field programs. In addition to the usual seafloor mapping (multibeam echosounder [MBES], side scan sonar [SSS], and gradiometer [GRAD]) to gather surficial information, these investigations also focused on the shallow subsurface using high to medium frequency sub-bottom profilers (SBP) to document the sediment conditions in the upper 3–10 m (9.8–32.8 ft) and provide penetration up to 10–20 m (32.8–65.6 ft) below seabed (BSB). Benthic grab samples, still images, and underwater video provided additional detail on surficial properties and benthic habitats, while vibracores (VCs) and shallow seabed cone penetration tests (CPTs) provided ground truthing

[25] The closest WTG/ESP position is also ~38 km (24 mi) from Fire Island, New York.

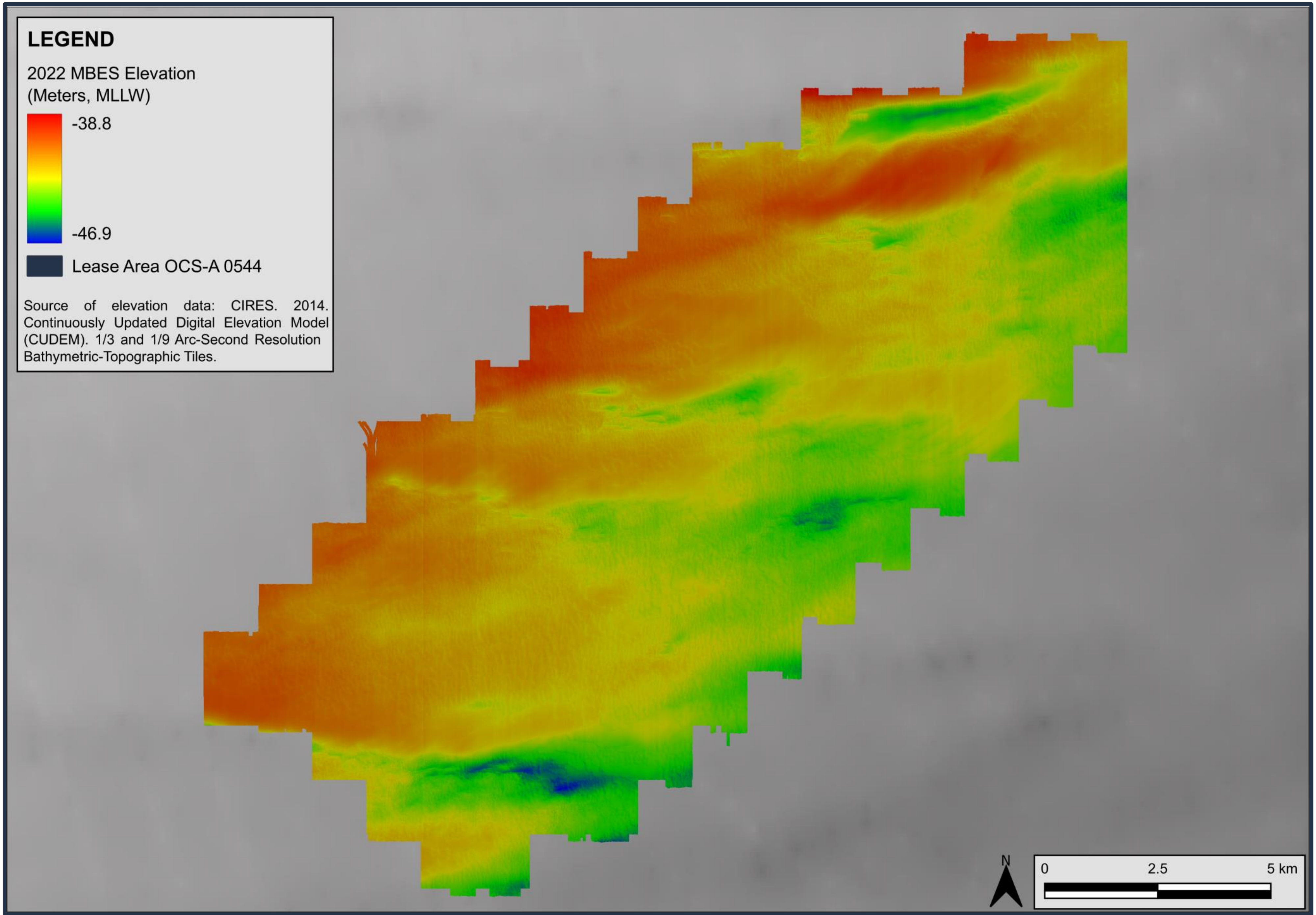

Figure 3.1-1
Water Depths in the Lease Area

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

and direct sampling of the upper 5–6 (16–20 ft) of the seabed. Single-channel seismic (SCS) and multi-channel seismic (MCS) data (sparker source) were collected to acoustically examine sediment lithologies to depths of over 100 m (328 ft) BSB. A deep geotechnical program was also utilized to provide direct sampling (boreholes and deep CPTs) up to 90 m (295 ft) within the Lease Area.

Table 3.3-1 provides a summary of geologic site conditions in the Lease Area.

Table 3.3-1 Geologic Conditions in the Lease Area

Results	Summary
[redacted]	[redacted]
[redacted]	[redacted]

3.3.1.2 OECC

The OECC extends from the northern end of the Lease Area, continues west along the boundary of neighboring Lease Area OCS-A 0512, and then proceeds northwest across the Ambrose to Nantucket and Nantucket to Ambrose Traffic Lanes towards the southern shore of Long Island, New York. As the OECC approaches shore, it splits into three variations to connect to three potential landfall site(s) (of which, up to two will be used): the Rockaway Beach Landfall Site, the Atlantic Beach Landfall Site, and the Jones Beach Landfall Site. The OECC, depending on the approach, traverses approximately 55–76 km (30–41 nautical miles [NM]) of New York's state- and federally-regulated waters in water depths ranging from 2.3–43.2 m (7.5–141.7 ft) (see Figure 3.3-2). Conditions in the OECC have been identified using a combination of marine geophysical, geotechnical, and environmental survey techniques during the 2023 field program.

Surface and subsurface conditions were interpreted from MBES, SSS, and shallow seismic data. The sonar data were then ground-truthed via sediment grab samples, VC samples, CPTs, and underwater video imagery.

Table 3.3-2 provides a summary of geologic site conditions in the OECC.

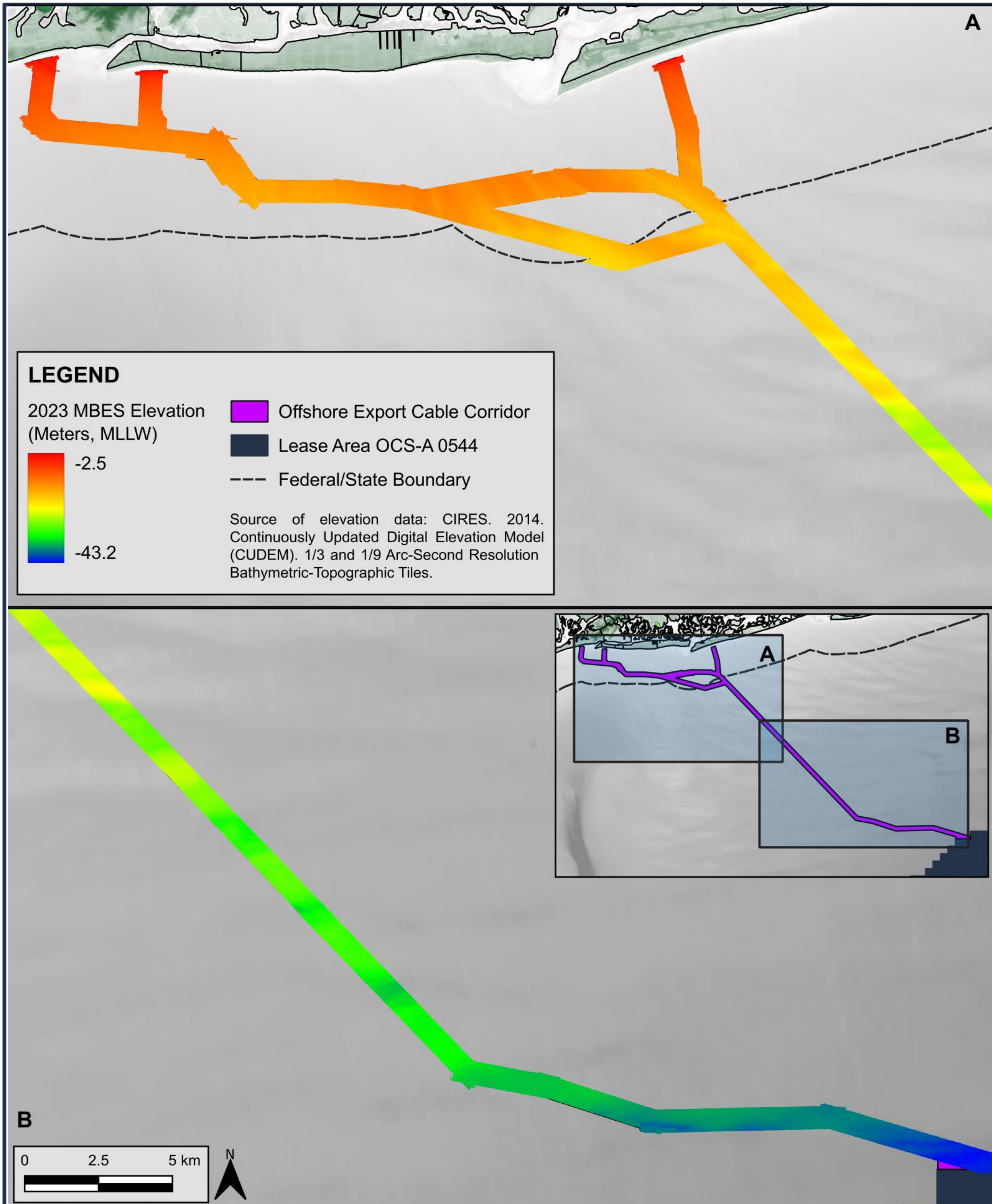

Figure 3.3-2
Water Depths in the OECC

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Table 3.3-2 Geologic Conditions in the OECC

Results	Summary
[redacted]	[redacted]
[redacted]	[redacted]

3.3.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

Geological conditions affect the design of the Vineyard Mid-Atlantic offshore facilities, including wind turbine generators (WTGs) and foundations, electrical service platforms (ESP[s]) and foundations, and offshore export, inter-array, and inter-link cables. Table 3.3-3 summarizes the geological features and hazards in the Offshore Development Area, potential impacts to Vineyard Mid-Atlantic, and the specific mitigation measures for each of the identified geological hazards.

The cables will be buried beneath the stable seafloor at a target depth of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters,[26] which is more than twice the burial depth required to protect the cables from fishing activities and generally provides a maximum of 1 in 100,000 year probability of anchor strike, which is considered a negligible risk.

Various concentration levels of glauconite were observed from boreholes strategically positioned throughout the Lease Area. Due to its unique soil properties and behaviors, concerns have been raised about glauconite and its effect on foundation installation and stability. Appendix II-B16 outlines the mitigation measures that are expected to remove or reduce the installation risk for the proposed foundation types and penetration depths.

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]

26 Based on a preliminary CBRA (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor to achieve a 1 in 100,000 year probability of anchor strike, subject to the results of the final CBRA.

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]

Table 3.3-3 Geological Impact and Hazard Assessment for Offshore Facilities (Continued)

Feature/Hazard Description	Impact Evaluation, Potential	Mitigation Measures
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

WTG and ESP foundation(s) will be positioned within a limited tolerance area to avoid any suspected adverse conditions interpreted from the geophysical and geotechnical data. Data on the deep sediment units, stratigraphy, and structures below the seafloor is acquired and examined to inform the Proponent of these site conditions. Single and multi-channel seismic profiles, downhole CPTs, and borings document the subsurface environment to at least expected foundation depths and in most places to 10 m (32.8 ft) beyond. An additional deep geotechnical campaign is planned for 2024 that will include sampling 10 m (32.8 ft) below the expected foundation depths. If necessary, foundation locations can then be strategically placed to avoid potential locally unsuitable subsurface features or designed to mitigate the hazards. Similarly, offshore cable systems will be micro-sited, within the limits of the cables' bending radius, to avoid any adverse environmental and hazardous conditions on the seafloor and in the shallow subsurface where possible.

In summary, all Vineyard Mid-Atlantic components will be designed for site-specific geological conditions. Known natural and anthropogenic hazards will be avoided to the extent practicable. The Proponent will develop one or more Facility Design Reports (FDRs) and Fabrication and Installation Reports (FIRs) for the proposed offshore facilities. The FDRs will contain the specific details of the offshore facilities' design, including structural drawings, justification for referenced design standards, design and load calculations, and summaries of the environmental, engineering, and geotechnical data used as the basis for the designs. The FIRs will describe how each structure will be fabricated, transported, installed, and commissioned. The FDRs and FIRs will be reviewed by a third-party Certified Verification Agent that certifies the offshore facilities are designed to withstand site-specific environmental and functional load conditions for the duration of the facilities' intended service life. As further described in Section 4 of Volume I, the Proponent will regularly monitor the offshore facilities via above and below-water inspections and surveys throughout the operational period. Underwater surveys could include the use of survey vessels, remotely operated vehicles (ROVs), remotely operated towed vehicles (ROTVs), autonomous offshore vehicles/vessels, and/or divers. Geophysical survey equipment may include, but is not limited to, side scan sonar, multibeam echosounders, magnetometers/gradiometers, and sub-bottom/seismic profilers.

4 Biological Resources

4.1 Terrestrial Habitat and Wildlife (Including Inland Birds)

This section addresses the potential impacts of Vineyard Mid-Atlantic on terrestrial habitat and wildlife (including inland birds) in the Onshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to terrestrial wildlife species during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

This section discusses terrestrial wildlife resources along the onshore cable routes, at the onshore substation sites and onshore reactive compensation stations (RCSs) (if used), at the terrestrial portion of the landfall site(s), and at the points of interconnection (POIs). Coastal and marine birds are discussed in Section 4.2, bats are discussed in Section 4.3, and coastal habitats at the marine portion of the landfall site(s) are discussed in Section 4.4. Potential impacts to water quality from onshore construction are discussed in Section 3.2.

4.1.1 Description of Affected Environment

The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, potentially onshore RCSs, and POIs on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities.

Figures 4.1-1, 4.1-2, and 4.1-3 provide an overview of planned Vineyard Mid-Atlantic onshore facilities in Long Island, New York.

4.1.1.1 Onshore Development Area Terrestrial Habitats

Landfall Sites

Vineyard Mid-Atlantic's offshore export cables will transition onshore at up to two of the following landfall site(s) on the southern shore of Long Island, New York (Figures 4.1-1, 4.1-2, and 4.1-3):

- **Rockaway Beach Landfall Site:** The Rockaway Beach Landfall Site is located in a portion of a previously disturbed area adjacent to Rockaway Beach in Queens, New York. Surrounding land uses include the beach and open space, which are bordered by commercial properties and residential high-rises.

[redacted]

[redacted]

[redacted]

- **Atlantic Beach Landfall Site:** The Atlantic Beach Landfall Site is located in a paved parking area near the intersection of The Plaza and Ocean Boulevard in the Town of Hempstead, New York. The town-owned parking lot is bordered to the south by the Atlantic Beach Boardwalk. Nearby uses include the beach, beach clubs, hotels, a tennis club, and private residences.

- **Jones Beach Landfall Site:** The Jones Beach Landfall Site is located in a paved parking area (Field 1) within Jones Beach State Park. Jones Beach State Park is a 17 square kilometers (km^2) (2,400 acre) park in the Town of Hempstead, New York that is managed by the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP [date unknown]). Surrounding land uses include the boardwalk, beach, bike path, and open space.

The precise location of the landfall site(s) will be determined through consultations and coordination with state and local officials and property owners.

Points of Interconnection

Power generated by Vineyard Mid-Atlantic will be delivered to the regional electric grid at up to two of the following points of interconnection (POIs):

- **East Garden City Substation (Uniondale) POI:** The 138/345 kV East Garden City Substation is located in Uniondale, New York on Long Island. Vineyard Mid-Atlantic will interconnect to the 345 kV portion of the East Garden City Substation, which is owned and operated by the New York Power Authority (NYPA).[27] The East Garden City Substation POI is also referred to as the "Uniondale POI."

- **Ruland Road Substation POI:** The 138 kV Ruland Road Substation is located in Melville, New York on Long Island.[28] The Ruland Road Substation is operated by the Public Service Enterprise Group (PSEG) Long Island for the Long Island Power Authority (LIPA).

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[27] Note the Uniondale POI contains an adjacent undeveloped portion to the west of the current 138 kV/345 kV Uniondale substation. Plans for the expansion of the 345 kV POI are in development by NYPA as part of the Long Island Offshore Wind Designated Public Policy Project. Vineyard Mid-Atlantic may connect to the expanded portion of the Uniondale POI, which will be owned and operated by NYPA.

[28] A new 345 kV substation may be constructed by other entities adjacent to the existing 138 kV Ruland Road Substation as part of the Long Island Offshore Wind Export Public Policy Transmission Need Project. Vineyard Mid-Atlantic could interconnect at the new 345 kV substation, depending on the timeline of that project.

- **Eastern Queens Substation POI:** The proposed Eastern Queens Substation is located in Queens, New York on Long Island. Development of the Eastern Queens Substation is anticipated as part of the Consolidated Edison Company of New York, Inc.'s Reliable Clean City Project.

To deliver power to up to two POIs, underground high voltage alternating current (HVAC) or high voltage direct current (HVDC) onshore export cables will connect up to two of the potential landfall site(s) to two new onshore substations, and underground HVAC grid interconnection cables will connect the new onshore substations to the POIs. Modifications may be required at each POI to accommodate Vineyard Mid-Atlantic's interconnection. Any required system upgrades at the POI are expected to be constructed by the existing substation's owner/operator. More detailed information is available in Section 3.8 of COP Volume I.

<u>Onshore Cable Routes</u>

Onshore cable routes are shown on Figures 4.1-1, 4.1-2, and 4.1-3. Each onshore cable route has been sited to predominantly follow existing city/village, town, county, and state roads. Underground trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies). More detailed information about the selection of onshore cable routes is included in Section 2.7.3 of COP Volume I and displayed in Figure 4.1-1.

Likely onshore cable routes are described in Sections 3.8.1 through 3.8.3 of COP Volume I however, Vineyard Mid-Atlantic may ultimately use any combination of route segments shown on Figures 4.1-1, 4.1-2, and 4.1-3.

<u>Onshore Substations and Reactive Compensation Stations</u>

Vineyard Mid-Atlantic will include two onshore substations on Long Island, New York. The two onshore substation sites will be located within up to two of the following onshore substation site envelopes shown in Figure 4.1-1, Figure 4.1-2, and Figure 4.1-3.

- **Onshore Substation Site Envelope A:** [redacted]

- **Onshore Substation Site Envelope B:** [redacted]

[redacted]

- **Onshore Substation Site Envelope C:** [redacted]

- **Onshore Substation Site Envelope D:** [redacted]

If HVAC export cables are used, an onshore RCS may be located along each onshore export cable route. These onshore substation site envelopes could also be used for an RCS, however both an RCS and onshore substation site would not be located in the same onshore substation site envelope.

Although the Proponent may select a parcel that contains mapped wetlands for an onshore substation site or reactive compensation station site, the facility footprint would be sited to minimize or avoid impacts on wetlands.

Terrestrial Habitats

Habitat types were analyzed using a variety of sources including United States Geological Survey (USGS) data, habitat maps from the Nature Conservancy (Figure 4.1-4; see also Figure 4.1-5), and New York State Department of Environmental Conservation (NYSDEC) environmental resource mapper (ERM). Figure 4.1-6 shows rare and endangered species and Figure 4.1-7 includes wetlands and waterbodies proximal to the Onshore Development Area. Section 5.5, and analysis in Appendix II-C, includes mapped land cover and land uses (Figure 5.5-4).

USGS National Land Cover Base (NLCD) habitat types indicates that developed land accounts for approximately 93.4% of the Onshore Development Area. After developed, NLCD indicates the next three most prevalent land use land cover types co-located with the Onshore Development Area are forested habitat (~2.5%), wetlands (~1.9%), and open water (~1.3%). The remaining <1% is made up of barren land, grassland, shrub, and agricultural land (see Appendix II-C).

The Northeast Habitat Map, a collaborative dataset put together by the Nature Conservancy, Nature Serve, North Atlantic Landscape Conservation Cooperative, Northeast Climate Science Center, Nature Conservancy of Canada, Atlantic Canada Conservation Data, and Eastern Conservation Science, identifies more specific habitat types along areas of proposed Vineyard Mid-Atlantic activities. As mentioned above, while the onshore facilities are located primarily in developed areas, less prevalent habitats near the onshore facilities include open water, Atlantic coastal plain beach and dune, and tidal salt marsh/estuarine marsh (Figure 4.1-4). In addition to this, Figure 4.1-4 provides an overview of other mapped habitat types in the Onshore Development Area.

Atlantic coastal plain beach and dune are located adjacent to potential landfall sites. This habitat is typically a sparsely vegetated beach, dune or barrier island on unconsolidated sand and shell sediments on the Atlantic coast. Trees and shrubs are restricted to sheltered areas. This habitat is subject to change due to winds and floods thus salt-tolerant and succulent annuals make up the majority of any vegetation that establishes in these habitats. While marsh-like vegetation can be found in areas that are permanently or semi-permanently flooded, they are subject to salt spray or overwash during storms.

Tidal salt marsh/estuarine marsh is a habitat that includes salt marsh, brackish marsh, and freshwater tidal marsh. Typically, a salt marsh has salt marsh cordgrass; brackish areas support salt marsh cordgrass as well as narrowleaf cattail; and freshwater tidal areas can include wild rice marshes and forbs such as water hemp and/or rosemallow. This habitat is estimated to be found in areas north of the Atlantic Beach and Jones Beach Landfall Sites along the southern ends of onshore cable routes (Figure 4.1-4). As described further in Appendix II-D, these tidal wetlands are part of the Long Island South Shore Estuary Reserve, specifically the Western Bays sub-region. The western Bays sub-region extends from the western boundary of the Town of Hempstead to the Nassau-Suffolk County line (Figure 4.1-5). Additionally, this intertidal and subtidal area is home to a number of intertidal benthic species including, but not limited to, hard clam (*Mercenaria mercenaria*), soft shell clam (*Mya arenaria*), Atlantic bay scallop (*Argopecten irradians*), Atlantic sea scallop (*Placopecten magellanicus*), Eastern oyster (*Crassostrea virginica*), Atlantic surfclam (*Spisula solidissima*), blue mussel (*Mytilus edulis*), and bank (ribbed) mussel (*Geukensia demissa*) (NYSDEC 2023).

NYSDEC Statewide Seagrass Map identifies eelgrass in the bays behind Long Island's barrier islands. However, all onshore routes will not intersect any of the NYSDEC mapped eelgrass areas (Figure 4.1-4), which are at least 0.9 kilometers (km) (0.6 miles [mi]) east of the Jones Beach to Ruland Road Eastern Onshore Cable Route. Further, trenchless crossing methods are expected to be used where the onshore cable routes traverse unique features such as wetlands and waterbodies to avoid impacts to those features, including eelgrass.

Information on habitats is also available from the New York Natural Heritage Program (NYNHP), which is a joint partnership between State University of New York (SUNY) College of Environmental Science and Forestry (ESF) and the NYSDEC. The NYSDEC hosts an online ERM that includes the following data layers:

- all animals listed by New York State (NYS) as endangered or threatened;
- all plants listed by NYS as endangered or threatened;
- some animals listed by NYS as special concern;

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Data Source: Eastern Conservation Science, The Nature Conservancy (TNC)

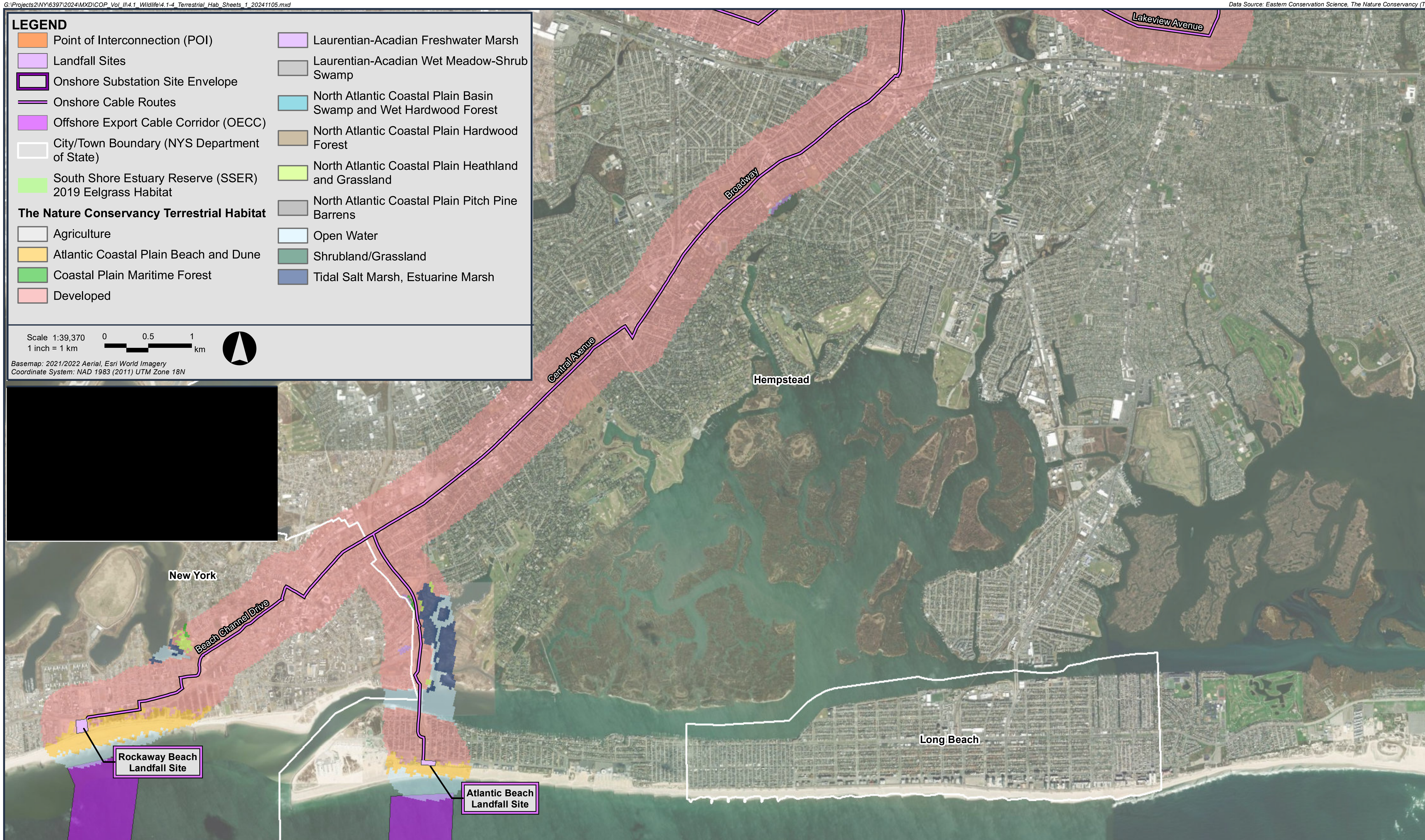

Figure 4.1-4, Map Sheet 1 of 5

Terrestrial Habitat Proximal to Onshore Facilities

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

[redacted]

[redacted]

[redacted]

[redacted]

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

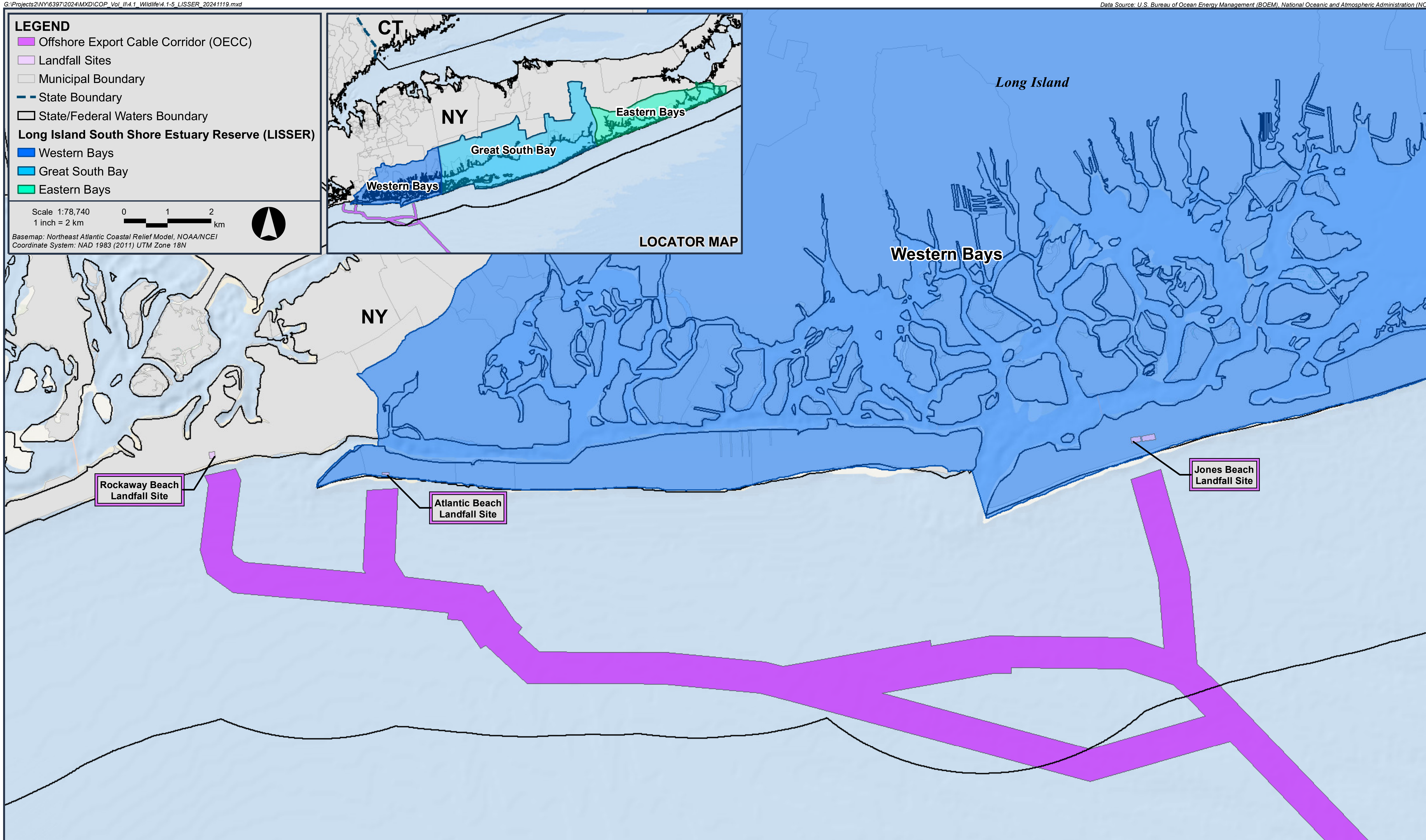

Figure 4.1-5
Long Island South Shore Estuary Reserve

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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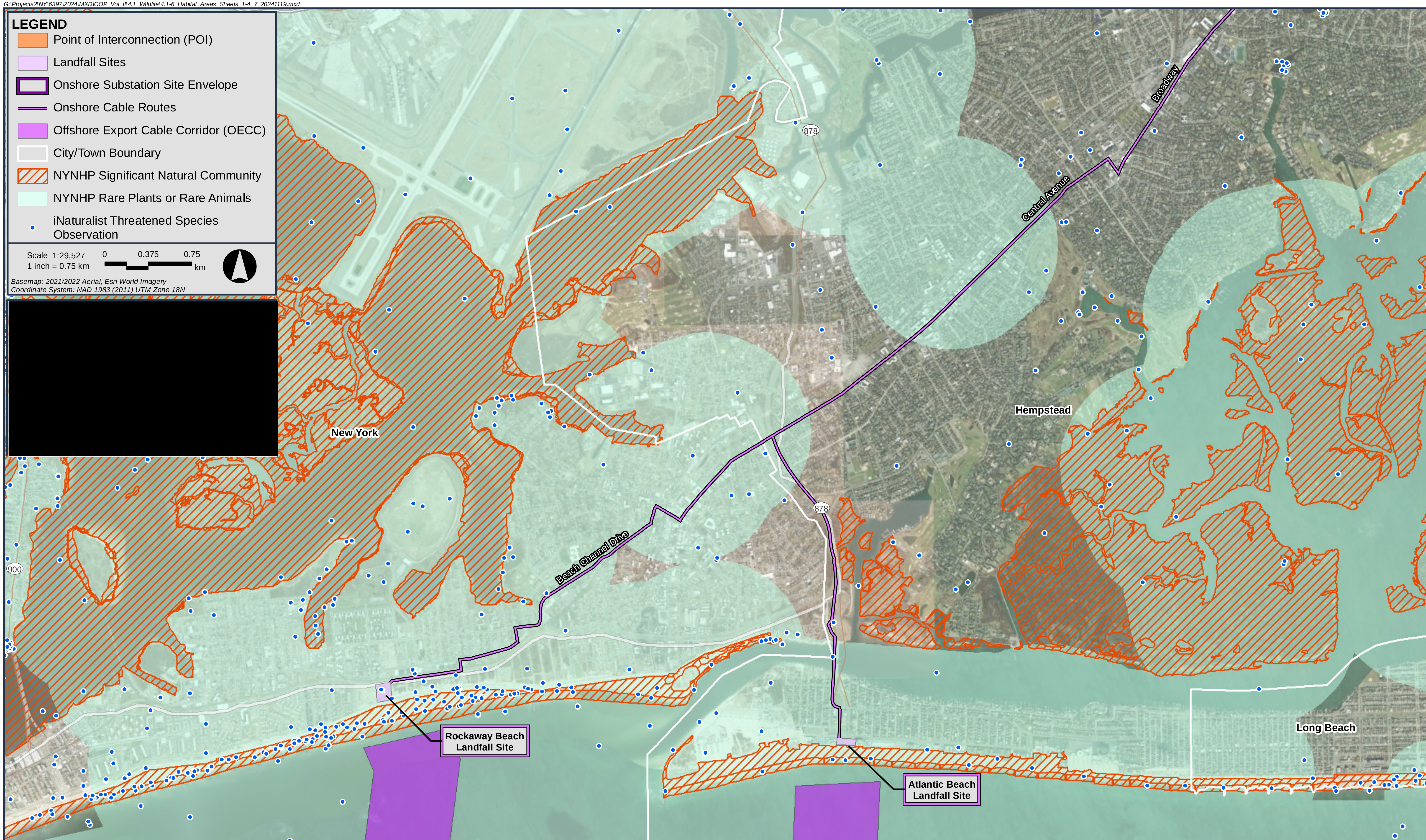

Figure 4.1-6, Map Sheet 1 of 7

Rare Species Habitats Proximal to Onshore Facilities

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Figure 4.1-6, MapSheet 2 of 7

Rare Species Habitats Proximal to Onshore Facilities

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

[redacted]

[redacted]

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Figure 4.1-6,Map Sheet5 of 7
Rare Species Habitats Proximal to Onshore Facilities

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

[redacted]

[redacted]

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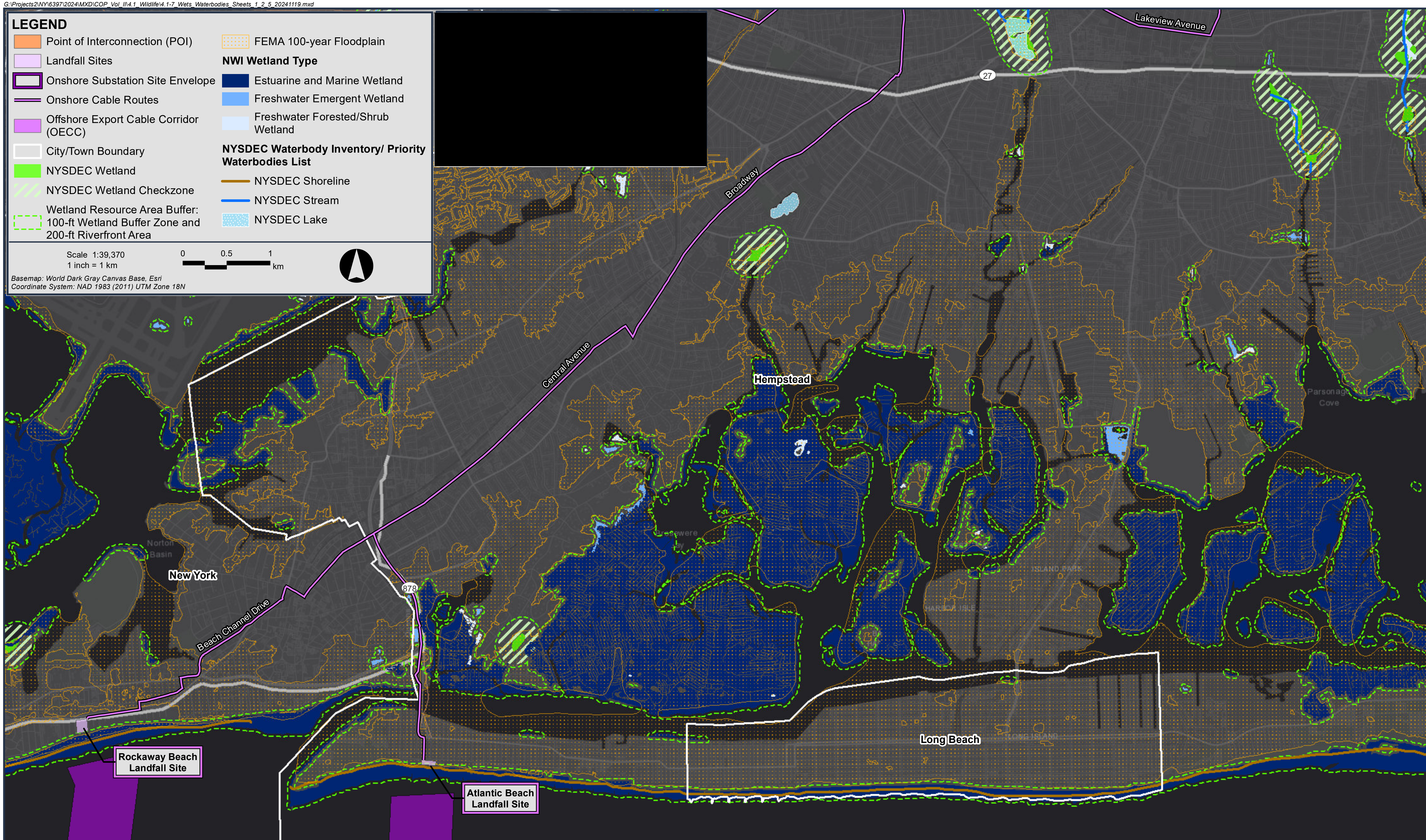

Figure 4.1-7, Map Sheet 1 of 5

Wetlands and Waterbodies Proximal to Onshore Facilities

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

[redacted]

[redacted]

[redacted]

[redacted]

- some plants listed by NYS as rare;
- some species not officially listed by NYS, "but which nevertheless are rare in New York";
- wetlands and waterbodies in NYS.

Locations shown of these layers are not precise and are intended for planning and screening purposes.

While most of the onshore facilities are located in developed areas, portions of the onshore facilities are located in or adjacent to NYNHP mapped significant natural communities or mapped rare plants or rare animal areas (Figure 4.1-6). However, each potential landfall site has intentionally been sited in a previously disturbed area and the onshore cable routes are approximately 99% co-located with existing roadways and/or utility ROWs. Further, the onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas)[29] via open trenching. Accordingly, potential effects from the onshore facilities to terrestrial wildlife and habitat will be minimized.

As shown in Figure 4.1-7, portions of the onshore facilities overlap with mapped wetlands or the Federal Emergency Management Agency (FEMA) 100-year floodplain. Underground trenchless crossing trenchless are expected to be used where the onshore cable routes traverse unique features such as wetlands and waterbodies to avoid impacts to those features. More detail on specialty cable crossing methods is included in Section 3.8.4.3 of COP Volume I. Additionally, although the Proponent may select an onshore substation site parcel that contains mapped wetlands, the facility footprint would be sited to minimize or avoid impacts on wetlands. Finally, the onshore facilities will be designed to meet all applicable floodplain requirements.

4.1.1.2 Terrestrial Fauna Including Inland Birds

Species known to commonly occur in, and within, the habitats adjacent to the landfall site(s), POIs, onshore substation site envelopes, and onshore cable routes are listed in Table 4.1-1 (Nature Conservancy 2013; NYSDEC 2015a).

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29 In limited areas, the onshore cable routes may follow utility rights-of-way (ROWs) or depart from public roadway layouts, particularly at complex crossings.

Table 4.1-1 Commonly Occurring Species in the Onshore Development Area

Common Name	Scientific Name
Mammals	
White-tailed deer	*Odocoileus virginianus*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Common raccoon	*Procyon lotor*
White-footed mouse	*Peromyscus maniculatus*
Eastern mole	*Scalopus aquaticus*
Long-tailed weasel	*Mustela frenata*
Gray squirrel	*Sciurus carolinensis*
Meadow vole	*Microtus pennsylvanicus*
North American least shrew	*Cryptotis parvus*
Reptiles and Amphibians	
American toad	*Anaxyrus americanus*
Spotted turtle	*Clemmys guttata*
Woodland box turtle	*Terrapene carolina carolina*
Fowler's toad	*Anaxyrus fowleri*
Eastern hognose snake	*Heterodon platirhinos*
Plants	
American beachgrass	*Ammophila breviligulata*
Coast-blite goosefoot	*Chenopodium rubrum*
Oysterleaf	*Mertensia maritima*
Saltmarsh aster	*Symphyotrichum subulatum*
Sea lyme-grass	*Leymus mollis ssp mollis*
Seabeach amaranth	*Amaranthus pumilus*
Seabeach knotweed	*Polygonum glaucum*
Seabeach needlegrass	*Aristida tuberculosa*
Slender sea purslane	*Sesuvium maritimum*
Northern blazing star	*Liatris scariosa*
Lion's-foot	*Prenanthes alba*
Sundial lupine	*Lupinus perennis*
Butterfly milkweed	*Asclepias tuberosa*
Eastern silvery aster	*Symphyotrichum concolor*
Small white leek	*Allium tricoccum*

Listed Species

Species that are listed through the United States Fish and Wildlife Service (USFWS) information for planning consultation (IpaC) tool as endangered or threatened that may occur in the Onshore Development Area are included in Table 4.1-2 (USFWS 2024).

Table 4.1-2 USFWS Listed Species in the Onshore Development Area

Type	Common Name	Latin Name	Federal Status
Mammal	Northern long-eared bat[1]	*Myotis septentrionalis*	Endangered
	Tricolored bat[1]	*Perimyotis subflavus*	Proposed Endangered
Birds	Piping plover	*Charadrius melodus*	Threatened
	Red knot	*Calidris canutus rufa*	Threatened
	Roseate tern	*Sterna dougllaii dougllaii*	Endangered
Insects	Monarch butterfly	*Danaus plexippus*	Candidate
Plants	Sandplain gerardia	*Agalinis acuta*	Endangered
	Seabeach amaranth	*Amaranthus pumilus*	Threatened

Note:

1. Bats are discussed in more detail in Section 4.3

Only proposed Red knot (*Calidris canutus rufa*) Critical Habitat was found at this location, as is discussed in Appendix II-C. The Proponent will continue to consult with state and federal agencies regarding listed species. More information regarding bird and nesting habitat is provided below.

Inland Birds

Based on analysis of eBird data, there are 248 bird species that may be present at or near the Onshore Development Area (see Appendix II-C for full list). Coastal and marine areas will primarily include seabirds, waterfowl, sea ducks, shorebirds, and songbirds; freshwater areas will include waterbirds, shorebirds, wading birds, nightjars, and songbirds; and terrestrial areas will include raptors, nightjars, and songbirds.

As mentioned above, three bird species federally listed under the Endangered Species Act are likely to use coastal areas in the vicinity of the Onshore Development Area: piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and roseate tern (*Sterna.d. dougllaii*) (Table 4.1-2). In addition, eBird data identified 12 species listed as threatened or endangered in New York, and 11 species listed as Special Concern in New York, that may be present in or near the Onshore Development Area (Table 4.1-3). In addition to this, the USFWS IpaC planning tool indicates that six of the federally or state-listed species that may be present in or near the Onshore Development Area are migratory birds of conservation concern (Table 4.1-3). Lastly, in October 2023, NYNHP also identified eight of the eBird observed listed species to be present in or near the Onshore Development Area. See Appendix II-C for more detail.

Table 4.1-3 eBird Observations in the Onshore Development Area with Conservation Status

Common Name	Latin Name	Federal Status	State Status	NYNHP	IpaC
Ducks, Geese, and Swans					
Pied-billed grebe	*Podilymbus podiceps*	None	Threatened		
Shorebirds					
Piping plover	*Charadrius melodus*	Threatened	Endangered	•	
Red knot	*Calidris canutus rufa*	Threatened	Threatened		
Terns					
Roseate tern	*Sterna dougllaii dougllaii*	Endangered	Endangered	•	•
Least tern	*Sternula antillarum*	None	Threatened	•	
Black tern	*Chlidonias niger*	None	Endangered		
Common tern	*Sterna hirundo*	None	Threatened	•	
Skimmers					
Black skimmer	*Rynchops niger*	None	Special Concern	•	•
Loons					
Common loon	*Gavia immer*	None	Special Concern		•
Bitterns					
American bittern	*Botaurus lentiginosus*	None	Special Concern		
Least bittern	*Ixobrychus exilis*	None	Threatened		
Raptors					
Northern harrier	*Circus hudsonius*	None	Threatened		
Bald eagle	*Haliaeetus leucocephalus*	Bald and Golden Eagle Protection Act	Threatened	•	•
Peregrine falcon	*Falco peregrinus*	None	Endangered	•	
Red-shouldered hawk	*Buteo lineatus*	None	Special Concern		
Short-eared owl	*Asio flammeus*	None	Endangered	•	
Nightjars and Allies					
Eastern whip-poor-will	*Antrostomus vociferus*	None	Special Concern		•
Common nighthawk	*Chordeiles minor*	None	Special Concern		
Woodpeckers					
Red-headed woodpecker	*Melanerpes erythrocephalus*	None	Special Concern		•
Songbirds					
Vesper sparrow	*Pooecetes gramineus*	None	Special Concern		
Seaside sparrow	*Ammospiza maritima*	None	Special Concern		
Horned lark	*Eremophila alpestris*	None	Special Concern		
Yellow-breasted chat	*Icteria virens*	None	Special Concern		

The three federally listed species are all present along the Long Island coast for part of the year. Red knots pass through during both spring (April–May) and especially fall (August–October) migrations, while piping plovers and roseate terns are also present during spring and fall migrations, with some individuals remaining in the state throughout the breeding season (May–August). The eBird data for these three federally listed species near landfall sites was further analyzed, and the number of individuals over the 10-year period of 2013-2023 that were recorded by eBird users in the immediate area of each landfall site was calculated. These numbers indicate whether or not the listed species are commonly observed near landfall sites and is not evidence of nesting (or the absence of nesting). (A fourth federally listed species, black-capped petrel [*Pterodroma hasitata*], is present in the marine environment farther from the Long Island coast; see Appendix II-C.)

Red knots (specifically the rufa subspecies that uses the Atlantic flyway) breed in the Arctic and winter at sites as far south as Tierra del Fuego, Argentina. During both migrations, red knots use key staging and stopover areas to rest and feed on clams, crustaceans, and invertebrates in varied habitats including sandy coastal beaches, tidal inlets, the mouths of bays and estuaries, salt marshes, and tidal mudflats, where they. The south shore of Long Island is one such important stopover location during spring and fall migration in New York (NYSDEC 2015b). One landfall site, Jones Beach, overlaps with proposed Critical Habitat for red knots, designated by the USFWS as the Jones Inlet unit. Another proposed Red Knot Critical Habitat Unit, Jamaica Bay unit, is southwest of Rockaway Beach Landfall Site within the Gateway National Recreation Area (USFWS 2021). Over the 2013-2023 time period, eBird users observed 1,450 red knots around the Jones Beach Landfall Site and 12 around the Rockaway Beach Landfall Site. No Red Knots were observed by eBird users around the Atlantic Beach Landfall Site.

Piping plovers nest on coastal beaches in summer and feed on exposed wet sand and in adjacent habitat by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening. Piping plovers arrive in New York in March and leave by October, with most departing by early September (NYSDEC 2019). As of the most recently available data from 2018, there were 82 active piping plover nesting sites on Long Island, and NYSDEC identified Jones Beach Island West and Long Beach Island Lido Beach as two of the top five breeding sites (NYSDEC 2018). Over the 2013-2023 time period, eBird users observed 1,365 piping plovers around the Jones Beach Landfall Site, 196 around the Rockaway Beach Landfall Site, and 3 around the Atlantic Beach Landfall Site.

Roseate terns nest in colonies in the summer, typically on islands away from predators, among other nesting tern species. The largest breeding colony of roseate terns in New York is on Great Gull Island off eastern Long Island (NYSDEC 2015c), approximately 137 km (85 mi) east of the closest potential landfall site (Jones Beach Landfall Site). Individuals may fly over the Onshore Development Area during spring and fall migrations but are unlikely to linger. Over the 2013-2023 time period, eBird users reported seeing 18 Roseate Terns around the Jones Beach Landfall Site, and 1 around the Rockaway Beach Landfall Site. No Roseate Terns were observed by eBird users at the Atlantic Beach Landfall Site.

4.1.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect terrestrial habitat and wildlife (including inland birds) during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.1-4.

Table 4.1-4 Impact Producing Factors for Terrestrial Habitat and Wildlife

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Onshore Construction and Maintenance Activities	•	•	•
Ground Disturbance and Habitat Modification	•	•	•
Noise	•	•	•
Artificial Light	•	•	•

Potential effects to terrestrial habitat and wildlife were assessed using the maximum design scenario for Vineyard Mid-Atlantic's onshore facilities as described in Section 1.5.

4.1.2.1 Onshore Construction and Maintenance Activities

Onshore construction and maintenance activities may temporarily result in impacts to terrestrial habitats and wildlife. Temporary air emissions may occur from support vehicles and equipment during construction, maintenance, and decommissioning activities. Such emissions are expected to be similar to other onshore construction projects. Potential air emissions from Vineyard Mid-Atlantic activities are further described in Section 3.1.

The effects of ground disturbance, noise, and artificial light are discussed further in Sections 4.1.2.2, 4.1.2.3, and 4.1.2.4, respectively.

4.1.2.2 Ground Disturbance and Habitat Modification

Localized ground disturbance will occur from construction, O&M, and decommissioning of the landfall sites, onshore cable routes, new substations, and onshore RCSs (if used). To minimize disturbance, the Proponent has located the onshore cable routes primarily within public roadway layouts (or immediately adjacent areas).[30] The Proponent intends to prioritize onshore substation sites and onshore RCS sites (if used) in industrial/commercial areas that have been previously disturbed, although land clearing and grading may be needed depending on the

[30] In limited areas, the onshore cable routes may follow utility rights-of-way (ROWs) or depart from public roadway layouts, particularly at complex crossings.

sites ultimately selected. Ground disturbance associated with Vineyard Mid-Atlantic will be temporary and disturbed areas will be restored to their existing conditions. Construction will be conducted in accordance with soil erosion and sedimentation control plans.

Landfall Sites and Onshore Cable Routes

As further detailed in Section 3.7.1 of COP Volume I, at each landfall site, the offshore export cables are expected to transition onshore using horizontal directional drilling (HDD). HDD at the landfall sites will require a staging area to be located in a parking lot or previously disturbed area. Further detail regarding dimensions and anticipated temporary disturbances associated with the approach pit, exit pit, and staging areas are located in Section 3.7.2 of COP Volume I.

At all potential landfall sites, the expected use of HDD will avoid direct impacts to bird nesting beach habitat. In general, potential landfall sites are located in previously disturbed areas adjacent to the beach areas which likely limit disturbance to beach nesting bird habitat. Given the potential presence of the three federally listed bird species near potential landfall sites, Vineyard Mid-Atlantic will consult with NYSDEC and USFWS prior to construction activities to determine if there are any beach nesting birds in the vicinity of the landfall sites and discuss any appropriate mitigation measures. The Proponent anticipates that onshore construction at the landfall sites in Long Island will occur outside of the period from Memorial Day to Labor Day, further avoiding potential impacts.

The Proponent will work with municipalities to develop the construction schedule and hours in accordance with local ordinances. Certain activities cannot stop once they are initiated, such as conduit pull-in for the HDD work, which may extend work in some circumstances. Disturbed ground and/or infrastructure will be restored to pre-existing conditions following completion.

Although all potential onshore cable routes travel through NYNHP mapped areas of rare plants or rare animals and are in or immediately adjacent to significant natural communities, the onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas) to minimize disturbance to terrestrial wildlife and habitat. The onshore cable routes are approximately 99% co-located with existing roadways and/or utility ROWs. The onshore cables may be installed within a duct bank or installed within directly buried conduit(s). Both HVDC and HVAC onshore cables typically require splices every 152–457 meters (m) (500–1,500 feet [ft]) or more. At each splice location, one or more splice vaults will be installed. The duct bank and splice vaults are expected to be installed in open trenches using conventional construction equipment (e.g., hydraulic excavator, loader, dump trucks, flatbed trucks, crew vehicles, cement delivery trucks, and paving equipment). While one trench will typically be used, two trenches may be needed for portions of the onshore cable routes. The trench dimensions will vary along the onshore cable route (depending on the duct bank layout) but are expected to measure up to approximately 3.4 m (11 ft) in depth, 4.0 m (13 ft) in width at the bottom, and 4.3 m (14 ft) in width at the top. In locations where splice vaults are necessary, the excavated area will be larger (up to approximately 13 m [43 ft] wide, 15 m [50 ft] long, and 6 m [20 ft] deep). Since the splice vaults may be installed anywhere along the onshore cable routes, the maximum extent of disturbance along the entire route is based on the dimensions of the area excavated for splice vaults.

Any pavement will be removed before excavating and shoring the trenches. Minimal tree trimming and/or tree clearing may be needed where the routes follow existing roadway layouts, depending on the final duct bank alignment.[31] Tree trimming, tree clearing, and/or grading may be required to facilitate onshore cable installation in limited areas where the routes depart from the public roadway layout (particularly at complex crossings) and at trenchless crossing staging areas (see Section 3.8.4.3 of COP Volume I). The work, however, will be confined to as narrow a corridor as possible. Excavated material will be hauled away in trucks daily and recycled or disposed of in accordance with state regulations.

Underground trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies). Specific to where the onshore cables traverse tidal wetlands within the Western Bays, the Proponent intends to use multiple trenchless crossings (e.g., HDD, pipe jacking, or direct pipe trenchless drilling) to avoid impacts to these areas.

The Proponent's contractor will identify construction staging areas (i.e., equipment laydown and storage areas) proximate to the onshore cable routes. With the exception of staging areas for trenchless crossings (see Section 3.8.4.3 of COP Volume I), the Proponent anticipates that construction staging areas will either be in paved areas or at locations already utilized for similar activities and are therefore not expected to cause new ground disturbance. Mitigation measures such as erosion and sedimentation controls will be utilized during construction.

No permanent impacts along the onshore cable routes are expected upon completion of construction. Vineyard Mid-Atlantic infrastructure is proposed to be installed entirely underground and any temporarily disturbed areas will be restored. Since there will be little to no habitat disturbance in the Onshore Development Area and there are substantial developed areas directly adjacent to most construction areas, few, if any, impacts to wildlife and wildlife habitat (including inland birds and bird habitats) are expected. Prior to construction activities, the Proponent will consult with state and federal agencies to determine if any listed species are known to be present.

During O&M, periodic maintenance may be required. If onshore cable repairs are required, the cables would typically be accessed through manholes installed at the splice vaults and transition vaults thereby avoiding and minimizing land disturbance.

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[31] Subject to further engineering and consultations with local and state agencies (e.g., New York State Department of Transportation [NYSDOT]).

Onshore Substation Sites and Reactive Compensation Stations

Construction of each onshore substation, and onshore RCS (if used) will include site preparation (e.g., land clearing and grading), installation of the substation equipment and cables, commissioning, and site clean-up and restoration. Temporary fencing and a security gate will be installed around the perimeter of the construction area and temporary erosion control measures will be installed. Land clearing and grading may be needed. Onshore substation sites may require up to approximately 0.06 km^2 (15 acres) of tree clearing and ground disturbance (per site) from grading, excavation, and trenching.[32] Construction of each onshore RCS may require up to ~0.008 km^2 (2 acres) of tree clearing and ground disturbance.[33] Through the permitting process, the Proponent will consult with state and federal agencies to develop appropriate time of year restrictions for tree clearing, if needed. This limited loss of forested habitat during onshore substation construction is unlikely to have population level impacts on wildlife, including inland birds. Prior to construction activities, Vineyard Mid-Atlantic will consult with the state and federal agencies to determine if any listed species are known to be present, and if surveys are needed.

Upon completion of construction of the onshore substation or onshore RCS (if used), a permanent fence will be installed and the disturbed area immediately adjacent and outside of the fence will be restored and revegetated (if required). Visual screening and sound attenuation walls may be installed, if needed. The Proponent will coordinate with local municipalities regarding local ordinances.

Periodic maintenance will likely occur within the fenced perimeter of the onshore substation site and onshore RCS site (if used). During decommissioning, potential impacts are expected to be similar to construction and appropriate environmental protection measures, such as installing erosion and sedimentation controls, will be implemented.

4.1.2.3 Noise

Noise from equipment during construction, O&M, or decommissioning may disturb or temporarily displace nearby wildlife, including inland birds. It is anticipated that any wildlife affected will return once construction activities are complete, as is typically observed. Construction will largely take place in areas that are already impacted by traffic noise and occasional construction. Therefore, impacts are expected to be short-term and localized and are not anticipated to have impacts on wildlife populations.

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32 The actual size of the onshore substation site parcel may be larger than the area cleared and disturbed to accommodate the onshore substation.

33 The actual size of the parcel may be larger than the area cleared and disturbed to accommodate the onshore RCS.

4.1.2.4 Artificial Light

During construction, temporary lighting may be required at work areas, which could cause limited disturbance of wildlife, including inland birds. Lighting during O&M is expected to be minimal and will primarily occur at the onshore substations and onshore RCSs (if used), which will have outdoor lights installed. The majority of lights will only be used on an as-needed basis (e.g., if equipment inspection is needed at night) and when necessary for work crew safety. For security reasons, a few lights at the onshore substations will typically be illuminated on dusk–to-dawn sensors and a few lights will likely be controlled by motion-sensors. Outdoor lighting at the onshore substation sites will typically be equipped with light shields to prevent light from encroaching into adjacent areas, which would minimize the effects of artificial light on wildlife, including inland birds. If onshore RCSs are used, the Proponent will ensure that the outdoor lighting scheme complies with local requirements.

In summary, the majority of artificial lighting will be used in localized areas for specific scenarios and will be lit for short time periods, which will limit disturbance to terrestrial wildlife. Whenever practicable, the Proponent will down-shield lighting or use down-lighting to minimize the effects of artificial light on terrestrial fauna. The Proponent will work with municipalities to ensure any lights installed comply with local ordinances.

4.1.2.5 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to terrestrial habitat and wildlife (including inland birds) during Vineyard Mid-Atlantic are summarized below:

- The Proponent will continue to consult with state and federal agencies regarding listed species.

- The onshore cable routes have been sited primarily within public roadway layouts, and the Proponent intends to prioritize onshore substation sites and onshore RCS sites (if used) in industrial/commercial areas that have been previously disturbed, although land clearing and grading may be needed depending on the sites ultimately selected.

- Onshore cables are expected to be installed entirely underground to minimize disturbance.

- HDD is expected to be used at all landfall sites to avoid or minimize disturbance.

- Underground trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands [including tidal wetlands within the Western Bays], and waterbodies) to avoid impacts to those features.

- Ground disturbances will be temporary and disturbed areas will be restored.

- Whenever practicable, the Proponent will down-shield lighting or use down-lighting to minimize the effects of artificial light on terrestrial fauna.

- Visual screening and sound attenuation walls may be installed, if needed.

- Best management practices for erosion and sedimentation control measures will be utilized during construction.

- The timing of onshore construction activities will be coordinated with state and local agencies. Onshore construction at the landfall sites is planned to occur outside of the period from Memorial Day to Labor Day.

4.2 Coastal and Marine Birds

This section addresses the potential impacts of Vineyard Mid-Atlantic on marine birds and non-marine migratory birds in the Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to coastal and marine birds during the construction, operation, and decommissioning of Vineyard Mid-Atlantic. A detailed analysis is provided in Appendix II-C.

The potential impacts of Vineyard Mid-Atlantic on inland birds in the Onshore Development Area, including at the terrestrial portion of the landfall sites, are discussed in Section 4.1.

4.2.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The avian risk assessment considered the affected environment by analyzing the available data on exposure of birds to the Lease Area (i.e., the extent of overlap between avian distribution and the Lease Area). Exposure was assessed for each species and each taxonomic group, where "exposure" is defined as the extent of overlap between a species' or taxonomic group's seasonal or annual distribution and the Lease Area. The results presented provide a summary of species that may occur in the Lease Area, with exposure scores discussed in the Impacts section (Section 4.2.2). Because the most significant potential impacts to birds are related to presence of structures in the Lease Area, exposure in the rest of the Offshore Development Area (OECC, landfall approaches) was not assessed separately. Detailed methods and results for the avian risk assessment are provided in Appendix II-C.

The data sources used to characterize exposure in the assessment include:

- New York State Energy Research and Development Authority (NYSERDA) Digital Aerial Baseline Survey of Marine Wildlife (NYSERDA surveys; Normandeau Associates and APEM 2021a, b). This dataset consists of 12 quarterly digital aerial surveys flown from 2016-2019 that cover the New York Offshore Planning Area (NYSERDA study area), which is inclusive of the entirety of the Lease Area. NYSERDA's contractors, APEM and Normandeau Associates, conducted the digital aerial surveys from summer 2016 to spring 2019 using strip-transect-based non-overlapping imagery.

- Digital Aerial Wildlife Survey of Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0512 (Lease Area OCS-A 0512 surveys; Normandeau Associates and APEM 2019, 2021c). Following the methods described in the previous bullet, APEM and Normandeau also did a study of BOEM Lease Area OCS-A 0512, plus a 4 kilometer (km) (2.5 miles [mi]) buffer, which overlaps with 45.1% of Lease Area OCS-A 0544. The 24 months of imagery coverage range from 5.1 to 5.9% of Lease Area OCS-A 0544. The surveys were conducted from November 2017–October 2018 and February 2019–December 2019 following a grid-based sampling system.

- Marine-life Data and Analysis Team (MDAT) version 3 marine bird relative density and distribution models (hereafter MDAT models; Winship et al. 2023; Curtice et al. 2019).

- Additional data sources, including individual tracking studies, scientific literature, and records in the Northwest Atlantic Seabird Catalog.

4.2.1.1 Lease Area OCS-A 0544

The Lease Area is 174 square kilometers (km^2) (43,056 acres) in size and lies 38 km (24 mi) south of Fire Island, New York at its shortest distance from land. The Lease Area is situated in the New York Bight, a geographic region of the Mid-Atlantic United States (US) coast that spans a roughly triangular area from Long Island in the northeast, to the Hudson River and Raritan River estuaries in the northwest, to Cape May in the southwest. The seafloor in this region is characterized by a broad expanse of gently sloping, sandy-bottomed continental shelf. Beyond the shelf edge, the continental slope descends rapidly to the deeper Atlantic basin around 2,600 meters (m) (8,530 feet [ft]) below sea level (GEBCO 2021). The Lease Area lies outside core concentration areas of marine birds, which MDAT models predict to mostly occur closer to the Long Island coast and the Hudson/Raritan estuary, with an additional offshore concentration area approximately 15 km (9.3 mi) to the west-northwest (see Figure 4.2-1). The spatial exposure models of the NYSERDA study area mostly concur with the MDAT models in predicting the greatest concentrations of birds closer to the coast than the Lease Area, though in winter this pattern is reversed, and the birds are more dense farther offshore than the Lease Area (see Figure 4.2-2).

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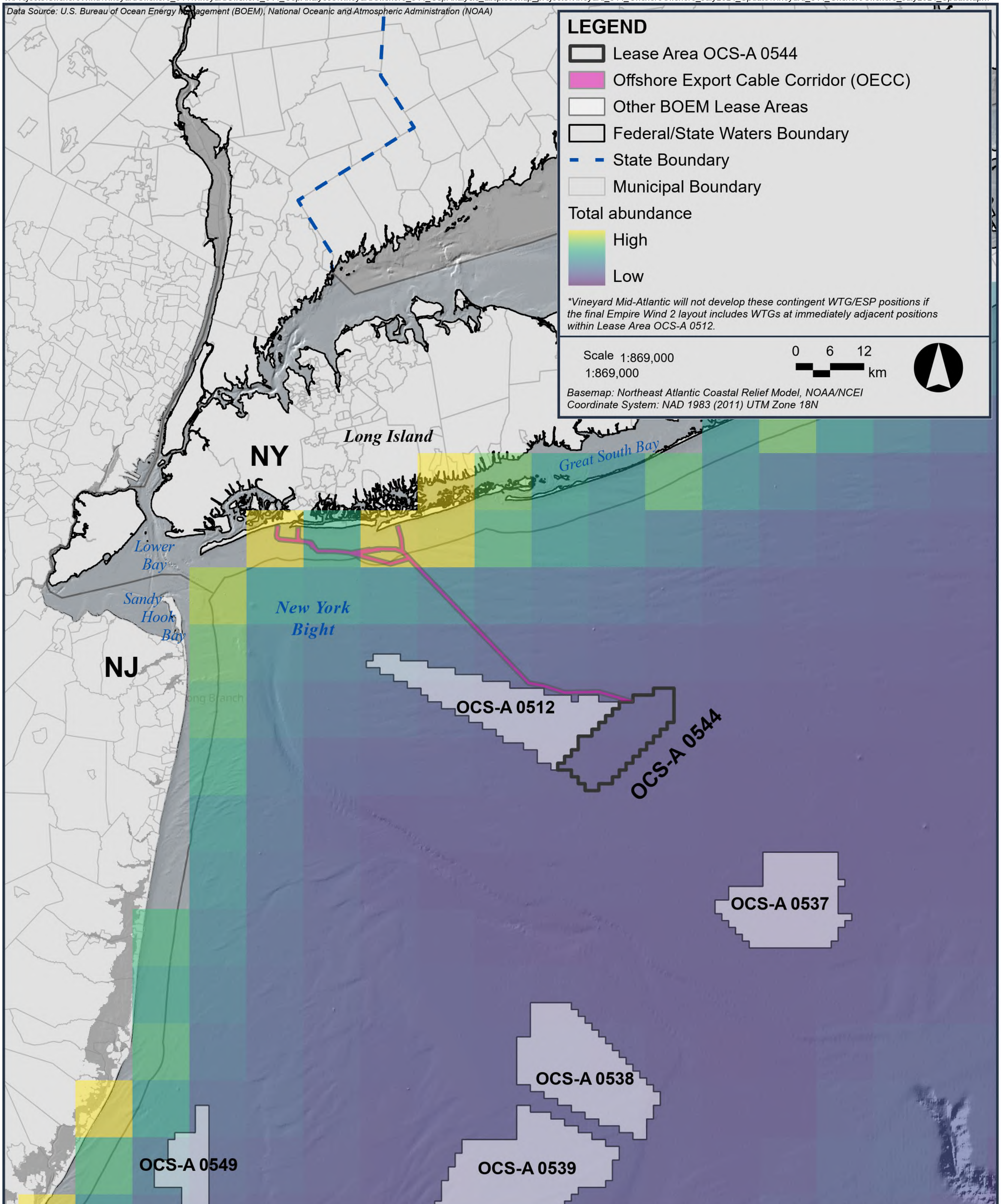

Figure 4.2-1

Total predicted long-term average relative abundance for all MDAT modeled birds

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

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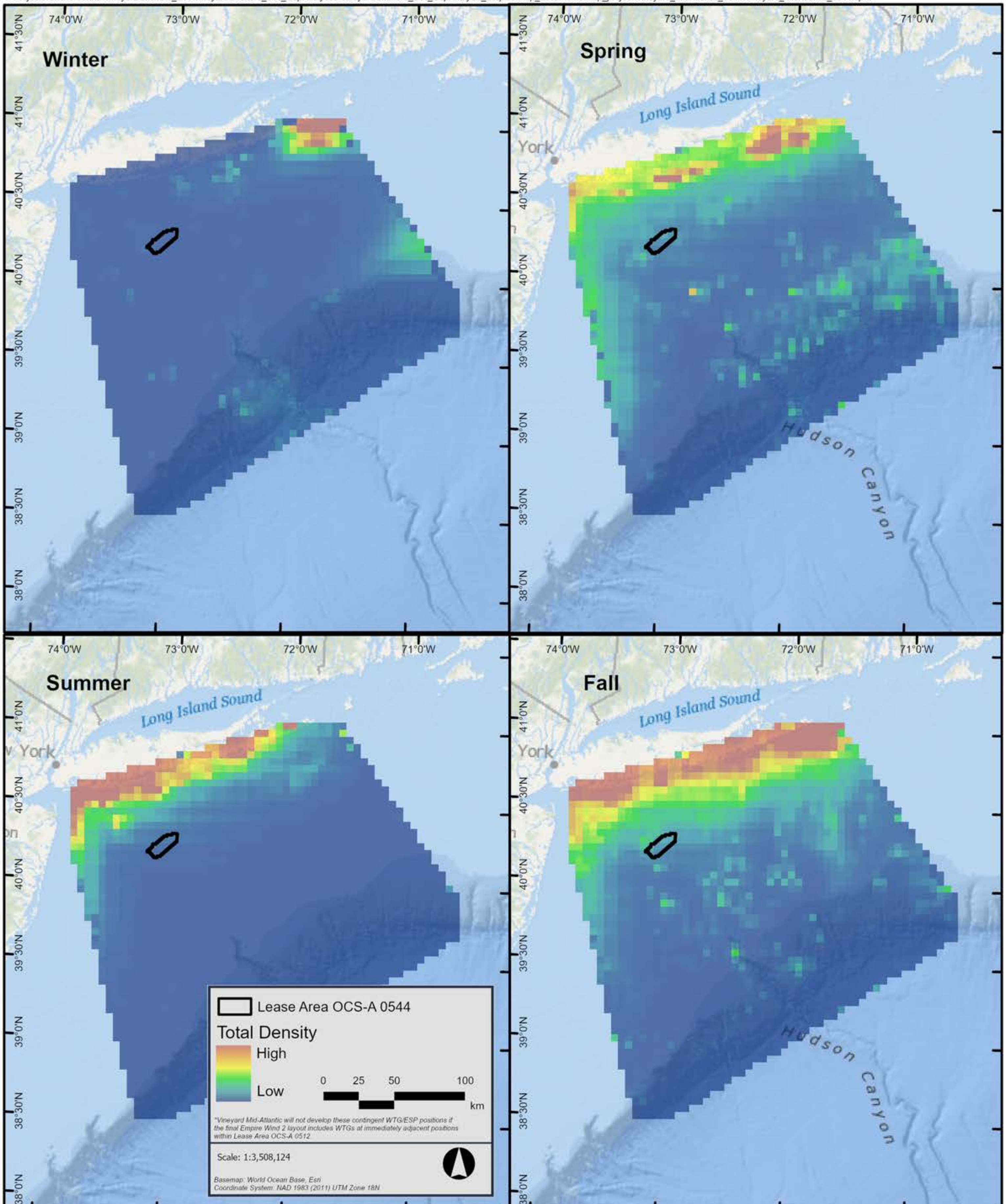

Figure 4.2-2

Modeled APEM digital aerial surveys for all modeled taxa in Lease Area OCS-A 0544

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

A total of 22 bird species were detected in the Lease Area during the NYSERDA surveys and Lease Area OCS-A 0512 surveys (see Table 4.2-1), including sea ducks, phalaropes, auks, gulls, terns, loons, shearwaters, petrels, storm-petrels, and gannets. All the observed species were marine birds, although digital aerial surveys are not designed to detect nocturnal migrants and have difficulty detecting small migratory songbirds and shorebirds. There are four species listed under the Endangered Species Act that may pass through the Lease Area or vicinity: piping plover (*Charadrius m. melodus*), red knot (*Calidris canutus rufa*), roseate tern (*Sterna dougallii*), and black-capped petrel (*Pterodroma hasitata*). Of these four federally listed species, only black-capped petrels were observed in the Lease Area during digital aerial surveys, though roseate terns were observed elsewhere in the larger NYSERDA study area. The Lease Area is 120 km (75 mi) from the nearest roseate tern breeding colony (Great Gull Island, New York), well outside the normal foraging range. The black-capped petrel, listed as *Endangered* under the Endangered Species Act (ESA) as of January 2024, was observed in the Lease Area in summer. A detailed exposure assessment is provided in Appendix II-C and is summarized in Section 4.2.2.

Table 4.2-1 Avian Species[1] Recorded in the Lease Area by Season, with IPaC Results

Species	Scientific Name	Winter	Spring	Summer	Fall	IPaC
Sea Ducks						
Surf scoter	*Melanitta perspicillata*				•	V[2]
Phalaropes						
Red phalarope	*Phalaropus fulicarius*	•			•	
Auks						
Razorbill	*Alca torda*	•				V
Gulls, Jaegers, and Skuas						
Bonaparte's gull	*Chroicocephalus philadelphia*	•	•		•	
Black-legged kittiwake	*Rissa tridactyla*	•	•		•	V
Laughing gull	*Leucophaeus atricilla*	•	•			
Ring-billed gull	*Larus delawarensis*	•	•	•		
Great black-backed gull	*Larus marinus*	•			•	
Herring gull	*Larus argentatus*	•	•		•	
Iceland gull	*Larus glaucoides*	•				
Lesser black-backed gull	*Larus fuscus*		•			
Terns						
Least tern	*Sternula antillarum*	•		•		
Common tern	*Sterna hirundo*	•		•		
Forster's tern	*Sterna forsteri*	•		•		
Loons						
Common loon	*Gavia immer*	•	•		•	V
Red-throated loon	*Gavia stellata*	•	•		•	V

Table 4.2-1 Avian Species[1] Recorded in the Lease Area by Season, with IPaC Results (Continued)

Species	Scientific Name	Winter	Spring	Summer	Fall	IPaC
Shearwaters, Petrels, and Storm-petrels						
Cory's shearwater	*Calonectris diomedea*			•		BCC[3]
Great shearwater	*Ardenna gravis*			•	•	
Sooty shearwater	*Ardenna grisea*			•	•	
Wilson's storm-petrel	*Oceanites oceanicus*			•		V
Black-capped petrel	*Pterodroma hasitata*			•		
Gannets, Cormorants, and Pelicans						
Northern gannet	*Morus bassanus*	•	•		•	

Notes:

1. Species detected in the Lease Area based on the NYSERDA surveys and Lease Area OCS-A 0512 surveys, cross-referenced with results from the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) database query (http://ecos.fws.gov/ipac/).
2. "V" denotes an IPaC designation of "Non-BCC [Bird of Conservation Concern] - Vulnerable" for migratory birds USFWS considers to have potential susceptibilities in offshore areas from certain types of development or activities.
3. "BCC" denotes an IPaC designation of "BCC Rangewide" for migratory birds USFWS considers to be of concern throughout their range anywhere in the US.

4.2.1.2 Offshore Export Cable Corridor

The OECC extends west from the northern portion of the Lease Area and turns northwest toward western Long Island. Near the federal/state waters boundary, the OECC splits into three variations to connect to three potential landfall sites (of which, up to two will be used): the Rockaway Beach Approach, the Atlantic Beach Approach, and the Jones Beach Approach. The Proponent has also identified a "Western Landfall Sites OECC Variant" that may be used for routing offshore export cables to the Rockaway Beach and Atlantic Beach Landfall Sites. Species likely to occur in, or in the vicinity of, the OECC are expected to be similar to the Lease Area, with the potential for occurrence of non-marine birds such as waterfowl, shorebirds, wading birds, raptors, and songbirds as distance to the shore decreases. A portion of the OECC traverses an area mapped as sea duck key habitat (see Figure 4-17 in Appendix II-C; Sea Duck Joint Venture 2022).

4.2.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect coastal and marine birds during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.2-2. IPFs are similar in each development phase but will be temporary and localized during both construction and decommissioning.

Table 4.2-2 Impact Producing Factors for Coastal and Marine Birds

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Presence of Structures: Collision and Displacement	•	•	•
Suspended Sediments and Deposition	•	•	•
Noise	•	•	•
Vessel Activity	•	•	•
Artificial Light	•	•	•

Potential effects to coastal (non-marine migratory) birds and marine birds were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

4.2.2.1 Presence of Structures: Collision and Displacement

The presence of wind turbine generators (WTGs) and electrical service platforms (ESPs) can create a collision and/or displacement hazard for birds. Potential impacts of structures were evaluated by considering how vulnerable species will be exposed (likelihood of occurrence) to IPFs. To be at risk of an impact, a species must be both exposed to a wind farm ***and*** be vulnerable to either displacement or collision (Goodale and Stenhouse 2016). Vulnerability is defined as behavioral factors (e.g., flight height, and avoidance) that increase the likelihood that a bird will either collide with a WTG (or other structure such as an ESP) or be displaced from the Lease Area (Goodale and Stenhouse 2016).

For non-marine migratory species, vulnerability was evaluated based on existing assessments (e.g., Furness et al. 2013), and documented behavioral response to offshore wind farms in the literature. For marine birds, a semi-quantitative scoring process was developed and exposure and relative vulnerability to the operation of Vineyard Mid-Atlantic was determined. The determination was based on the maximum WTG dimensions (tip height and rotor diameter) and the minimum tip clearance (aka air gap) under consideration. Details on the methods for this assessment are provided in Appendix II-C. A summary of the exposure and vulnerability results is provided below for each major taxonomic group of birds. Please see Appendix II-C for the complete description of the results.

<u>**Non-Marine Migratory Birds**</u>

- *Grebes and Waterfowl:* Exposure for this group is expected to be minimal. The digital aerial surveys did not detect any members of this group in the Lease Area, and there were very few observations of this group across the entire NYSERDA study area. The literature indicates that grebes and waterfowl spend most of the year in freshwater aquatic systems and near-shore marine systems, breed in freshwater wetlands, and are unlikely to extensively use areas as far offshore as the Lease Area. Collision risk and displacement risk were both minimal, based on the minimal exposure of this group.

- *Shorebirds:* Shorebirds are expected to have minimal to low exposure to the Lease Area. They mostly use nearshore areas, though they undertake migratory flights that may cross the outer continental shelf. There is considerable uncertainty about shorebird offshore migratory patterns, and they are difficult to detect in digital aerial surveys. Model-estimated shorebird flight altitudes of non-stop flights over Federal waters ranged (5–95%) from 28–2,940 m (92-9,646 ft), with a mean of 914 m (2,999 ft) in spring, and 545 m (1,788 ft) in fall (Loring et al. 2021). Most of these flights occur high above the rotor swept zone (RSZ), leading to reduced collision risk, though other recent studies show that at least some related shorebird species in Europe may fly lower while migrating over the sea (Schwemmer et al. 2023). Because shorebirds do not use the offshore environment as a primary foraging habitat, displacement is less of a concern. Collision risk is minimal to low and displacement risk is minimal for this group. Two ESA-listed shorebirds were assessed separately (red knot and piping plover) and the results are summarized below.
    - *Red knot*: Exposure is expected to be minimal to low and was assessed using only species accounts, literature, and the results of tracking studies, as no detections of red knots exist in Northwest Atlantic Seabird Catalog in the vicinity of the New York Bight region or occurred during the NYSERDA surveys or Lease Area OCS-A 0512 surveys, although these surveys are not designed to detect nocturnal migrants. Overall, there is no habitat for the species in the Lease Area, and exposure will be limited to migration. During their northbound spring migration, tagged birds have generally been tracked departing the US Atlantic Coast and heading overland on a northwest trajectory to their breeding grounds (Pelton et al. 2022, Loring et al. 2021, Smith et al. 2023a). As such, any exposure to the Lease Area is much more likely to occur during southbound fall migrations. In a NanoTag tracking study, Loring et al. (2018) fitted 388 red knots with very high frequency (VHF) transmitters during fall migration at stopover sites in Canada, Massachusetts, and New Jersey. Over half of red knots tagged in Massachusetts and New Jersey passed through federal waters of the Atlantic outer continental shelf (OCS), and 11% were exposed to one or more BOEM wind energy areas (Loring et al. 2018), but only one is estimated to have passed through the Lease Area (see Appendix II-C). Most tracked flights in the wind energy areas occurred between 20 and 200 m (65-656 feet [ft]), with a mean of 106 m (348 ft), though a large error range of 100-200 m (328-656 ft) was noted (Loring et al. 2018). The study noted that its use of land-based Motus receivers with a range of roughly 20-80 km (12-50 mi), depending on flight height, meant incomplete coverage offshore, particularly for low-altitude flights. Red knots likely adjust their altitudes to take advantage of local weather conditions, including flying at lower altitudes in headwinds (Baker et al. 2020) or during periods of poor weather and

high winds (Burger et al. 2011). Because their feeding habitat is close to the coast and not offshore (Burger et al. 2011), any avoidance behavior is not likely to lead to habitat loss. Collision risk is minimal to low and displacement risk is minimal.

  - *Piping plover*: Exposure of piping plovers to the Lease Area is expected to be low. There were no detections of piping plovers in the digital aerial surveys, though shorebirds of this size are difficult to detect with this method. Overall, there is no habitat for the species in the Lease Area, and any exposure will be limited to migration. A NanoTag tracking study with land-based VHF Motus receivers showed that three tagged piping plovers may have passed through the Lease Area based on estimated tracklines (see Appendix II-C; Loring et al. 2019), though the study noted the incomplete coverage of the Atlantic OCS by the land-based receivers. Flight heights were modeled and estimated over BOEM wind energy areas in the Atlantic OCS in this study, with a mean flight height of 317 m (1,040 ft; Loring et al. 2019), which falls within Vineyard Mid-Atlantic's RSZ. As noted for shorebirds generally, flight heights can vary with weather, and during periods of poor visibility, piping plovers may fly lower (Loring et al. 2019, Loring et al. 2021, Dirksen et al. 2000 in Loring et al. 2019). Piping plovers would not be displaced during breeding or migratory staging because the Lease Area provides no habitat for the species during these life history stages. Collision risk is low, and displacement risk is minimal.

- *Wading Birds*: Wading bird exposure is expected to be minimal to low. There were no observations of species in this group within the Lease Area, and there were only three total observations of great blue herons (*Ardea herodias*) in the entire NYSERDA study area. The available tracking data indicate that migrating great blue herons do traverse the New York Bight in the vicinity of the Lease Area over the Atlantic OCS (see Figure 4-5 in Appendix II-C; Brzorad 2023), but the lack of detections in surveys suggests that exposure on these migratory flights will be infrequent. Birds migrating offshore may fly at higher altitudes to take advantage of favorable tail winds. For example, herons tracked via radar migrating over the Strait of Messina in southern Italy had mean flight heights of 821 meters (2,694 feet; Mateos-Rodríguez and Liechti 2012), well above the RSZ. Flight height data from a tracking study indicates that migrating great blue herons may have the potential to fly within the RSZ when flying over the Atlantic OCS (Dolinski 2019; see Appendix II-C). Records of wading birds colliding with WTGs at terrestrial wind farms are very uncommon (Skov et al. 2018). Displacement of wading birds is not a concern as the offshore environment is not providing primary foraging habitat. Collision risk is minimal to low and displacement risk is minimal.

- *Raptors*: The raptors group is expected to have minimal to low exposure to the Lease Area. There were no observations of species in this group within the Lease Area and only one observation in the entire NYSERDA study area (an osprey [*Pandion haliaetus*]). The literature indicates that the species in this group are unlikely to extensively use offshore areas, but some may pass through on migratory flights. Available tracking data indicate that osprey, merlins, and peregrine falcons may occasionally use offshore areas in the vicinity of the Lease Area (see Appendix II-C). Falcons may be attracted to WTGs as perching sites, and peregrine falcons and kestrels have been observed landing on the platform deck of offshore WTGs (Hill et al. 2014; Skov et al. 2016). Peregrine falcon fatalities have not been documented at European offshore wind projects, such as during the monitoring effort at the Thanet Offshore Wind Farm (Skov et al. 2018). Observations of raptors at the Anholt Offshore Wind Farm in the Baltic Sea (20 km [12.4 mi] from the coast) indicate macro-avoidance behavior (i.e., avoiding entire wind farm) (13–59% of birds observed depending on the species), which has the potential to cause a barrier for migrants in some locations, but may also reduce collision risk. Collision risk and displacement risk are minimal to low for raptors. One species federally protected by the Bald and Golden Eagle Protection Act, the bald eagle, was assessed separately and the results are summarized below.

  - *Bald eagle*: Exposure of the bald eagle is expected to be minimal. There are no detections of bald eagles in the Lease Area in digital aerial surveys. Species accounts support a minimal exposure determination, as the offshore area is not located along any likely or known migration routes, individuals tend not to fly over large water bodies, and features that might potentially attract them offshore (i.e., islands) are absent nearby. During migration movements, bald eagles generally rely on thermals, which are poorly developed over the ocean. Collision risk and displacement risk were not assessed for bald eagles due to their infrequent occurrence in offshore waters.

- *Songbirds*: Songbirds are expected to have minimal to low exposure to the Lease Area. The literature indicates that songbirds do not use the outer continental shelf as habitat, but they may pass through during migratory flights. There is considerable uncertainty around the timing and location of these migratory flights, and songbirds are difficult to detect in digital aerial surveys. Fatalities of songbirds have been documented at terrestrial WTGs (Erickson et al. 2014; Choi et al. 2020). Songbirds may be able to avoid colliding with offshore WTGs (Petersen and Maim 2006) but are known to collide with illuminated terrestrial and marine structures (Fox et al. 2006). Species accounts in the literature indicate that songbirds do not use the Atlantic OCS as habitat, so there is little concern about displacement from foraging or other habitat uses. Collision risk and displacement risk are minimal to low.

Marine Birds

- *Sea Ducks*: Exposure for sea ducks is expected to be minimal. While the OECC crosses through an area mapped as a Key Habitat Site, the Lease Area does not overlap with Key Habitat Sites identified by the Sea Duck Joint Venture (Sea Duck Joint Venture 2022). Tracking data indicate that some species may infrequently use offshore areas in the vicinity of the Lease Area during spring and fall migration. Within the Lease Area, only surf scoters were observed, and only during fall. Tracking data indicates that core use areas for the majority of this taxa group are inshore of the Lease Area. MDAT model predictions showed surf scoters (*Melanitta perspicillata*) present within the Lease Area in spring; generally, the remaining species were all inshore of the Lease Area. Sea ducks are generally not considered vulnerable to collision (Furness et al. 2013) because they primarily fly below the RSZ and have strong avoidance behavior. Sea ducks are considered vulnerable to displacement (Furness et al. 2013), which can lead to effective habitat loss (Petersen and Fox 2007; Percival 2010; Langston 2013). However, avoidance of individual wind energy facilities is not expected to significantly increase energy expenditure (Masden 2019). Collision risk and displacement risk are minimal.

- *Phalaropes*: Phalaropes are expected to have minimal exposure to the Lease Area. Though taxonomically they are shorebirds, phalaropes spend much of their life history in marine environments. Digital aerial surveys detected phalaropes in the Lease Area during the winter and fall, but at much lower densities than observed in the broader NYSERDA study area. While little is known regarding how phalaropes will respond to offshore wind turbines, their low flight height limits their vulnerability to collision. Their vulnerability to displacement is not well studied and is under high uncertainty. Collision risk and displacement risk are minimal despite the uncertainty about their vulnerability to collision and vulnerability, due to phalaropes' minimal exposure.

- *Auks*: Auks are expected to have low exposure to the Lease Area. Unidentified alcids were frequently observed in the Lease Area in winter and spring. While auks were among the most abundant species observed in the Lease Area, their density was significantly higher elsewhere in the NYSERDA study area. Auks are expected to have limited behavioral vulnerability to collision, based on the available flight height data from the Northwest Atlantic Seabird Catalog, which indicate that auks fly low near the sea surface, and below the RSZ. Auks are expected to be vulnerable to displacement, due to their sensitivity to disturbance and documented avoidance of offshore wind farms (Dierschke et al. 2016, Furness et al. 2013, Wade et al. 2016), but their minimal exposure prevents most displacement risk. Collision risk is minimal and displacement risk is low.

- *Gulls, Skuas, and Jaegers:* Gulls, skuas, and jaegers are expected to have minimal to low exposure. During digital aerial surveys, gulls were the most commonly observed species within the Lease Area. Gulls were most prominent during the winter, spring, and fall. Bonaparte's gull (*Chroicocephalus philadelphia*) and black-legged kittiwake (*Rissa tridactyla*) were among the most frequently observed gulls. Gulls, jaegers, and skuas rank at the top of collision vulnerability assessments because they can fly within the RSZ (Johnston et al. 2014), have a documented attraction to WTGs (Vanermen et al. 2015), and have been documented to collide with WTGs (Skov et al. 2018). However, many recent studies have documented meso-avoidance and micro-avoidance behavior among gulls that indicates a lower collision risk than previously thought (Vanermen et al. 2019, Green et al. 2023, Tjørnløv et al. 2023). Collision risk and displacement risk are minimal to low.

- *Terns:* Exposure for terns is expected to be minimal. Terns were infrequently detected in the Lease Area by digital aerial surveys during most of the year, though they were more frequently detected in spring – especially medium terns. Radio telemetry tracking data for common terns (*Sterna hirundo*) indicates that this species is unlikely to use offshore areas in the vicinity of the Lease Area during spring and fall migration periods, though the study noted its use of land-based Motus receivers with incomplete coverage of the Atlantic OCS (Loring et al. 2019). As a group, terns are expected to have low behavioral vulnerability to collision. For the WTGs under consideration, the available flight height data shows that terns were estimated to fly in the RSZ 4% of the time. Displacement in terns has not been well studied, but the available information supports a low to medium displacement risk because terns have been shown to have a 76% lower abundance inside offshore wind farms and are estimated to start avoidance behaviors at a distance of 1.5 km (0.93 mi; Welcker and Nehls 2016). Collision risk and displacement risk are minimal. One ESA-listed tern, the roseate tern, was assessed separately and the results are summarized below.
  - *Roseate tern*: Roseate terns are expected to have minimal to low exposure to the Lease Area. The northwest Atlantic Ocean population of roseate terns has been federally listed as endangered since 1987. None were detected in the Lease Area, but they were observed elsewhere in the larger NYSERDA study area. Because the nearest breeding colony, Great Gull Island, is 120 km (75 mi) away from the Lease Area at the closest point, roseate terns would only potentially be exposed to the Lease Area during fall and spring migration periods. During migration, few roseate terns are predicted to occur within the Lease Area according to the regional MDAT models. The models show that roseate terns are generally concentrated closer to shore during spring migration and have low exposure in the New York Bight during the summer and fall. The Loring et al. (2019) radio telemetry tracking study referenced above for common terns also studied roseate terns (n=145) and found that they are unlikely to pass through the Lease Area, although one modeled flight path passed near the Lease Area's northwest boundary (again with the caveat of land-based Motus receivers and poor offshore coverage). Little information is available specifically about roseate tern vulnerability, but, based on similarities between this species and common terns, they are expected to be vulnerable to displacement. Collision risk and displacement risk are low.
- *Loons*: Loon exposure to the Lease Area is expected to be low. In the digital aerial surveys, common loons and red-throated loons were frequently observed in the Lease Area in all seasons except summer, but their density was lower than surrounding areas. Tracking data for red-throated loons (Gray et al. 2017) indicates that this species, which

breeds in freshwater habitats in summer and migrates to and from coastal wintering habitats, is only likely to pass through the Lease Area and vicinity during spring migration periods and stays closer to shore during fall migration. There is strong evidence in the literature that the pronounced avoidance response among loons precludes their vulnerability to collision with WTGs (Furness et al. 2013). On the other hand, their strong avoidance means that loons are the most vulnerable group to displacement. In a recent North Sea study, red-throated loon distribution and abundance shifted dramatically after offshore wind construction, with fewer birds in the study area; those that remained were aggregating far from the five offshore wind farms (Garthe et al. 2023). Collision risk is minimal to low and displacement risk is low.

- *Shearwaters, Petrels, and Storm-Petrels*: Exposure of shearwaters, petrels, and storm-petrels is expected to be minimal. During digital aerial surveys, storm-petrels and shearwaters were among the most abundant species during summer. Flight height data from Northwest Atlantic Seabird Catalog indicate that the birds in this group are nearly always observed flying low to the sea surface, with shearwaters and petrels only in the RSZ 0.1% of the time and storm-petrels only 0.04% of the time. Interactions with offshore wind farms have not been well studied in this species group. There is some evidence that lighting may attract this group, as some species forage at night on vertically migrating bioluminescent aquatic prey and are instinctively attracted to artificial light sources (Imber 1975; Montevecchi 2006). A recent report for the Scottish Government (Deakin et al. 2022) thoroughly reviewed the available literature on lighting attraction among members of this group; it is clear that powerful light can disorient these birds (especially fledglings in foggy conditions) and cause them to circle light sources, but the evidence on the existence and strength of light attraction is inconclusive. The distance of the Lease Area from shore and the nearest breeding colonies (Leach's Storm-Petrel colonies in the Gulf of Maine) ensures that such an event would be exceedingly unlikely. Collision risk and displacement risk are minimal.

    - *Black-capped petrel*: Exposure of black-capped petrels is expected to be minimal. In digital aerial surveys, there were only scattered, infrequent detections of this species, which breeds on Caribbean islands and is expected to range as far north as the New York Bight only occasionally. This species is known to collide with lighted telecommunication towers on breeding islands (Goetz et al. 2012). This behavior could make black-capped petrels vulnerable to collision with lighted offshore vessels and structures (Jodice et al. 2021), though it is uncertain whether or how strongly related species are attracted to artificial light (Deakin et al. 2022). The highly pelagic nature of this species and its near absence from continental shelf waters of the southeastern US led Simons et al. (2013) to conclude it unlikely that wind farms will be detrimental to this species. Collision risk and displacement risk are minimal.

- *Gannets*: Exposure to the Lease Area is expected to be low. Northern gannets (*Morus bassanus*) were among the most frequently observed species in the Lease Area and in the larger NYSERDA study area in digital aerial surveys, and their density was low relative to the surrounding areas. Satellite tracking data (Gray et al. 2016) indicates that northern gannets are likely to use areas within the Lease Area during winter as well as spring and fall migration periods, but the Lease Area lies outside core use (>50% use) areas (see Appendix II-C). During digital aerial surveys, northern gannets were observed in the Lease Area in all seasons except summer and were among the most common bird species during both winter and spring. Flight height data from the Northwest Atlantic Seabird Catalog indicate that northern gannets fly in the proposed RSZ 17% of the time. While northern gannets have been ranked more vulnerable to collision risk by some studies (Furness et al. 2013; Garthe et al. 2014; Cleasby et al. 2015), many studies indicate that they avoid wind farms (Hartman et al. 2012; Garthe et al. 2014; Vanermen et al. 2015). A recent study offshore of Aberdeen, Scotland (Tjørnløv et al. 2023) extensively studied flight behavior of northern gannets (as well as four gull species). Though northern gannets were documented flying through the wind farm, they showed strong avoidance behavior close to spinning turbine blades, and in 10,000 bird videos and over 3,000 combined video-radar tracks, there were no collisions or even near misses (Tjørnløv et al. 2023). Collision risk and displacement risk are low.

- *Cormorants and Pelicans*: This group is expected to have minimal exposure to the Lease Area. During digital aerial surveys, no cormorants or pelicans were observed within the Lease Area. Regionally, cormorants are observed most frequently during the summer and fall months. The available flight height data from the Northwest Atlantic Seabird Catalog indicate that cormorants fly in the RSZ 36% of the time and pelicans 8% of the time. Cormorants have been documented to be attracted to WTGs because of an increase in food resources and newly available loafing habitat (i.e., perching areas; Krijgsveld et al. 2011; Lindeboom et al. 2011). The double-crested cormorant (*Phalacrocorax auritus*) is expected to have some behavioral vulnerability to collision because they can fly within the RSZ, but low vulnerability to displacement. The brown pelican (*Pelecanus occidentalis*) is expected to have medium displacement vulnerability, largely driven by their low habitat flexibility. Collision risk and displacement risk are minimal.

Overall, coastal and marine birds are expected to have a range of exposure and behavioral vulnerability. For all groups and species, collision risk and displacement risk are minimal, minimal to low, or low. Exposure of federally listed species is expected to be limited. To further minimize risk, and to the extent practical and in accordance with health and safety requirements, the Proponent will evaluate the feasibility of installing bird deterrents at WTGs and ESPs that have been identified as having high use by birds.

4.2.2.2 Suspended Sediments and Deposition

Offshore export cable installation will generate minimal suspended sediments that will be temporary and localized. For foraging marine birds, the suspended sediments could temporarily inhibit detecting prey in the bottom few meters of the water column and could locally displace prey. However, water quality is expected to return to prior conditions within a few hours, minimizing effects to prey (see Sections 4.5.2 and 4.6.2 for more details). Therefore, any effects are expected to be temporary, and, if displaced by cable installation activities, birds will likely only need to fly a short distance to alternate foraging locations to find prey. There may be short-term disturbance of resident birds during construction (Fox and Petersen 2019), but birds that are initially disturbed by cable installation will likely return to the area after construction activities are completed. While the OECC will pass through roughly 50 km (31 mi) of mapped key habitat for sea ducks (see Appendix II-C), the temporary effects of sediment suspension and deposition will quickly abate. Overall, bird exposure to construction IPFs will be ephemeral and limited, especially in the Lease Area, which is located far offshore. In summary, suspended sediments and deposition are unlikely to pose population-level risk for any species because the IPF will be temporary and localized.

4.2.2.3 Noise

Noise from pile driving during construction may cause birds to avoid the construction area and can disturb the local prey base. When pile driving occurs close to tern colonies (within 2 km [1.24 mi]), pile driving noise may disperse the local abundance of prey fish (e.g., herring). The decreased abundance of prey can reduce seabird foraging success and may cause reduced reproductive success for multiple years (Perrow et al. 2011). However, the footprint of any displacement (should it occur) is small for each piling event compared to available habitat, and the Lease Area is much farther than 2 km (1.24 mi) from the nearest breeding bird colonies. Any short-term disruption in the prey base would be expected to recover completely once construction is completed. The Biological Assessment for Vineyard Wind 1 found that impacts from pile driving and noise related to construction would be "insignificant and discountable" (BOEM 2019). It is unknown how temporary noise from offshore wind construction and operations and maintenance may affect marine bird behavior both above the water and underwater, but one study found sensitive hearing thresholds in one auk species related to auks in the northeast US Atlantic coast (Smith et al. 2023b). In summary, noise is unlikely to pose population-level risk for any species because the IPF will be largely limited to construction and will be temporary and localized.

4.2.2.4 Vessel Activity

During construction, coastal and marine birds may encounter installation vessels within the Lease Area or along the OECC, but such exposure in any given location will be limited to a finite temporal and ephemeral period. While birds may encounter construction equipment during migration and may land on vessels, mortality from collision is unlikely.

During O&M, regular vessel trips to the Lease Area are expected as part of planned maintenance or periodic repairs for the WTGs and ESPs. Helicopters may also be used. Less frequent vessel trips may also be required for any needed maintenance of the offshore export cables.

Marine bird species vary in their reactions to operational WTGs and the associated vessel and helicopter traffic that may be required during maintenance and repair activities (Fox and Petersen 2019). Increased vessel traffic has the potential to affect distributions of birds foraging in the immediate area (Fox et al. 2006; Furness et al. 2013). Gulls and cormorants may be attracted to and perch on construction equipment. In contrast, some marine birds (e.g., sea ducks and loons) may be disturbed by vessels, equipment, and activities, which may lead to temporary displacement from cable installation and wind farm construction areas (MMS 2007). However, sea ducks have been shown to return to areas with repeated boat traffic (Ramírez-garofalo 2020), and vessel traffic is unlikely to cause long-term habitat loss. In summary, vessel traffic is unlikely to pose population-level risk for any species.

4.2.2.5 Artificial Light

Artificial light on vessels, construction equipment, WTGs, and ESPs can attract birds and increase collision risk, as discussed above. For songbirds, movement during low visibility periods creates the highest collision risk conditions; at an offshore research station with substantial lighting, songbird mortalities have been documented during poor weather conditions (Hüppop et al. 2006). Evidence of nocturnal soaring, perching, and feeding under lighted structures in terrestrial and offshore settings has been noted in peregrine falcons (Cochran 1985; Johnson et al. 2011; Kettel et al. 2016; Voous 1961), and these behaviors increase the exposure risk in this species.

Certain marine birds are known to be attracted to offshore vessels and structures, especially when brightly lit (Montevecchi 2006; Wiese et al. 2001). This response may be particularly activated by artificial lighting during periods of poor visibility, when collision risk is likely to be highest. However, there is little data on avian behavior in the marine environment during such periods, as surveys are generally limited to periods of good weather during daylight hours. As noted above in relation to the presence of structures, shearwaters, petrels, and storm-petrels are known to forage on vertically migrating bioluminescent prey and are instinctively attracted to light sources of any kind (Imber 1975), but the existence and strength of attraction from distance is very uncertain, and the risks are thought to be mainly to fledgling birds close to breeding colonies in poor visibility conditions (Deakin et al. 2022).

The WTGs and ESP(s) will require lighting that complies with Federal Aviation Administration (FAA), US Coast Guard (USCG), BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) guidelines. While potential for colliding with lit structures in the marine environment may increase if there is substantial lighting (e.g., Hüppop et al. 2006), Vineyard Mid-Atlantic will minimize lighting by using best management practices and an Aircraft Detection Lighting System (ADLS) or similar system that automatically activates all aviation obstruction lights when aircraft approach the structures, subject to BOEM and FAA approval. The use of an ADLS would substantially reduce the amount of time that the aviation obstruction lights are illuminated (see Section 4.1.5 of COP Volume I). Down-lighting and down-shielding lighting will be used to minimize upward illumination where practicable, such as at offshore ESPs and/or for marine navigation lights if approved by USCG. In summary, lighting is unlikely to pose population-level risk for any species because Vineyard Mid-Atlantic will reduce lighting to the maximum extent practicable, which will alleviate any increased risk of collision.

4.2.2.6 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to non-marine migratory birds and marine birds during construction, operation and maintenance, and decommissioning Vineyard Mid-Atlantic are summarized below:

- The location of the Vineyard Mid-Atlantic WTGs far offshore largely avoids exposure to non-marine migratory birds.
- The Proponent will minimize lighting to the extent practicable by using best management practices and adhering to USCG, FAA, and BOEM guidance.
- The Proponent will use an ADLS or similar system that automatically activates all aviation obstruction lights when aircraft approach the Lease Area, subject to BOEM and FAA approval.
- The Proponent will develop a framework for a post-construction monitoring program for birds to contribute to the understanding of how birds will interact with offshore wind activities, with particular attention to reducing key uncertainties in exposure and vulnerability (see Appendix II-C for a detailed discussion of uncertainty).
- The Proponent will document any dead or injured birds found on vessels and structures during O&M.
- To the extent practical and in accordance with health and safety requirements, the Proponent will evaluate the feasibility of installing bird deterrents at WTGs and ESPs that have been identified as having high use by birds.

4.3 Bats

This section addresses the potential impacts of Vineyard Mid-Atlantic on bats in the Offshore Development Area and Onshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to bats during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

4.3.1 Description of Affected Environment

The Offshore Development Area (see Section 4 of Appendix II-C) is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader surrounding region that could be affected by Vineyard Mid-Atlantic activities. At its closest point, the 174 square kilometer (km^2 [43,056 acre]) Lease Area (and nearest wind turbine generator [WTG]/electrical service platform [ESP] position) is approximately 38 kilometers (km) (24 miles [mi]) south of Fire Island, New York.

The Onshore Development Area consists of the landfall site(s), onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The methods used to assess the affected environment and potential impacts of Vineyard Mid-Atlantic on bats include scientific literature review, bat natural history, and state-specific resources on known maternity roosts and hibernacula of listed species.

4.3.1.1 Overview of Bat Species in New York

There are nine species of bats known to be present in New York, six of which are year-round residents (Table 4.3-1). Three of these bat species are federally listed or proposed for listing under the Endangered Species Act (ESA). The Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*) are currently federally listed as endangered (USFWS 2022a), and the tricolored bat (*Perimyotis subflavus*) is proposed for listing (USFWS 2022b). Of these three, only the northern long-eared bat and tricolored bat have the potential to occur in the vicinity of the Onshore Development Area and/or Offshore Development Area.

Bat species can be categorized into two major groups based on their wintering strategy: cave-hibernating bats and migratory tree bats. Both groups of bats are nocturnal insectivores that use a variety of forested and open habitats for foraging during the summer. Cave-hibernating bats generally exhibit lower activity in the offshore environment than migratory tree bats (Sjollema et al. 2014). These species hibernate in caves, mines, and other structures, and feed primarily on insects in terrestrial and freshwater habitats in the same region as their hibernacula. Their movements occur primarily during the fall. The presence of the fungal disease white-nose syndrome (WNS) in hibernacula has caused high mortality among cave-hibernating bats and led to the northern long-eared bat being listed as threatened under the ESA, and as discussed below, the proposed listing of tricolored bat. Migratory tree bats, rather than hibernating in the winter months, fly to southern parts of the United States (US). Eastern red bats (*Lasiurus borealis*) may exhibit shoreline migration (Cryan 2003; Hatch et al. 2013; True et al. 2021). Targeted surveys, for example, have observed this species up to 41.8 km (26 mi) off the coast of New Jersey, Delaware, and Virginia (Hatch et al. 2013).

Every bat species in New York has the potential to utilize the Vineyard Mid-Atlantic Onshore and Offshore Development Areas actively or inadvertently. Exposure of cave-hibernating and migratory tree bats to the specific activities and facilities within the Lease Area is assessed below. The northern long-eared bat is discussed separately in this section because it is a federally listed species.

Table 4.3-1 Bat Species Present in New York, Type, and Conservation Status

Common Name	Scientific Name	Type[3]	New York State Status[1]	Federal Status[1]
Eastern small-footed bat	*Myotis leibii*	Cave-hibernating bat	SC	-
Little brown bat	*Myotis lucifugus*	Cave-hibernating bat	SGCN	-
Northern long-eared bat	*Myotis septentrionalis*	Cave-hibernating bat	E	E
Indiana bat[2]	*Myotis sodalis*	Cave-hibernating bat	E	E
Tricolored bat	*Perimyotis subflavus*	Cave-hibernating bat	SGCN	P
Big brown bat	*Eptesicus fuscus*	Cave-hibernating bat	-	-
Eastern red bat	*Lasiurus borealis*	Migratory Tree Bat	-	-
Hoary bat	*Lasiurus cinereus*	Migratory Tree Bat	-	-
Silver-haired bat	*Lasionycteris noctivagans*	Migratory Tree Bat	-	-

Notes:

1. E = Endangered; T = Threatened; SGCN = Species of Greatest Conservation Need; SC = Special Concern; *P* = Proposed for Federal Listing.
2. Range does not indicate presence in Onshore or Offshore Development Areas.
3. "Type" refers to two major life history strategies among bats in eastern North America; cave-hibernating bats roost in large numbers in caves during the winter, while migratory tree bats do not aggregate in caves and are known to migrate considerable distances.

Federally Listed Species

As shown in Table 4.3-1 above, two federally-listed bat species are present in New York – the northern long-eared bat and the Indiana bat – and one species proposed for listing, the tricolored bat. Of these three, only the northern long-eared bat and tricolored bat are found in the vicinity of the Onshore Development Area and Offshore Development Area. There were no records of Indiana bats in the United States Fish and Wildlife Service (USFWS) information for planning and consultation (IPaC) database for the Onshore Development Area. There are eight known winter hibernacula containing Indiana bats in New York; these occur in Albany, Essex, Warren, Jefferson, Onondaga, and Ulster counties (NYSDEC 2019a). The summer range of Indiana bats likely includes a wider area outside these counties, but the species has never been recorded on Long Island and thus its expected range does not include Long Island. Thus, this assessment will focus solely on the potential exposure of northern long-eared bat and tricolored bat to Vineyard Mid-Atlantic's onshore and offshore activities.

Northern Long-Eared Bat

The northern long-eared bat, like other cave-hibernating bats, is an insectivorous bat that hibernates in caves, mines, and other locations (e.g., possibly talus slopes) in winter and spends the remainder of the year in forested habitats. During the summer, northern long-eared bats roost under tree bark and in cavities and crevices of live and dead trees (Sasse and Perkins 1996; Foster and Kurta 1999; Owen et al. 2001; Perry and Thill 2007). Anthropogenic structures will also occasionally be used for roosting (Amelon and Burhans 2006; Timpone et al. 2010).

Most foraging activity takes place between the understory and forest canopy, typically up to 3 meters (m) (10 feet [ft]) off the ground (Brack and Whitaker 2001). Foraging occurs within a few kilometers of roost sites (Broders et al. 2006; Henderson and Broders 2008; Lacki et al. 2009; Timpone et al. 2010), and roost locations are frequently relocated every two to three days (Foster and Kurta 1999; Owen et al. 2001; Carter and Feldhamer 2005; Timpone et al. 2010). The species' range includes most of the eastern and mid-western US and southern Canada. Due to impacts from WNS, the species has declined by 90–100% in most locations where the disease has occurred, and declines are expected to continue as the disease spreads throughout the remainder of the species' range (USFWS 2016).

The northern long-eared bat is active from March to November (Menzel et al. 2002, Brooks and Ford 2005). At summer roosting locations, the northern long-eared bat forms maternity colonies (aggregations of females and juveniles) where females give birth to young in mid-June. Roosting tree selection is variable and the size of tree and canopy cover changes with reproductive stage (USFWS 2016). The bats are born flightless and remain so until mid-July (Carter and Feldhamer 2005). Adult females and volant juveniles remain in maternity colonies until mid-August, at which time the colonies begin to break up and bats begin migrating to their hibernation sites (Menzel et al. 2002). Bats forage around the hibernation site and mating occurs prior to entering hibernation in a period known as fall swarm (Broders and Forbes 2004; Brooks and Ford 2005). Throughout the summer months and during breeding, northern long-eared bats have small home ranges of less than 0.1 km^2 (25 acres) (Silvis et al. 2016 in Dowling et al. 2017). Migratory movements, however, can be up to 275 km (170 mi) (Griffin 1945 in Dowling et al. 2017).

Despite severe population declines, northern long-eared bats have historically been known to occur across all New York counties (apart from the five New York City counties: New York County [Manhattan], Kings County [Brooklyn], Bronx County [The Bronx], Richmond County [Staten Island], and Queens County [Queens]; NYSDEC 2019b; New York Natural Heritage Program [NYNHP] 2023a). Occupancy modeling from the North American Bat Monitoring Program (NABat) suggests a low probability of northern long-eared bat summer occupancy across all of Long Island (Udell et al. 2022).

Tricolored Bat

The tricolored bat, another insectivorous cave-hibernating bat, is common in eastern North America, ranging from Central America to southern Canada (Hoofer et al. 2006). During summer, tricolored bats roost both in buildings and in foliage. Females may roost alone or in colonies, while males are mostly solitary (Veilleux et al. 2003; Poissant et al. 2010; Leivers et al. 2019). Tricolored bats are not known to migrate long distances prior to hibernation, but stable isotope analysis suggests instances of latitudinal migration of greater distances than traditionally thought (Fraser et al. 2012). After engaging in swarming behavior in autumn, hibernation occurs in caves, abandoned mines, and human-made structures (Slider and Kurta 2011).

Tricolored bats are one of the species most affected by WNS, with hibernacula counts at caves in WNS-positive regions showing reductions of >90% from previous counts (Cheng et al. 2021; Perea et al. 2022). Presence of WNS in hibernacula has been confirmed across an estimated 59% of the total distribution (Cheng et al. 2021), and population declines have been documented throughout most of the range (Hoyt et al. 2021). As a result of these range-wide declines, the USFWS has drafted a proposal to list tricolored bats as endangered under the ESA (USFWS 2022b). The USFWS's Species Status Assessment Report for the tricolored bat predicts that even in the absence of further WNS spread and wind energy development, the population viability for the species is likely to experience rapid decline over the next decade (USFWS 2021).

Tricolored bats have historically been recorded in winter hibernacula in all regions of New York, most commonly in the southern and western parts of the state (NYNHP 2023b). Current distributions of tricolored bats in the state are unknown, and the statewide range may have contracted due to WNS. Occupancy modeling from NABat suggests a low probability of summer occupancy across all of Long Island (Udell et al. 2022).

4.3.1.2 Offshore Development Area

This section assesses the potential exposure (i.e., likelihood of occurrence) of cave-hibernating and migratory tree bats to the Offshore Development Area, which consists of the Lease Area and the OECC to Long Island, New York. The assessment of potential exposure to bats during construction includes activities within the Lease Area and OECC. For operations and maintenance (O&M), however, the assessment only includes the WTGs within the Lease Area, because O&M activities within the OECC are not expected to affect bats and stationary objects (such as ESPs) are not generally considered a collision risk for bats (BOEM 2014) because they are able to detect objects with echolocation (Johnson et al. 2004; Horn et al. 2008). See Table 4.3-2 for definitions of exposure.

Table 4.3-2 Definitions of Exposure Levels

Exposure Level	Definition
minimal	Based upon the literature, little to no evidence of use of the offshore environment for breeding, wintering, or staging and minimal predicted use during migration.
low	Based upon the literature, some evidence of use of the offshore environment during migration but a low proportion of the population is expected to be exposed.
medium	Based upon the literature, moderate evidence of use of the offshore environment during any season and a moderate proportion of the population is exposed.
high	Based upon the literature, strong evidence of use of the offshore environment and the offshore environment is primary habitat during any season and a high proportion of the population is exposed.

While data gaps remain on offshore bat movements, bats have been documented in the marine environment in the US (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; Hatch et al. 2013; Pelletier et al. 2013; Stantec 2016a; Dowling and O'Dell 2018) and in Europe (Boshamer and Bekker 2008; Ahlén et al. 2009; Lagerveld et al. 2015). All recorded instances of North American bats flying over open ocean have occurred in the Atlantic region between Nova Scotia and North Carolina, with visual observations occurring between 2.6 km (1.6 mi) and 817.3 km (507.8 mi) from the nearest land (Solick and Newman 2021). Importantly, over 60% of those records occurred in water depths shallow enough (<60 m [197 ft]) to be developed using current turbine technology. Bats have been observed to temporarily roost on structures on nearshore islands, such as lighthouses (Dowling et al. 2017), and there is evidence of bats, particularly eastern red bats, migrating offshore in the Atlantic (Hatch et al. 2013). In a bat acoustic study conducted in the Mid-Atlantic during the spring and fall of 2009 and 2010 (86 nights), the maximum distance that bats were detected from shore was 21.9 km (13.6 mi), and the mean distance was 8.4 km (5.2 mi) (Sjollema et al. 2014). In Maine, bats were detected on islands up to 41.6 km (25.8 mi) from the mainland (Peterson et al. 2014). In the Mid-Atlantic acoustic study, eastern red bats comprised 78% of all bat detections offshore (166 bat detections during 898 monitoring hours) and bat activity decreased as wind speed increased (Sjollema et al. 2014). In addition, eastern red bats were detected in the Mid-Atlantic up to 44 km (27.3 mi) offshore during boat-based surveys, and up to 41.8 km (25.9 mi) offshore during high resolution digital aerial surveys (Hatch et al. 2013). Acoustic bat detectors deployed aboard research vessels at sea have detected bat activity up to 130 km (80.8 mi) from shore (Stantec 2016a).

Several studies have also highlighted the relationship between bat activity and weather conditions. In general, bat activity has been found to occur primarily during nights with warmer temperatures and low wind speeds (Fiedler 2004; Reynolds 2006; Cryan, Gorresen, et al. 2014; Stantec 2016b; Gorresen et al. 2020). Boat-based acoustic surveys conducted for the Atlantic

Shores Offshore Wind project (Lease Area OCS-A 0499) found that bat activity was most often recorded at a mean wind speed of 4.6 meters per second (10.3 miles per hour [mph]) and a mean temperature of 23.7° C (74.6° F) (Biodiversity Research Institute 2021). Similarly, in Lease Area OCS-A 0512, the location of the Empire Wind 1 and Empire Wind 2 projects (collectively, the "Empire Wind projects"), 77% of bat passes were detected at average nightly wind speeds below 8 meters per second (17.9 mph) (Tetra Tech 2022). Smith and McWilliams (2016) developed predictive models of regional nightly bat activity using continuous acoustic monitoring at several locations in coastal Rhode Island. Bat activity was found to steadily decrease with decreasing temperatures, and departures from seasonally normal temperatures increasingly inhibited bat activity later in the season (September–October). Although Smith and McWilliams (2016) found no association with wind speed and activity of migratory bats (primarily eastern red bats and silver-haired bats [*Lasionycteris noctivagans*]), they demonstrate a strong relationship with "wind profit," a variable indicating combinations of wind speeds and directions that would likely induce coastal flight paths.

Cave-hibernating bats hibernate regionally in caves, mines, and other structures, and feed primarily on insects in terrestrial and freshwater habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Sjollema et al. 2014), with movements primarily during the fall (Peterson et al. 2014; Stantec 2016a). In the mid-Atlantic, the maximum distance from shore that *Myotis* species were detected was 11.5 km (7.1 mi) (Sjollema et al. 2014). However, at least one ship record indicates that these species are capable of flying much farther from shore. Thompson et al. (2015) documented dozens of *Myotis* bats (unknown spp.) landing and roosting on their ship 110 km (68.4 mi) from the nearest land. These studies suggest that the use of coastline as a migratory pathway by cave-hibernating bats is likely limited to the fall migration period. Furthermore, acoustic studies generally indicate lower use of the offshore environment by cave-hibernating bats (as compared to tree-roosting species). A study in the Netherlands utilizing global positioning system (GPS) tags and Motus receivers documented noctules (*Nyctalus noctula*; a common cave-hibernating bat in Europe) traveling up to 12.7 km (7.9 mi) from shore (Lagerveld and Mostert 2023). However, it was deemed unlikely that offshore wind farms in the Netherlands will significantly affect coastal populations of noctule since offshore wind developments take place beyond their regular foraging range (Lagerveld and Mostert 2023). Data from New York State Energy Research and Development (NYSERDA) metocean buoys deployed within the New York Bight recorded only 10 calls (nine identified silver-haired bats and one unknown low-frequency call [i.e., non-*Myotis* species]) from August 2019 to June 2022, all of which occurred between August and October (Normandeau Associates 2022b), further indicating limited use of the offshore environment by cave-hibernating bats. The study for the Empire Wind projects (Tetra Tech 2022) detected three bat species within that project's lease area (OCS-A 0512) in 2018, including infrequent detections of big brown bats (*Eptesicus fuscus*), though no *Myotis* species were confirmed. Vessel-based acoustic surveys conducted for the Atlantic Shores Offshore Wind project in 2020 and 2021 detected five recordings of tricolored bats and three additional unidentified *Myotis* calls (Biodiversity Research Institute 2021).

Tree bats generally migrate to southwestern and southern parts of the US to overwinter (Cryan 2003; Cryan, Stricker, et al. 2014; Wieringa et al. 2021), and have been documented in the offshore environment (Hatch et al. 2013; True et al. 2021). Eastern red bats were detected in the Mid-Atlantic up to 41.8 km (25.9 mi) offshore by high resolution digital video aerial surveys (Hatch et al. 2013). These bats were all observed in September off Delaware and Maryland. Eastern red bats have been detected migrating from Martha's Vineyard late in the fall, and one bat was tracked as far south as Maryland, indicating that individuals of this species can travel at least 450 km (279.6 mi) over water in a single night (Dowling et al. 2017). These results are supported by historical observations of eastern red bats offshore, as well as acoustic and survey results (Hatch et al. 2013; Peterson et al. 2014; Sjollema et al. 2014). Tree bats are most likely to pass through the Lease Area during the migration period (late summer/early fall), but their use of the area would likely be rare. While little local data are available, offshore vessel-based acoustic surveys for the Empire Wind projects recorded bat detections in Lease Area OCS-A 0512 primarily comprised of eastern red bats and silver-haired bats, concentrated during fall migration (Tetra Tech 2022). Big brown bats were documented infrequently, and hoary bats (*Lasiurus cinereus*) were also detected in the offshore environment, but closer to shore and not within OCS-A 0512.

Overall, these data suggest that tree bats are the most likely species group to pass through the Lease Area, primarily during the migration period (late summer/early fall). Because bat movement offshore is generally limited to fall migration and cave-hibernating bat use offshore is limited, spatiotemporal exposure for both cave-hibernating and migratory tree bats is expected to be minimal to low.

Bat exposure to the OECC will be generally similar to the Lease Area, although bat activity is expected to be relatively higher closer to shore. Where the OECC passes through coastal areas, cave-hibernating bat activity may be higher than farther offshore. While bats are expected to be more common overland, they will use coastal areas and nearshore waters while migrating or foraging (Dowling et al. 2017; True et al. 2023). Relatively stable warm air temperatures and seasonal insect distributions over water present foraging opportunities for bats during the summer breeding and migratory periods (Pelletier et al. 2013). Some species, such as the little brown bat and tricolored bat, regularly forage over water bodies. The big brown bat, eastern red bat, and hoary bat are also known to use waterways as foraging areas, as well as travel corridors (Barbour and Davis 1969; True et al. 2023).

<u>Federally Listed Species</u>

Northern long-eared bats are not expected to be exposed to the Lease Area. Little information is available on any movements northern long-eared bats may make offshore, including movements in the New York Bight. Offshore vessel-based acoustic surveys for the Empire Wind projects (Lease Area OCS-A 0512) did not record any confirmed detections of northern long-eared bats (Tetra Tech 2022). One Nanotag tracking study on Martha's Vineyard (n = 8; July to October 2016) did not record any offshore movements by northern long-eared bat (Dowling et al. 2017). Tracking data suggest that at least some northern-long eared bats overwinter on the island (Dowling et al. 2017). If northern long-eared bats were to migrate over water, movements would likely be from Martha's Vineyard to the mainland. The related little brown bat (*Myotis lucifugus*) has been found to migrate from Martha's Vineyard to Cape Cod. As such, northern long-eared bats may likewise migrate to mainland hibernacula between August and September.

Offshore observations of tricolored bats are rare (Solick and Newman 2021), though they have been acoustically detected and visually observed on islands and in coastal habitats (Broders et al. 2003; Stantec 2016a). One tricolored bat was opportunistically observed 103.5 km (64.3 mi) due east of Corolla, North Carolina in August 2018 (Thornton et al. 2023). This observation occurred on a survey vessel operating in the vicinity of a planned offshore wind farm (Coastal Virginia Offshore Wind [CVOW]); however, it was unknown whether the bat had flown or had stowed away on the vessel and transited from port. Given that the Lease Area is located far from shore, exposure is expected to be minimal, and potential impacts to tricolored bats and northern long-eared bats are unlikely.

4.3.1.3 Onshore Development Area

Forested areas can serve as important foraging habitat for bats. Preferred foraging habitat, however, varies among species. The type of foraging habitat a bat species selects may be linked to the flight capabilities, preferred diet, and echolocation capabilities of each species (Norberg and Rayner 1987). Small, maneuverable species like the northern long-eared bat and the little brown bat can forage in cluttered conditions, such as the forest understory or small forest gaps. Larger, faster-flying bats, such as the hoary bat, often forage above the forest canopy or in forest gaps (Taylor 2006). Some species, such as the little brown bat and the tricolored bat, regularly forage over water sources. The big brown bat, eastern red bat, and hoary bat are also known to use waterways as foraging areas as well as travel corridors.

Forested habitats also provide roosting areas for both migratory and non-migratory species. Some species roost solely in the foliage of trees, while others select dead or dying trees where they roost in peeling bark or inside crevices. Some species may select forest interior sites, while others prefer edge habitats. All bat species present in Long Island, New York are known to utilize various types of forested areas during summer for foraging and roosting. Caves and mines are also key habitat for cave-hibernating bats. These locations serve as winter hibernacula, fall swarm locations (i.e., areas where mating takes place in the fall months), and summer roosting locations for some individuals (Tuttle and Taylor 1998).

Potential disturbance of bat habitat by the construction and installation of Vineyard Mid-Atlantic's onshore facilities is primarily limited to small areas around the onshore substation sites, potential onshore RCSs, points of interconnection (POIs), and onshore cable routes, although the onshore facilities are primarily in, or adjacent to, disturbed areas (see Section 3 of Appendix II-C for more details on the co-location analysis). Any treed or forested areas adjacent to or in the footprint of the onshore facilities may serve as roosting or foraging habitat for bats, including northern long-eared bats and tricolored bats, but only select sites (e.g., caves, mines) possess the necessary features to serve as hibernacula. Depending on the onshore substation and onshore RCS sites ultimately selected, some land clearing and grading may be needed, including limited tree clearing if trees are present (see Section 4.3.2.2 for more information about the possible scope of tree clearing).

The East Garden City Substation (Uniondale), Ruland Road Substation and the proposed Eastern Queens Substation POIs are in, or adjacent to, disturbed areas, with minimal to no tree cover. Onshore Substation Site Envelope A, B, C, and D are in, or adjacent to, disturbed areas with varying amounts of tree cover. The onshore cable routes are primarily co-located with existing disturbed areas within public roadway layouts, which will avoid most impacts to bat habitat. In addition, approximately 93.4% of the habitat adjacent to the onshore cable routes is developed (see Section 3 of Appendix II-C). Minimal tree trimming, tree clearing, and/or grading may be required to facilitate onshore cable installation in limited areas where the routes depart from the public roadway layout (particularly at complex crossings) and at trenchless crossing staging areas (see Section 3.8.4.3 of COP Volume I). The work, however, will be confined to as narrow a corridor as possible. Accordingly, the onshore cable routes are generally not expected to affect bats because they primarily follow previously disturbed corridors, thereby minimizing any potential impacts to bat habitat. Similarly, the cable landfall sites are located in previously disturbed and developed areas that do not provide optimal bat habitat.

Federally Listed Species

As discussed above, the assessment of the Onshore Development Area is primarily limited to the onshore substation sites, potential RCSs, POIs, and onshore cable routes. Any forested areas at the locations of the onshore facilities may serve as roosting or foraging habitat for bats, including northern long-eared bats and tricolored bats. On Long Island, the Town of Oyster Bay in Nassau County and the Town of Huntington in Suffolk County have confirmed summer occurrence of northern long-eared bat (NYSDEC 2022). Portions of the onshore cable routes and [redacted] are in Oyster Bay, and portions of the onshore cable routes, [redacted] and the entirety of the Ruland Road Substation POI are in Huntington. Based on aerial imagery there is minimal tree cover at Onshore Substation Site Envelope D and the Ruland Road Substation POI. Additionally, a recent study with passive acoustic recording devices in Suffolk County on Long Island detected northern long-eared bats on 30% of nights and demonstrated that this species favors forested patches (Hoff et al. 2024). Current distributions of tricolored bats in the state are unknown, and the statewide range may have contracted due to WNS. Tricolored bats are generally thought to travel short distances (<100 km [62 mi]) between summer breeding habitat and winter hibernacula (Smith et al. 2022), and limited data exists on the distances traveled during the summer period (Fraser et al. 2012).Occupancy modeling from NABat suggests a low probability summer occupancy for both species across all of Long Island (Udell et al. 2022).

4.3.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect bats during the construction, O&M, and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.3-3. IPFs are similar in each development phase but will be temporary and localized during both construction and decommissioning.

Table 4.3-3 Impact Producing Factors for Bats

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Presence of Structures: Collision and Displacement	•	•	•
Ground Disturbance and Habitat Modification	•		•
Noise	•		•
Vessel Activity	•	•	•
Artificial Light	•	•	•

Potential effects to bats were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

4.3.2.1 Presence of Structures: Collision and Displacement

Offshore Construction

Bats may be attracted to construction vessels (particularly if insects are drawn to the lights of the vessels) as well as WTGs and ESP(s) under construction (BOEM 2014). Bats at onshore wind facilities have been documented as showing higher attraction and more frequent approaches to stationary WTGs (Cryan, Stricker, et al. 2014), but stationary objects are not generally considered a collision risk for bats because of their use of echolocation (Johnson et al. 2004; Horn et al. 2008; BOEM 2012). Overall, since there is little evidence to suggest that stationary objects pose significant risk to bats, behavioral vulnerability to collision is expected to be insignificant. As such, risk to bat populations is unlikely. This finding is consistent with the Bureau of Ocean Energy Management's (BOEM) assessment in the Final Environmental Impact Statement (FEIS) for the Empire Wind projects, which concluded that the impact of offshore construction and installation would be "negligible" (BOEM 2022a).

Offshore Operations & Maintenance

IPFs for bats during offshore O&M include collision or displacement from physical structures. If bats pass through the Lease Area, injury or mortality from collision with WTGs is a potential risk. Bats are not expected to regularly forage in the Lease Area but may be present during fall migration (BOEM 2012; BOEM 2019). However, as previously discussed, the exposure of cave-hibernating bats to the Lease Area is expected to be minimal to low and would only occur rarely during migration when a small number of bats may occur in the Lease Area given its distance from shore (BOEM 2014). Therefore, population level risks to cave-hibernating bats are unlikely. This finding is consistent with BOEM's assessment in the FEIS for the Empire Wind projects (BOEM 2022a).

Migratory tree bats are more likely to pass through the Lease Area than cave-hibernating bats, but overall, a small number of bats are expected in the Lease Area given its distance from shore (BOEM 2014). While there is evidence of bats visiting WTGs close to shore (4 to 7 km [2.5 to 4.3 mi]) in the Baltic Sea, which is enclosed by land (Ahlén et al. 2009; Rydell and Wickman 2015), the Lease Area is farther offshore and there are no nearby landing areas (e.g., islands) that might otherwise increase the presence of bats in the Lease Area. Therefore, risks to bat populations are expected to be unlikely. This finding is consistent with BOEM's assessment in the FEIS for Empire Wind (BOEM 2022a).

Artificial lighting as a distinct IPF is covered in Section 4.3.2.5 below, but the potential effects of lighting on collision and displacement are discussed here. The need for lighting on offshore structures during O&M of Vineyard Mid-Atlantic is expected to include marine navigation lighting and aviation obstruction lights; best practices will be considered, when necessary, to mitigate any risks (see Section 4.3.2.4 below and also Section 4.1.5 of COP Volume I for further information on best practices). Several studies have investigated the impacts of different lighting methods on attraction and avoidance behaviors in bats. Red aviation lights on top of WTG towers were previously considered a potential source of interest to bats; however, studies have shown that mortality at land-based towers with aviation lights is similar to or even less than mortality at towers without aviation lights (Arnett et al. 2008; Bennett and Hale 2014). Bennett and Hale (2014) reported higher red bat fatalities at unlit WTGs in comparison with those lit with red aviation lights. Bats may also be attracted to maintenance vessels servicing WTGs, ESP(s), or offshore export cables, particularly if insects are drawn to the lights of the vessels.

In summary, bats have a minimal to low exposure to the Lease Area because the Lease Area is located far offshore, and bat exposure is likely limited to a few individuals of migrating tree bats in the fall. Risks will be further minimized through mitigation measures. For these reasons, risks to bat populations are unlikely.

4.3.2.2 Ground Disturbance and Habitat Modification

Ground disturbance and habitat modification that have the potential to affect bats are limited to construction of Vineyard Mid-Atlantic components within the Onshore Development Area. Periodic maintenance will likely occur within the fenced perimeter of the onshore substation site(s) and RCS (if used), but these activities are not expected to affect bat habitat and will not be discussed further. During decommissioning, potential impacts are expected to be similar to construction. Activities in the Lease Area will not be discussed in this section.

<u>Onshore Construction</u>

In general, potential impacts to bats onshore are primarily limited to the onshore substation sites and the onshore RCSs (if used). [redacted] is in Oyster Bay and Huntington, and, as stated previously, both towns have confirmed summer occurrence of northern long-eared bat (NYSDEC 2022). Depending on the onshore substation and onshore RCS sites ultimately selected, varying amounts of land clearing and grading may be needed prior to excavation and trenching (for equipment foundations, cable trenches, containment, drainage, and retaining walls). Some onshore substation sites may require up to approximately 0.06 square kilometers (km^2) (15 acres) of tree clearing and ground disturbance (per site) from grading, excavation, and trenching.[34] Construction of each onshore RCS may require up to ~0.008 km^2 (2 acres) of tree clearing and ground disturbance.[35] The potential landfall sites do not provide suitable roosting habitat, so land disturbance and habitat alteration are not expected to impact bats at these locations.

Portions of the onshore cable routes are located in towns with known summer occurrence of northern long-eared bat (Oyster Bay and Huntington; NYSDEC 2022). However, the onshore cable routes are expected to be located primarily within public roadway layouts (or immediately adjacent areas)[36], which will avoid or minimize most impacts to bat habitat. Minimal tree trimming, tree clearing, and/or grading may be required to facilitate onshore cable installation in limited areas where the routes depart from the public roadway layout (particularly at complex crossings) and at trenchless crossing staging areas (see Section 3.8.4.3 of COP Volume I). The work, however, will be confined to as narrow a corridor as possible.

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[34] The actual size of the onshore substation site parcel may be larger than the area cleared and disturbed to accommodate the onshore substation.

[35] The actual size of the parcel may be larger than the area cleared and disturbed to accommodate the onshore RCS.

[36] In limited areas, the onshore cable routes may follow utility rights-of-way (ROWs) or depart from public roadway layouts, particularly at complex crossings.

At each POI (Uniondale POI, Ruland Road Substation POI or the proposed Eastern Queens Substation POI), the Proponent may install grid interconnection cables and associated duct bank (i.e., perform ground disturbing activities) within the property line of the existing substation. The POIs are developed sites and any tree trimming or tree clearing (if required) would be minimal.

Currently forested areas have the potential to serve as roosting or foraging habitat for bats, including northern long-eared bats. Tree clearing could result in permanent loss of potentially suitable summer roosting habitat. However, given the small area being cleared in relation to locally available habitat, habitat loss is unlikely to affect bat populations, including the northern long-eared bat. This finding is consistent with BOEM's assessment in the Empire Wind FEIS (BOEM 2022a) and draft Biological Assessment (BA) (BOEM 2022b). Furthermore, since the Onshore Development Area is co-located with existing development, risks to bat populations are unlikely.

During the permitting process, the Proponent will consult with New York State Department of Environmental Conservation (NYSDEC) to request the most current information on known northern long-eared bat and tricolored bat maternity roosts and hibernacula. In consultation with state and federal regulators, the Proponent will adhere to conservation strategies for the northern long-eared bat and tricolored bat, which will likely be similar to those implemented for other endangered bats, such as the Indiana bat. The conservation strategies could include time of year restrictions for tree clearing, if needed, to avoid or minimize impacts to bats and/or conducting bat surveys pursuant to current USFWS protocols to determine whether northern long-eared bats and tricolored bats are present in the areas proposed to be cleared.

4.3.2.3 Noise

This IPF section addresses sound generated during activities conducted both onshore and offshore, including pile driving and secondary noise sources, and any potential effects on bats.

Offshore Development Area

Noise occurring offshore is not expected to have any direct effects on bats, and the likelihood of indirect effects caused by noise (e.g., avoidance behavior) is believed to be low, as North American bat species are regularly observed navigating through and foraging within noisy urban areas (Schimpp et al. 2018). Most studies showing negative effects of noise on bats demonstrate a noise-induced reduction in foraging efficiency for gleaning species only (Schaub et al. 2008; Bunkley and Barber 2015). All species with the potential to occur in the Lease Area are aerial insectivores and are not known to rely on passive listening for prey.

Bunkley and Barber (2015) found that bats that emit low frequency (<35 kilohertz [kHz]) echolocation calls (e.g., silver-haired bats and hoary bats) were recorded less frequently at sites with compressor stations associated with natural gas extraction that produce broadband noise compared to quiet sites. Pile driving during construction could produce similar levels of noise offshore resulting in avoidance behavior for low frequency emitting species; however, there is no evidence to suggest that offshore pile driving would otherwise interfere with directional migratory flights, and noise associated with O&M and decommissioning is not expected to affect bat behavior. While uncertainty remains on how bats would respond to the stimulus of noise during construction (with pile driving having the potential to cause some limited, temporary avoidance behavior), overall, noise is unlikely to impact bats in the Offshore Development Area.

Onshore Development Area

Because the Onshore Development Area is almost entirely co-located with existing developed areas, noise disturbance of bat habitat will be limited. There are potential temporary and localized direct and indirect effects to bats arising from onshore construction noise. During the non-hibernation period, noise from equipment during construction and decommissioning has the potential to cause avoidance behavior (Bunkley and Barber 2015) or disrupt day-roosting bats, which may cause a direct effect if it induces fleeing during daylight hours, increasing predation risk (Rydell et al. 1996). Noise effects will be temporary and localized and not expected to cause any long-term fitness disadvantages, as frequent roost switching is common among bats. Reasonable efforts will be made to minimize noise as feasible, including between August and October when the vast majority of onshore bat activity occurs during the fall migratory period.

4.3.2.4 Artificial Light

The effects of lighting on bats are species-specific, depend on behavioral contexts, and may affect foraging (Bailey et al. 2019; Haddock et al. 2019; Russo et al. 2019), commuting (Stone et al. 2009; Stone et al. 2015), emergence, roosting, and breeding. Lighting can disrupt the composition and abundance of prey (Davies et al. 2012) and thus shift bat foraging strategies between lit and unlit sites (Cravens et al. 2018). Migratory bat species in Europe have a diverse set of responses to light-emitting diode light source (LED) lighting, exhibiting increased foraging when exposed to warm-white light and exhibiting phototaxis attraction when exposed to red and green LED light (Voigt et al. 2017; Voigt et al. 2018). In the US, (Cravens and Boyles 2019) found that of seven observed species, eastern red bats were the only species to prefer LED lit areas as they presumably gained some advantage in foraging success near lit areas. From light tolerance studies, *Myotis* species appear to be the bats most intolerant of intensely lit areas (Stone et al. 2009; Lacoeuilhe et al. 2014), perhaps a result of their slow flight and thus reduced capacity to evade predators (Stone et al. 2015).

Offshore Development Area

Artificial lighting will be required during the construction, O&M, and decommissioning of the Offshore Development Area. During construction and decommissioning, there will be a temporary increase in lighting from construction equipment and vessels with navigational, deck, and interior lights. During O&M, WTGs will require lighting that complies with Federal

Aviation Administration (FAA), US Coast Guard (USCG), BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) guidelines. Vessel use and associated lighting will also occur, though at a lower frequency than during construction and decommissioning. Other temporary lighting (e.g., helicopter hoist status lights on WTGs, helipad lights on the ESP[s], temporary outdoor lighting on the ESPs(s) if any maintenance occurs at night or during low-light conditions) may be used for safety when necessary. However, down-lighting and down-shielding lighting will be used to minimize upward illumination where practicable, such as at offshore ESPs and/or for marine navigation lights if approved by USCG. The Proponent will use an aircraft detection light system (ADLS) or similar system that automatically activates all aviation obstruction lights when aircraft approach the Lease Area (see Section 4.1.5 of COP Volume I).

At WTG arrays, Bennett and Hale (2014) found that eastern red bat fatality rates are significantly reduced at WTGs with red flashing lights compared to WTGs with no lights, and fatality rates for all other species observed in the study did not correlate with lighting. This finding suggests that hoary bats are neither attracted nor repelled from red aviation lighting on WTGs or ESPs[37], and eastern red bats are not attracted to aviation lights. Further, Arnett et al. (2008) showed that blinking red lights did not significantly influence the mortality rates of bats at onshore wind energy facilities. Red aviation lighting is less likely to attract invertebrate prey which may partly drive patterns of reduced attraction (Bennett and Hale 2014).

Based on available information, bats may be more likely to be attracted to the Offshore Development Area rather than displaced due to the presence of lighting, as they may investigate the WTGs or ESP(s) for potential roosting opportunities or use lighting on structures for navigational purposes while migrating. While these behaviors may increase their risk of collision, impacts from displacement are unlikely.

Onshore Development Area

The Onshore Development Area is primarily co-located with existing development. During construction, temporary lighting may be required at work areas. Any lighting required during onshore construction will be temporary and localized to the work area and is not expected to be a significant increase over the existing residential and commercial lighting in the area.

Lighting during O&M is expected to be minimal and will primarily occur at the onshore substations, which will have outdoor lights installed. The majority of lights will only be used on an as-needed basis (e.g., if equipment inspection is needed at night) and when necessary for work crew safety. For security reasons, a few lights at the onshore substations will typically be illuminated on dusk–to-dawn sensors and a few lights will likely be controlled by motion-

[37] If the height of the ESP(s) exceeds 60.96 m (200 ft) above Mean Sea Level or any obstruction standard contained in 14 CFR Part 77, they will similarly include an aviation obstruction lighting system in compliance with FAA and/or BOEM guidelines.

sensors. Outdoor lighting at the onshore substation sites will typically be equipped with light shields to prevent light from encroaching into adjacent areas and to minimize effects to bats (see Section 3.9.2 of COP Volume I). The Proponent will ensure that the lighting scheme complies with local requirements. Effects from lighting during decommissioning are expected to be similar to those during construction and will be temporary.

Lighting may have an indirect effect on bats by disrupting commuting routes (Stone et al. 2009) and reducing overall foraging habitat (Cravens et al. 2019). However, the limited onshore lighting during construction, O&M and decommissioning is unlikely to affect local bat populations due to the temporary and limited nature of the lighting and the expected use of light shields at the onshore substation sites.

4.3.2.5 Vessel Activity

Bats may be attracted to vessel lighting. Overall, stationary and slow-moving objects such as seagoing vessels are not generally considered a collision risk for bats (BOEM 2012) because of bats' use of echolocation (Johnson et al. 2004; Arnett et al. 2008; Horn et al. 2008). Thus, collision with vessels is unlikely. However, bats are known to use islands, ships, and other offshore structures as stopover points during travel (Pelletier et al. 2013). Vessels may also provide roosting opportunities offshore for rest (Nichols 1920; Norton 1930; Carter 1950). Such lighting and structures may either attract bats already flying offshore or impede movement through the area (Pelletier et al. 2013). If these attract or impede bat movements during migration, migratory routes may be altered or flight distances increased, leading to increased energetic demands (Pelletier et al. 2013). Overall, because there is little evidence to suggest that stationary or slow-moving objects pose significant collision risk to bats, and because the potential impacts from vessel attraction or avoidance are not likely to be severe, population level risk from vessel activity is unlikely.

4.3.2.6 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to bats during Vineyard Mid-Atlantic are summarized below:

Offshore

- The location of the Vineyard Mid-Atlantic WTGs far offshore minimizes exposure of bats.
- The Proponent will reduce lighting to the extent practicable.
- The Proponent will use an ADLS or similar system that automatically activates all aviation obstruction lights when aircraft approach the Lease Area, subject to BOEM and FAA approval.

Onshore

- Onshore cable routes will be installed primarily in public roadway layouts to avoid undisturbed habitat.
- Onshore cables are expected to be installed entirely underground.
- Ground disturbances will be temporary and disturbed areas will be restored to their existing conditions.
- Where practicable, the Proponent will down-shield lighting or use down-lighting to minimize the effects of artificial light on bats.
- The Proponent will consult with state and local agencies regarding the timing of onshore construction activities.
- In consultation with state and federal regulators, the Proponent will adhere to conservation strategies for the northern long-eared bat and tricolored bat.

4.4 Coastal Habitats

This section addresses the potential impacts of Vineyard Mid-Atlantic on Coastal Habitats in the Offshore Development Area and Onshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to coastal habitats during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Benthic resources are discussed in greater detail in Section 4.5, finfish and invertebrates are discussed in Section 4.6, and terrestrial habitat, wildlife, and wetlands (including a description of species at the landfall sites) are discussed in Section 4.1.

4.4.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities. This section focuses on the portions of the Offshore Development Area within coastal habitat, which extends offshore to the three nautical mile (5.5. kilometer [km]) limit. This includes the nearshore portion of the OECC as it approaches the potential landfall sites on Long Island, New York. The habitats and species present within the terrestrial portion of the landfall sites are discussed in Section 4.1.

As described further in Appendix II-B (the Marine Site Investigation Report), marine habitat boundaries are identified using survey data, including multibeam bathymetry, backscatter, side scan sonar, underwater video transects, and benthic grab samples.

4.4.1.1 *Offshore Export Cable Corridor*

The OECC extends from the northern end of the Lease Area, continues west along the boundary of neighboring Lease Area OCS-A 0512, and then proceeds northwest across the Ambrose to Nantucket and Nantucket to Ambrose Traffic Lanes towards the southern shore of Long Island, New York (see Figure 4.4-1).

As described further in Appendix II-B and Appendix II-D, surficial sediment conditions vary along the OECC. Sediment composition along the OECC was mainly classified as Soft Bottom and Heterogenous Complex habitats. Some ripples are located within Rippled Scour Depressions (RSDs), which are classified as Heterogeneous Complex habitats and primarily consist of Gravelly and Gravel Mix sediment typically observed in ripple troughs.

4.4.1.2 *Landfall Sites*

Vineyard Mid-Atlantic includes three potential landfall sites (of which, up to two will be used): the Rockaway Beach Landfall Site, the Atlantic Beach Landfall Site, and the Jones Beach Landfall Site. Both Vineyard Mid-Atlantic's 2023 field programs, which consisted of benthic grab and video survey data collection (see Appendix II-B), and the New York State Department of Environmental Conservation (NYSDEC) Statewide Seagrass Map (NYSDEC 2021) did not identify eelgrass locations at any of the three landfall sites. Note the NYSDEC Statewide Seagrass Map has integrated the most current available seagrass maps from the Long Island Sound Study, Peconic Estuary Program, and the South Shore Estuary Reserve (SSER) into one map portraying New York seagrass habitat (NYSDEC 2021).

Eelgrass was identified in the bays behind Long Island's barrier islands. However, all onshore routes will not intersect any of the NYSDEC mapped eelgrass areas (Figure 4.4-2), which are at least 0.9 km (0.6 miles) east of the onshore cable route associated with the Jones Beach Landfall Site. As described further in Section 4.1, trenchless crossing methods are expected to be used where the onshore cable routes traverse unique features such as wetlands and waterbodies to avoid impacts to those features.

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

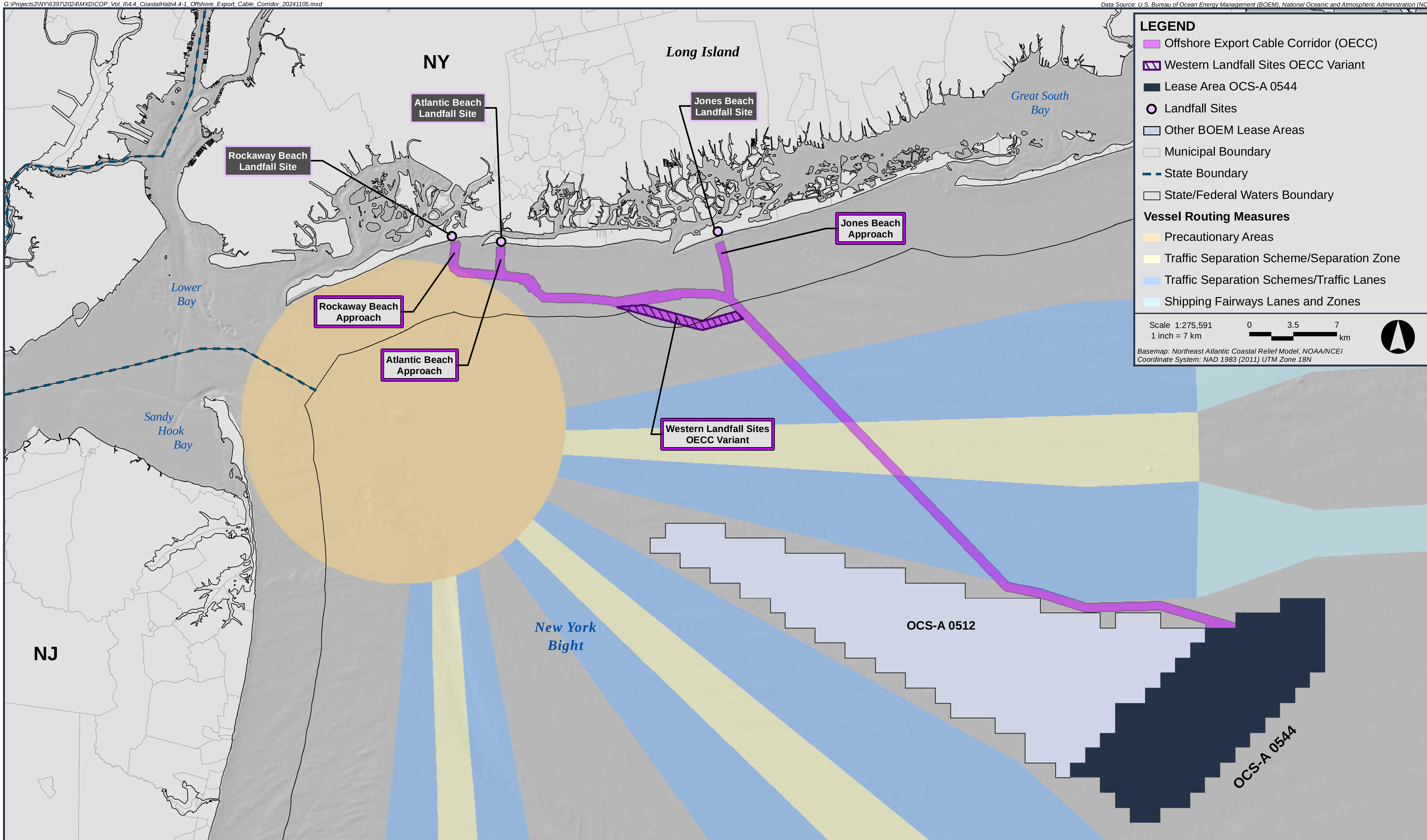

Figure 4.4-1
Offshore Export Cable Corridor

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[redacted]

4.4.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect coastal habitats during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.4-1.

Table 4.4-1 Impact Producing Factors for Coastal Habitats

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Seafloor Disturbance and Habitat Modification	•	•	•
Ground Disturbance and Habitat Modification	•	•	•

Potential effects to coastal habitats resources were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore and onshore facilities as described in Section 1.5.

4.4.2.1 Seafloor Disturbance and Habitat Modification

As described further in Section 2.8 of the COP Volume I, the OECC was sited to avoid or minimize potential impacts to sensitive habitats and resources to the extent possible. Throughout the OECC routing process, the Proponent consulted with numerous federal and state agencies, including the Bureau of Ocean Energy Management (BOEM), National Marine Fisheries Service (NMFS), United States Army Corps of Engineers (USACE), United States Coast Guard (USCG), and the New York State Department of State (NYSDOS), as well as stakeholders (including fishermen). Based on feedback obtained through the OECC routing process, the Proponent refined the OECC and consolidated the offshore export cables with other developers' proposed cables to the extent feasible.

Installation of offshore export cables is described in detail in Section 3.5 of COP Volume I and summarized here. Prior to cable installation, the offshore export cable alignments may require boulder clearance and minimal to no sand bedform leveling. Following those activities, pre-lay surveys and pre-lay grapnel runs will be performed to confirm that the cable alignments are suitable for installation. As described further in Section 4.5.2.1 and Appendix II-D, pre-installation and cable installation activities and the presence of cable protection (if required) within the OECC may result in effects to coastal habitat. Effects could range from minor ecological benefits from increased hard substrate (cable protection) to limited impacts from change or loss of habitat. However, these effects are considered to be localized and/or temporary and habitats are expected to begin recovery once construction, maintenance, or decommissioning activities are completed. The offshore cable will then be buried beneath the stable seafloor at a target depth of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters[38] likely using jetting techniques or a mechanical plow. For vessels other than anchored cable laying vessels (which must maintain tension on anchor lines), the use of mid-line anchor buoys will be considered (where feasible and considered safe) as a potential measure to reduce impacts to sensitive seafloor habitat from anchor line sweep. There is no anchor line sweep from anchored cable laying vessels because the anchor lines are under tension.

Temporary increases in suspended sediments and subsequent sediment deposition may occur in the OECC from the installation of offshore export cables and cable protection and may affect coastal habitats. Specifically, sediment is expected to be suspended into the water column during cable pre-installation activities (e.g., a pre-lay grapnel run, boulder clearance, etc.), cable installation, installation of cable protection (where required), the use of other equipment that contacts the seafloor (e.g., vessel anchors), and excavation and backfill of the temporary horizontal directional drilling (HDD) exit pit. Most of these activities would occur during construction, with potential for limited activities during O&M if cables require repair or maintenance; however, any impacts would be expected to be far less than those from construction activities. Impacts from suspended sediments and deposition would be temporary and confined to a small area close to the location of the installation activity. For a further description of these potential temporary effects, see Section 4.5.2.3.

The Proponent's goal is to minimize the use of cable protection to the greatest extent possible through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route. While every effort will be made to achieve sufficient burial, a limited portion of the offshore cables may require cable protection (rocks, rock bags, concrete mattresses, half-shell pipes, or similar) if a sufficient burial depth cannot be achieved. Cable protection may also be used where the cables need to cross other infrastructure (e.g., existing cables, pipelines, etc.), to secure the cable entry protection system in place, or where a cable splice requires protection. The Proponent will evaluate the feasibility of using nature-inclusive cable protection designs, which can include adding an additional layer of larger rock to provide larger crevices, using methods that can be easily relocated with minimal disturbance during cable repairs (e.g., rock bags with lifting points), and using mattresses with specially-designed concrete blocks that create additional nooks and crannies. The maximum potential seafloor disturbance from offshore export cable installation (including pre-installation activities and cable protection) is provided in Table 3.5-2 in COP Volume I (note the values in Table 3.5-2 are for state and federal waters).

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[38] Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

Following installation, the Proponent anticipates that the offshore export cables will likely include distributed temperature sensing (DTS), distributed acoustic sensing (DAS), online partial discharge (OLPD) monitoring, and/or a similar monitoring system to continuously assess the status of the cables and detect anomalous conditions, such as insufficient cable depth or possible cable damage. If the cables' monitoring system detects an anomalous condition, the Proponent will carefully review the issue and determine whether an ad-hoc cable survey is necessary. In the unlikely scenario that cable monitoring or surveys detect that a segment of cable no longer meets a sufficient burial depth, an analysis will be performed to determine whether additional measures (e.g., cable reburial or application of cable protection) are necessary.

During decommissioning, all physical components will be removed, although the offshore cables may be retired in place or removed. Temporary effects from decommissioning are expected to be similar to those experienced during construction. Long-term modifications of habitat are expected to be reversed when components on the seafloor such as cable protection are removed.

4.4.2.2 Ground Disturbance and Habitat Modification

Onshore construction and maintenance activities may result in temporary ground disturbance and habitat modification at landfall sites. The Proponent will work with municipalities to develop the construction schedule and hours in accordance with local ordinances. Onshore construction at the landfall sites is planned to occur outside of the period from Memorial Day to Labor Day. Certain activities cannot stop once they are initiated, such as conduit pull-in for the HDD work, which may extend work hours in some circumstances. Disturbed ground and/or infrastructure will be restored to existing conditions following completion.

As further detailed in Section 3.7.2 of COP Volume I, the offshore export cables are expected to transition onshore using HDD at each landfall site. HDD at the landfall sites will require a staging area to be located in a parking lot or other previously disturbed area. Further detail regarding dimensions and anticipated temporary disturbances associated with the approach pit, exit pit, and staging areas are located in Section 3.7.2 of COP Volume I.

HDD operations will use bentonite or other non-hazardous drilling fluid. Crews are trained to closely monitor both the position of the drill head and the drilling fluid pressure to reduce the risk of inadvertent releases of pressurized drilling fluid to the surface (i.e., drilling fluid seepage). The Proponent will develop an HDD Inadvertent Release Response Plan, which will describe measures to reduce the risk of an inadvertent release and the immediate corrective actions that will be taken in the unlikely event of an inadvertent release.

During O&M, periodic maintenance may be required. If onshore cable repairs are required at the landfall sites, the cables would typically be accessed through manholes installed at the transition vaults, thereby avoiding or minimizing ground disturbance.

4.4.2.3 *Summary of Avoidance, Minimization, and Mitigation Measures*

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to coastal habitats during Vineyard Mid-Atlantic are summarized below:

- The OECC was sited to avoid or minimize potential impacts to sensitive habitats (such as areas of eelgrass) and resources to the extent possible. Throughout the OECC routing process, the Proponent consulted with numerous agencies and stakeholders, and based on their feedback, consolidated the offshore export cables with other developers' proposed cables to the extent feasible.

- HDD is expected to be used at all landfall sites to minimize disturbance to coastal habitats.

- The Proponent will develop an HDD Inadvertent Release Response Plan, which will describe measures to reduce the risk of an inadvertent release and the immediate corrective actions that will be taken in the unlikely event of an inadvertent release.

- The offshore export, inter-array, and inter-link cables will be buried beneath the stable seafloor at a target depth of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters[39] to minimize impacts to coastal habitats.

- The Proponent's goal is to minimize the use of cable protection to the greatest extent possible through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route. The Proponent will evaluate the feasibility of using nature-inclusive cable protection designs.

- Following installation, the Proponent anticipates that the offshore export cables will include a monitoring system to continuously monitor the cables' status.

- Onshore construction at the landfall sites is planned to occur outside of the period from Memorial Day to Labor Day.

- For vessels other than anchored cable laying vessels (which must maintain tension on anchor lines), the use of mid-line anchor buoys will be considered (where feasible and considered safe) as a potential measure to reduce impacts to sensitive seafloor habitat from anchor line sweep. There is no anchor line sweep from anchored cable laying vessels because the anchor lines are under tension.

[39] Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

4.5 Benthic Resources

This section addresses the potential impacts and benefits of Vineyard Mid-Atlantic on benthic resources in the Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the proposed measures to avoid, minimize, and mitigate potential effects to benthic resources during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Essential Fish Habitat (EFH) is discussed in Appendix II-D, entrainment of larvae is analyzed in Appendix II-N, and electromagnetic field (EMF) modeling is presented in Appendix II-O.

4.5.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

This section presents a summary of benthic habitat and shellfish within the Lease Area and within and around the OECC. In general, the New York Bight Wind Energy Area (WEA), in which Lease Area OCS-A 0544 is located, was selected by Bureau of Energy Management (BOEM) because it contains relatively little sensitive finfish and invertebrate habitat (Guida et al. 2017). This description of benthic resources is based on a review of existing literature and survey data. Surveys, datasets, studies, and literature were identified and then assessed for applicability. The most relevant data and sources for characterizing benthic resources in the affected environment include:

- Northeast Fisheries Science Center (NEFSC) multispecies bottom trawl surveys (NEFSC 2022a, 2022 b)
- Northeast Area Monitoring and Assessment Program (NEAMAP) spring and fall trawl surveys
- National Oceanic and Atmospheric Administration (NOAA) Deep Sea Coral Data Portal database (NOAA 2022a, 2022b)
- Vineyard Mid-Atlantic's 2022/2023 benthic grab and video survey data
- Northeast Ocean Data Portal (2023) and Mid-Atlantic Ocean Data Portal (2023)
- National Centers for Coastal Ocean Science (NCCOS)/ BOEM Battista et al. (2019) Comprehensive Seafloor Substrate Mapping and Model Validation in the New York Bight

- New York State Department of Environmental Conservation (NYSDEC) Statewide Seagrass Map (NYSDEC 2021), Artificial Reefs Map (NYSDEC 2023a), and Marine Shellfish database (NYSDEC 2023b)

4.5.1.1 Lease Area OCS-A 0544

As discussed in the Marine Site Investigation Report (MSIR) (see Appendix II-B), habitat within the Lease Area was evaluated during a benthic survey conducted from August 26 to September 3, 2022 using geophysical trackline data, vibracores, 65 grab samples, and 35 video transects. Analyses of the grab samples and video transects indicate the Lease Area is comprised of primarily Soft Bottom habitat with some areas of Heterogeneous Complex habitat. The Soft Bottom habitat consists primarily of Medium Sand to Very Coase/Coarse Sand, with patches of Silty Sand in some areas. Heterogeneous Complex habitat contains Gravelly Sand to Sandy Gravel, with a component of Pebble/Granule. This Heterogeneous Complex habitat was found primarily in the northern portion of the Lease Area, with smaller portions in the central and southern portions of the Lease Area (see Figure 4.5-1). Video transects within the Lease Area indicate that the patches of Heterogeneous Complex habitat are discontinuous and surrounded by Soft Bottom habitat, typically found in ripple troughs. Shell hash was found in various locations in the eastern portion of the Lease Area and may be interspersed throughout the soft sediment habitats within the Lease Area. Small ripples were present throughout nearly the entire Lease Area in a north-northeast to south-southwest direction; however, no megaripples were found within the Lease Area.

Battista et al. (2019) also conducted seafloor substrate mapping within the vicinity of the Lease Area, focusing mainly on the adjacent Lease Area OCS-A 0512. This study did not include the Lease Area because, at the time of the study, the New York Wind Energy Area (NY WEA) did not include Lease Area OCS-A 0544. While the data collection was focused on the previously defined NY WEA, spatial predictive modeling was conducted to assess the extent of hard bottom habitats in the New York Bight region using environmental predictor variables including measures of depth and seafloor topography, seafloor substrate, and oceanography (Battista et al. 2019). The predictive modeling indicated the habitat is comprised mainly of soft sediment, predominantly Medium Sand with Very Coarse/Coarse Sand along the northern edge of the Lease Area with pockets of pebbles near the center of the Lease Area. There was a low percentage of Mud with low to medium Gravel content within the Lease Area. Therefore, the data from Battista et al. (2019) is consistent with the 2022 benthic samples taken from within the Lease Area OCS-A 0544. However, Battista et al. (2019) noted the presence of megaripples along the eastern edge of Lease Area OCS-A 0512 near the western border of Lease Area 0544 that was not observed during the 2022 benthic surveys.

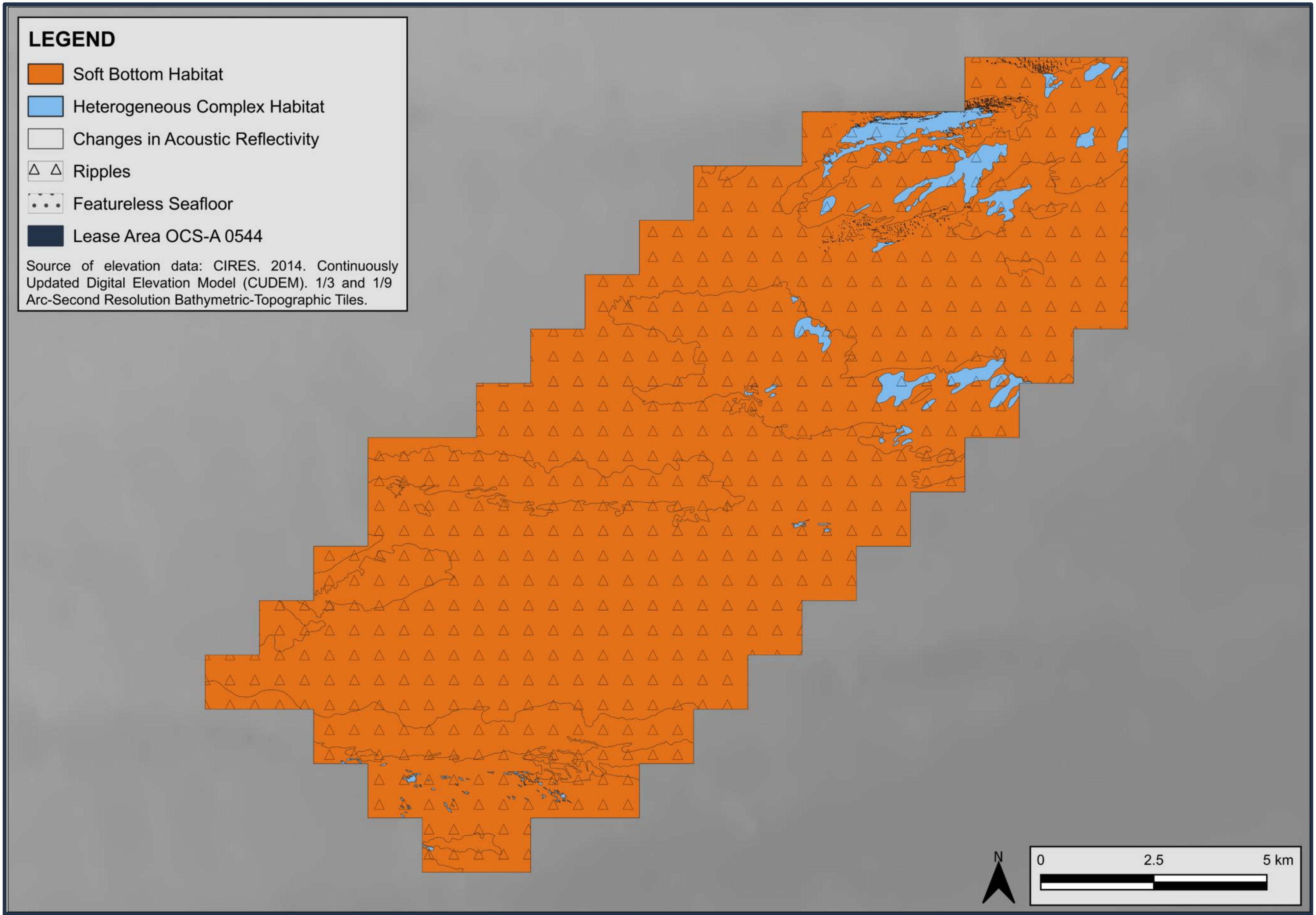

Figure 4.5-1
Habitat Mapping of Lease Area

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VINEYARD OFFSHORE

During the 2022 benthic surveys, a total of 65 grain size samples were attempted and successfully collected from 35 benthic grab stations. Of the 35 benthic grab stations, 15 stations included three replicate grain size samples while the other 20 sediment grab stations included just one grab sample. Thirty-five of the grain size samples were co-located with infaunal samples. Samples collected from 35 of these stations were assigned National Marine Fisheries Service (NMFS)-modified Coastal and Marine Ecological Classification Standard (CMECS) classifications and analyzed for benthic infaunal community composition (see Appendix II-B). The remaining samples were assigned CMECS classifications for the separate MSIR (see Appendix II-B). Grain size analysis showed that the average grain size of sediment within the Lease Area was predominantly sand, with 97.96% sand, 0.89% gravel, 0.12% mud, and 1.03% gravel-sized shell across the 65 grab samples. Forty-seven (47) benthic faunal species were observed in the 35 grab samples analyzed for the benthic factual report including 26 taxa of Annelida, 11 taxa of Mollusca, eight taxa of Arthropoda, one taxa of Echinodermata, and one taxa of Nemertea (see Table 4.5-1). Table 4.5-2 provides a summary of the relative abundance of the most abundant species collected and includes taxa accounting for ≥2% of the total abundance collected. The density of benthic infaunal individuals appeared to be highest near the center of the Lease Area and along the northeastern and southwestern ends of the Lease Area. The largest number of taxa found within a single grab sample was 20 unique taxa, accounting for over 41% of all the observed taxa within the 35 grab samples (see Appendix II-B for more detail).

Table 4.5-1 Benthic Infauna Taxa Observed by Phylum during 2022 Benthic Survey of Lease Area

Phylum	Number of Taxa	Relative Abundance %
Annelida	26	58.9%
Echinodermata	1	21.8%
Mollusca	11	7.5%
Arthropoda	8	6.4%
Nemertea	1	5.4%

Table 4.5-2 Relative Abundance of Benthic Infauna Taxa in 2022 Lease Area Samples

Scientific Name	Common Name	Relative Abundance (%)	Average Density per Sample (#/m²)	Number of Samples Containing Taxa
Echinarachnius parma	Common sand dollar	21.8	718	18
Polygordius spp.	Polygordiid polychaete	15.6	618	15
Goniadidae	Goniadid polychaete	9.7	522	15
Scoletoma spp.	Lumberinid polychaete	7.0	217	19

Table 4.5-2 Relative Abundance of Benthic Infauna Taxa in 2022 Lease Area Samples (Continued)

Scientific Name	Common Name	Relative Abundance (%)	Average Density per Sample (#/m²)	Number of Samples Containing Taxa
Nemertea	Nemertean ribbon worm	5.4	215	15
Lumbrinerides acuta	Lumberinid polychaete	4.4	290	9
Naididae w/ hair chaeta	Oligochaete worm	4.0	235	10
Nephtys spp.	Nephtyid polychaete (catworm)	3.3	217	9
Byblis serrata	Ampeliscid amphipod	2.4	179	8
Glycera spp.	Glycerid polychaete	2.3	232	-

NOAA's Deep Sea Coral Data Portal database provides spatial data on the presence of living bottom occurring in waters greater than 50 meters (m) (164 feet [ft]) deep through live sampling and observational surveys, records from archived samples from research institutions and museums, and records from scientific literature (Hourigan et al. 2017; NOAA 2022a, 2022b). One unspecified sponge was found approximately 18 kilometers (km) (11 miles [mi]) to the southeast of the Lease Area; however, none were documented within the Lease Area (see Figure 4.5-2). It is important to note the National Database for Deep Sea Corals and Sponges does not include "observations of absence." Areas which depict no observations in the database should not be interpreted as lacking for these taxa as limited areas have been surveyed for deep sea corals and sponges (NOAA 2020). Additionally, the NOAA Office of Coastal Management (OCM) uses statistical modeling to predict areas that can support both deep-sea hard and soft corals (NOAA 2022a, 2022b) and found no suitable habitat for deep-sea soft or stony corals within the Lease Area (see Figure 4.5-3). These habitat types are mostly present in the canyons along the continental shelf farther offshore.

The University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST) conducted a video survey from 2003 through 2012 covering the continental shelf from the southern Mid-Atlantic to the United States-Canadian border on the eastern Georges Bank. Those data were joined to the New England Fishery Management Council Swept Area Seabed Impact (SASI) model grid to develop maps of average abundance of several species of benthic invertebrates including sponges, hydrozoans, bryozoans, moon snails, hermit crabs, sea stars, sand dollars, and sea scallops. According to the SMAST analysis, sponges, bryozoans, and hydrozoans were present within the Lease Area in 25 percent or less of the samples, on average (see Figure 4.5-4). The SMAST surveys found no moon snails and a small presence of hermit crabs within the Lease Area (see Figure 4.5-5). Sea star abundance was relatively low in the Lease Area, while sand dollars were more prevalent and found in >75-100 percent of the samples (see Figure 4.5-6). Similarly, the abundance of sea scallops within the Lease Area was

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.5_Benthic\Fig_4.5-2_Coral_Sponge_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

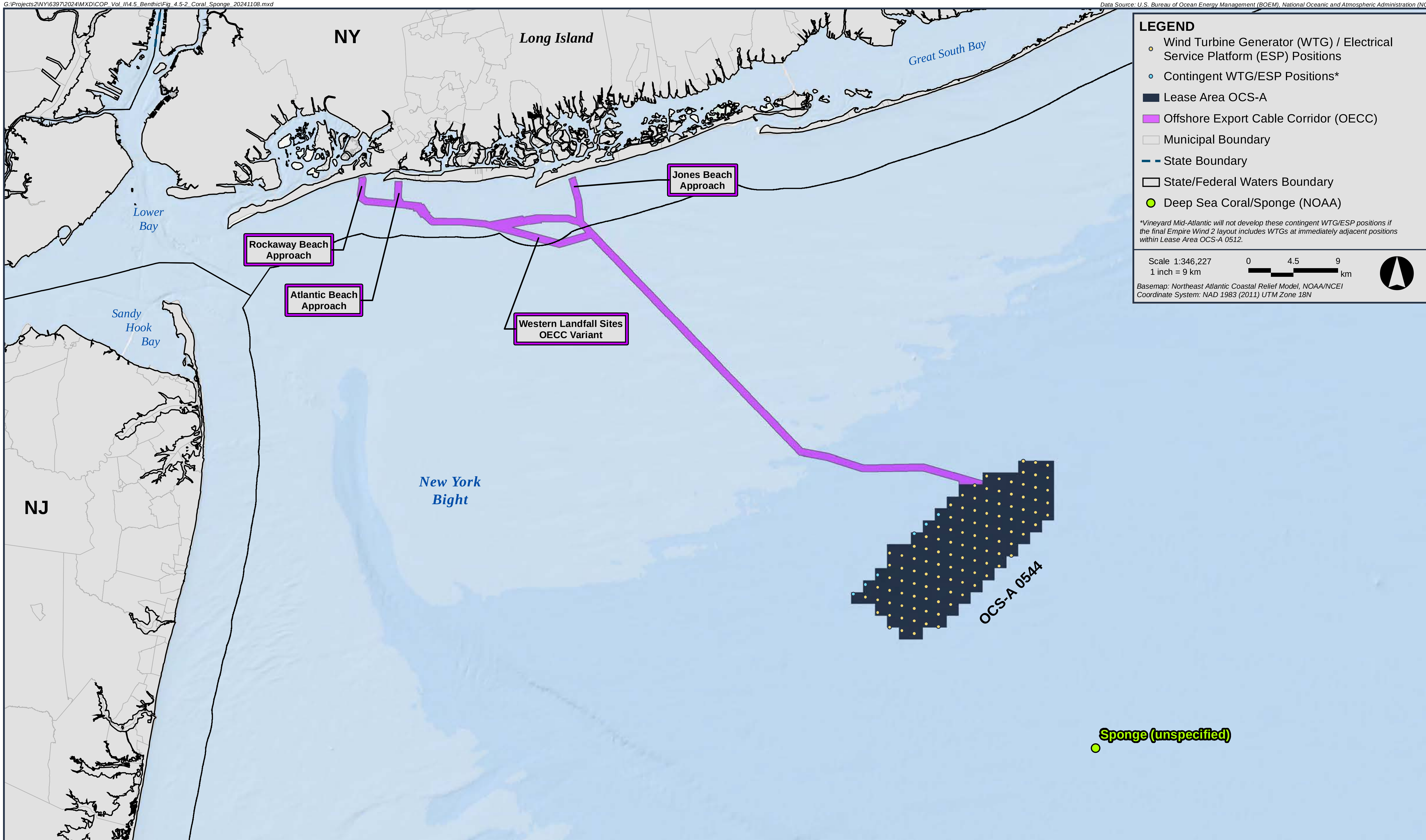


Figure 4.5-2

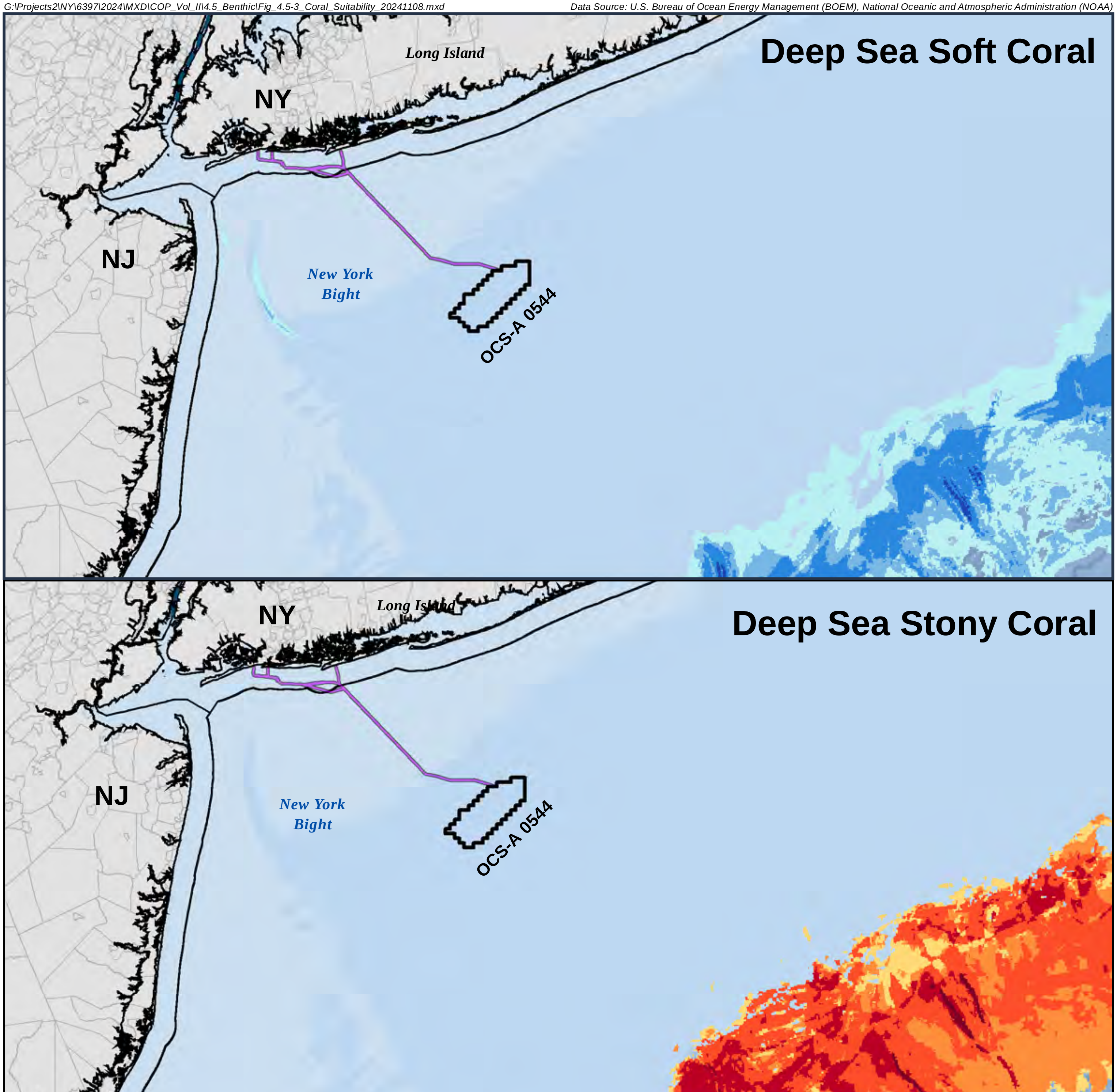
Locations of Observations of Deep Sea Coral and Sponge Species in Offshore Development Area (DSCRPT 2023)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.5_Benthic\Fig_4.5-3_Coral_Suitability_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Deep-Sea Soft Coral Habitat Suitablility

Predicted Likelihood

- Low
- Medium-Low
- Medium
- High
- Very High

Deep-Sea Stony Coral Habitat Suitablility

Predicted Likelihood

- Low
- Medium-Low
- Medium
- High
- Very High

Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

Basemap: World Ocean Base, Esri
Coordinate System: NAD 1983 (2011) UTM Zone 18N

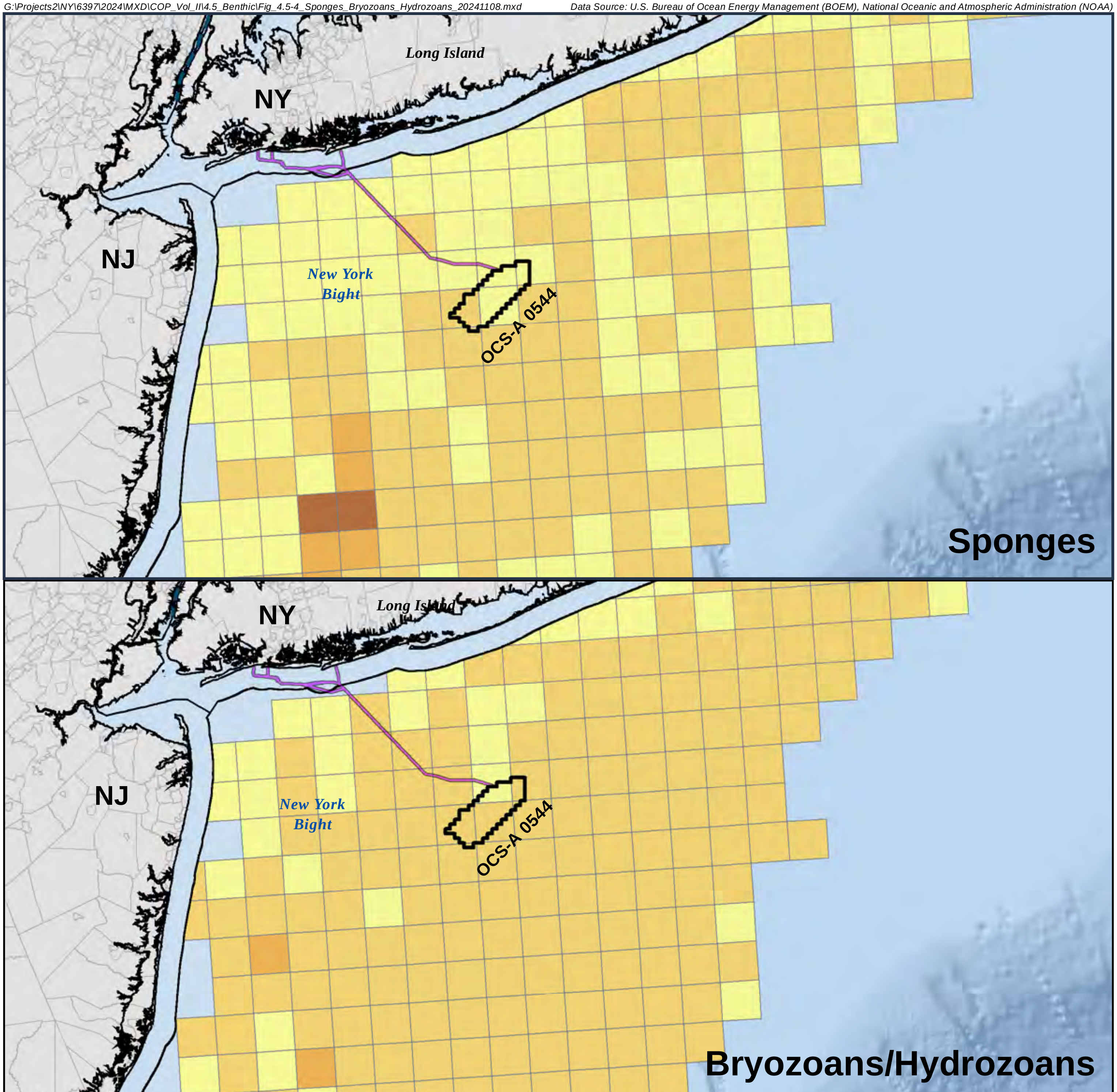
Figure 4.5-3

Deep Sea Coral Habitat Suitability (Marine Cadastre)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.5_Benthic\Fig_4.5-4_Sponges_Bryozoans_Hydrozoans_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Average percent of samples with Sponges, Bryozoans/Hydrozoans

- 0
- >0 - 25
- >25 - 50
- >50 - 75
- >75 - 100

Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

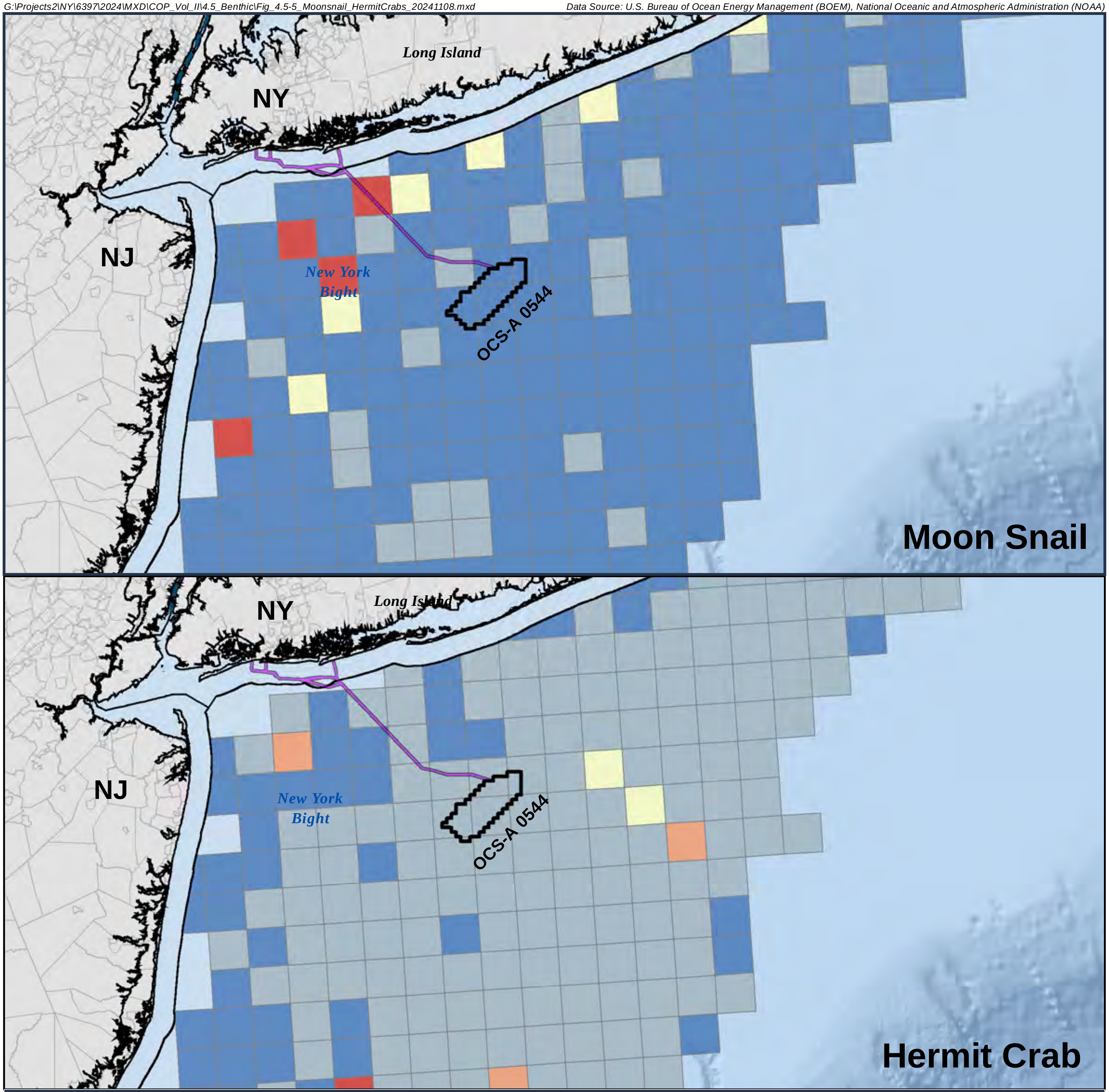
Basemap: World Ocean Base, Esri
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.5-4
Average Abundance of Sponges, Bryozoans and Hydrozoans (2003-2012, SMAST/TNC)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.5_Benthic\Fig_4.5-5_Moonsnail_HermitCrabs_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Average Abundance of Moon Snails

- 0 (<16th percentile)
- >0 - 0.2 (16th - 84th percentile)
- 0.3 (84th - 97.7th percentile)
- 0.4 (97.7th - 99.9th percentile)
- 0.5 - 0.8 (>99.9th Percentile)
- No Data

Average Abundance of Hermit Crabs

- 0 (<16th percentile)
- >0 - 0.78 (16th - 84th percentile)
- 0.79 - 1.2 (84th - 97.7th percentile)
- 1.3 - 1.7 (97.7th - 99.9th percentile)
- 1.8 - 6.2 (>99.9th percentile)

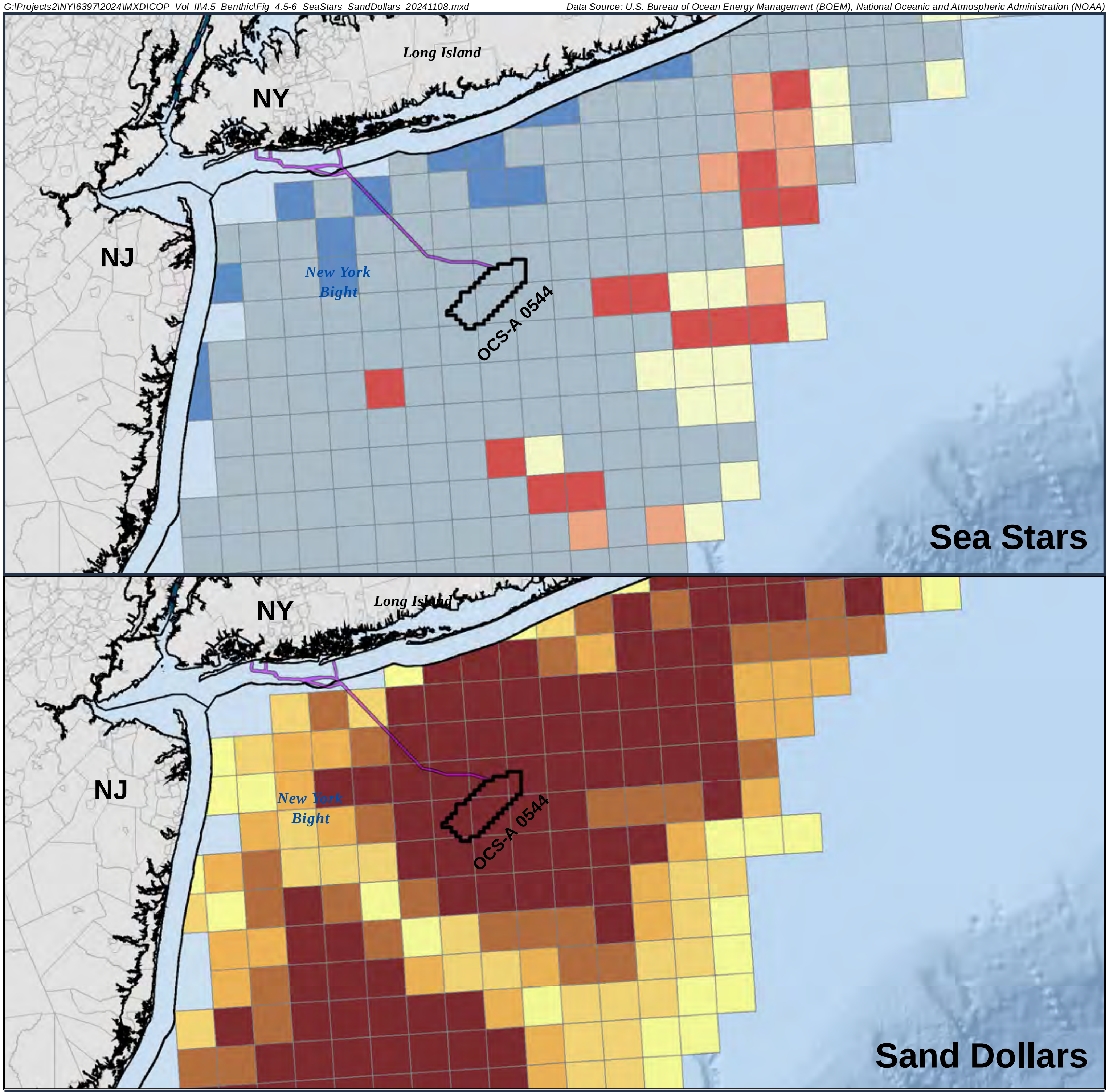
Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

Basemap: World Ocean Base, Esri
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.5-5
Average Abundance of Moonsnail and Hermit Crabs (2003-2012, SMAST/TNC)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE



LEGEND
- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Average Abundance of Sea Stars
- 0 (<16th percentile)
- 0 - 24 (16th - 84th percentile)
- 25 - 40 (84th - 97.7th percentile)
- 41 - 56 (97.7th - 99.9th percentile)
- 57 - 140 (>99.9th percentile)

Average Percent of Samples with Sand Dollars
- 0
- >0 - 25
- >25 - 50
- >50 - 75
- >75 - 100

Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

Basemap: World Ocean Base, Esri
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.5-6
Average Abundance of Sea Stars and Sand Dollars
(2003-2012, SMAST/TNC)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

also relatively low (see Figure 4.5-7). The abundance of echinoderms and sea scallops observed in the SMAST survey is consistent with the NEFSC data collected from within the Lease Area between 2010 and 2022, which is discussed further in Section 4.6. Additionally, the abundance of sand dollars is consistent with the results of the 2022 benthic survey within the Lease Area and the Battista et al. (2019) study adjacent to the Lease Area.

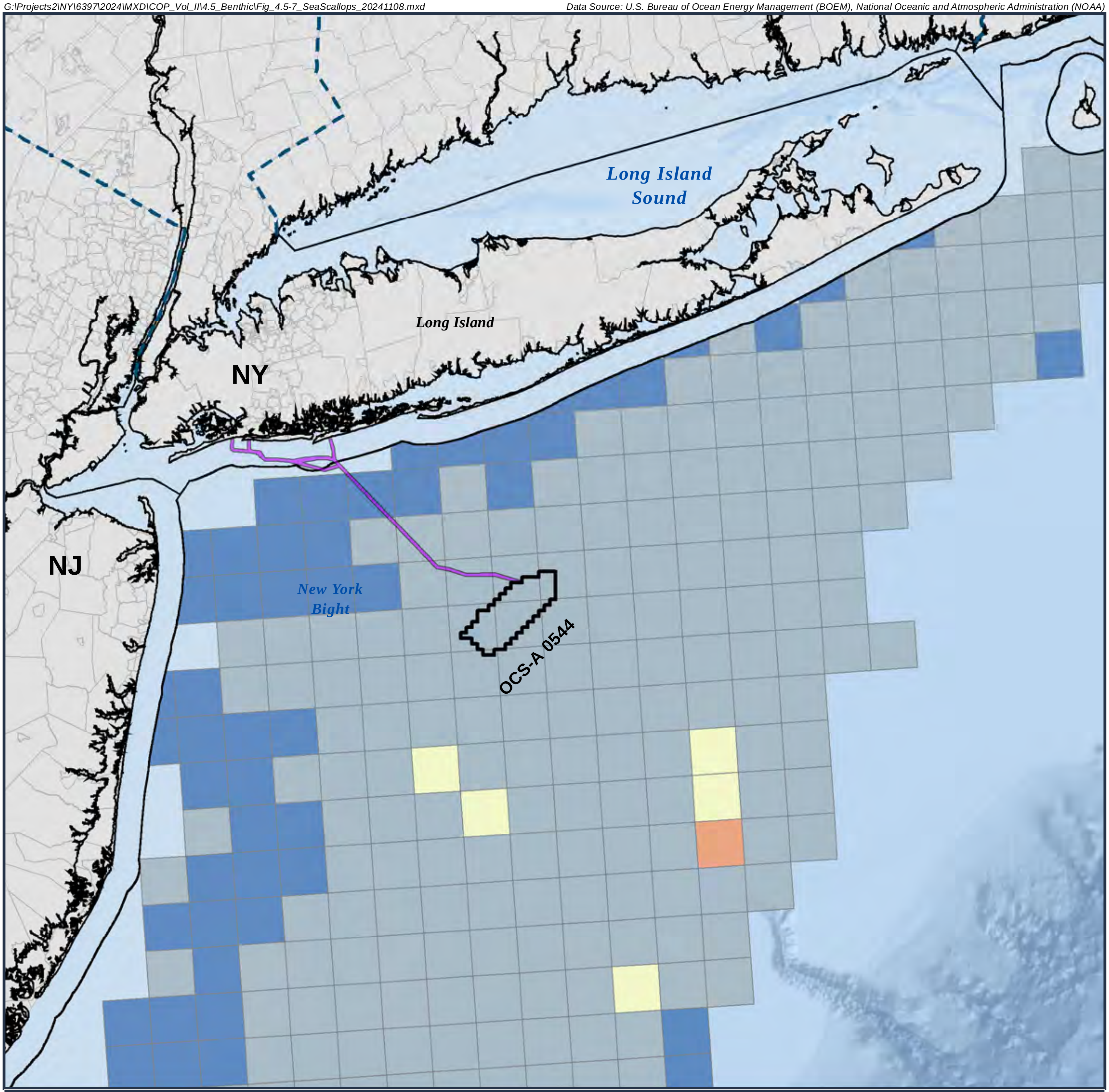
4.5.1.2 Offshore Export Cable Corridor

Habitat within the OECC was evaluated with data from environmental sampling conducted from May through July 2023 using 61 video transects and 107 total sediment grabs from 59 stations. Thirty-five of the 59 stations were collected as single grab samples, while 24 of the stations were collected in triplicate. Analyses of video transects, and grab samples show that the OECC is mainly Soft Bottom habitat with some areas of Heterogenous Complex habitat. The Soft Bottom habitat is classified as Fine/Very Fine Sand to Very Coarse/Coarse Sand. The Heterogenous Complex habitat consists of patches of Gravelly Sand and Sandy Gravel consisting of Pebble/Granule. The offshore segment of OECC closest to the Lease Area is mainly soft sediment being Sand or Muddy Sand, with some Gravelly sediment (see Figure 4.5-8). More northern areas begin to alternate between Sand, Gravel/Gravelly mixes, and a small distribution of shell hash (see Figure 4.5-9). Small sand ripples were present for the majority of the transects observed; however, no megaripples or sand waves were found within the OECC (see Appendix II-B).

Similarly, substrate mapping of the New York Bight by Battista et al. (2019) describes the habitat in the region in the vicinity of the OECC to be approximately 80%-100% sand, consisting of Medium Sand with pockets of Coarse Sand along the portions of the OECC near the Lease Area, and becoming Fine Sand closer to the landfall sites. This study showed low Mud content along the OECC with medium (40-60%) Gravel and Pebbles, representing potential Heterogenous Complex habitat near the landfall sites.

Observations within NOAA's Deep Sea Coral Data Portal database indicate no presence of living bottom located within or near the OECC (see Figure 4.5-1). The NOAA/OCM statistical modeling also indicates the lack of habitat suitability for deep-sea hard or soft coral species within or near the OECC (see Figure 4.5-2).

Similar to the results for the Lease Area, the SMAST video survey from 2003-2012 found sponges, bryozoans, and hydrozoans to be present within the Lease Area in 25 percent or less of the samples, on average (see Figure 4.5-3). The presence of hermit crabs along the OECC was relatively low, while the presence of moon snails increased along the shallower portions of the OECC (see Figure 4.5-5). According to the SMAST survey results, the presence of sea stars, sand dollars, and sea scallops decreased as the OECC approaches shore (see Figure 4.5-6 and 4.5-7, respectively).



LEGEND
- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Average Abundance of Sea Scallops (SMAST)
- 0 (<16th percentile)
- >0 - 4 (16th - 84th percentile)
- 5 - 7 (84th - 97.7th percentile)
- 8 - 10 (97.7th - 99.9th percentile)
- 11 - 32 (>99.9th percentile)

Scale 1:1,181,100
1 inch = 30 km

0 10 20 30 km

Basemap: World Ocean Base, Esri
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.5-7
Average Abundance of Sea Scallops (2003-2012, SMAST/TNC)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

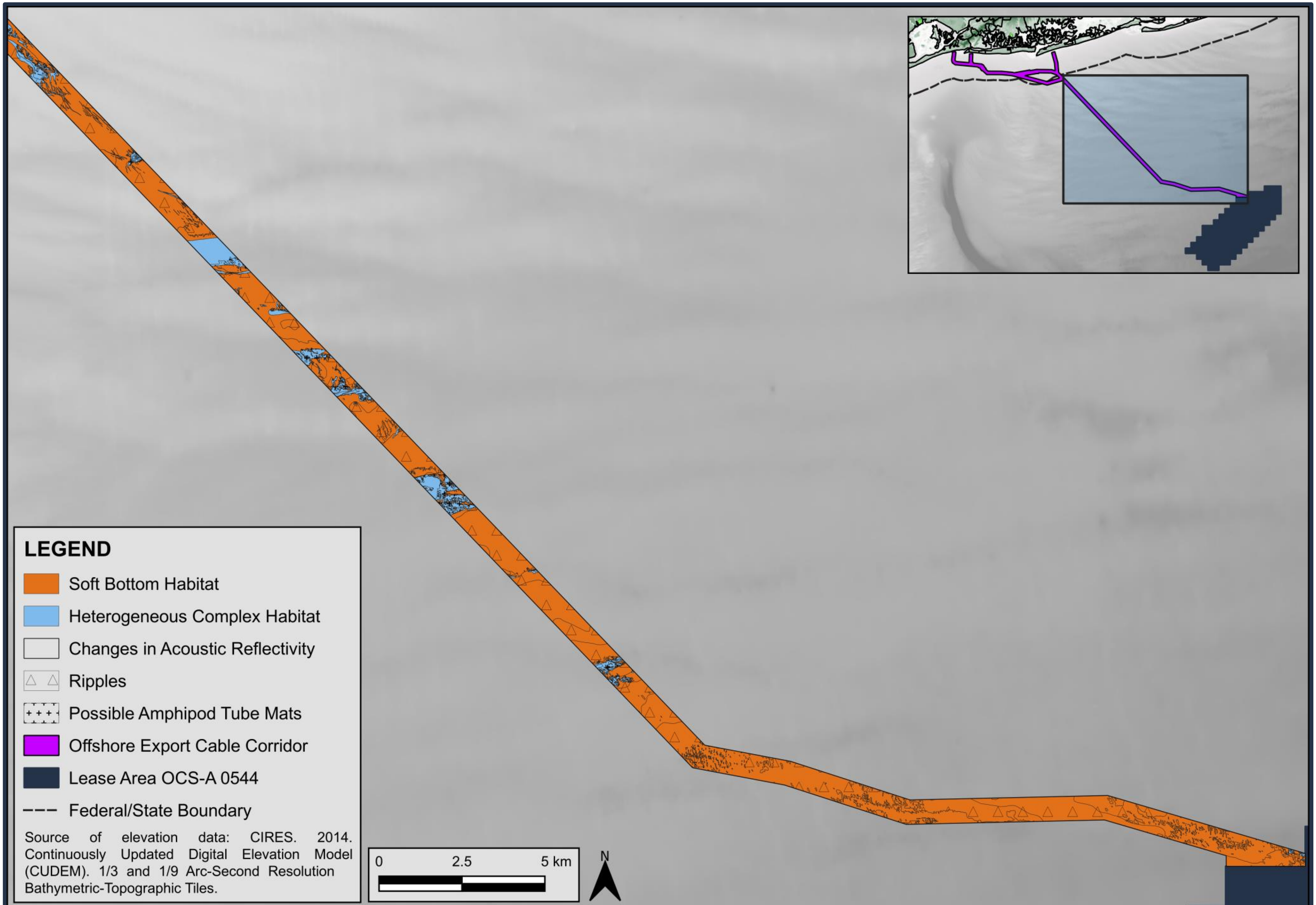


Figure 4.5-8
Habitat Mapping of Offshore Portion of OECC

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

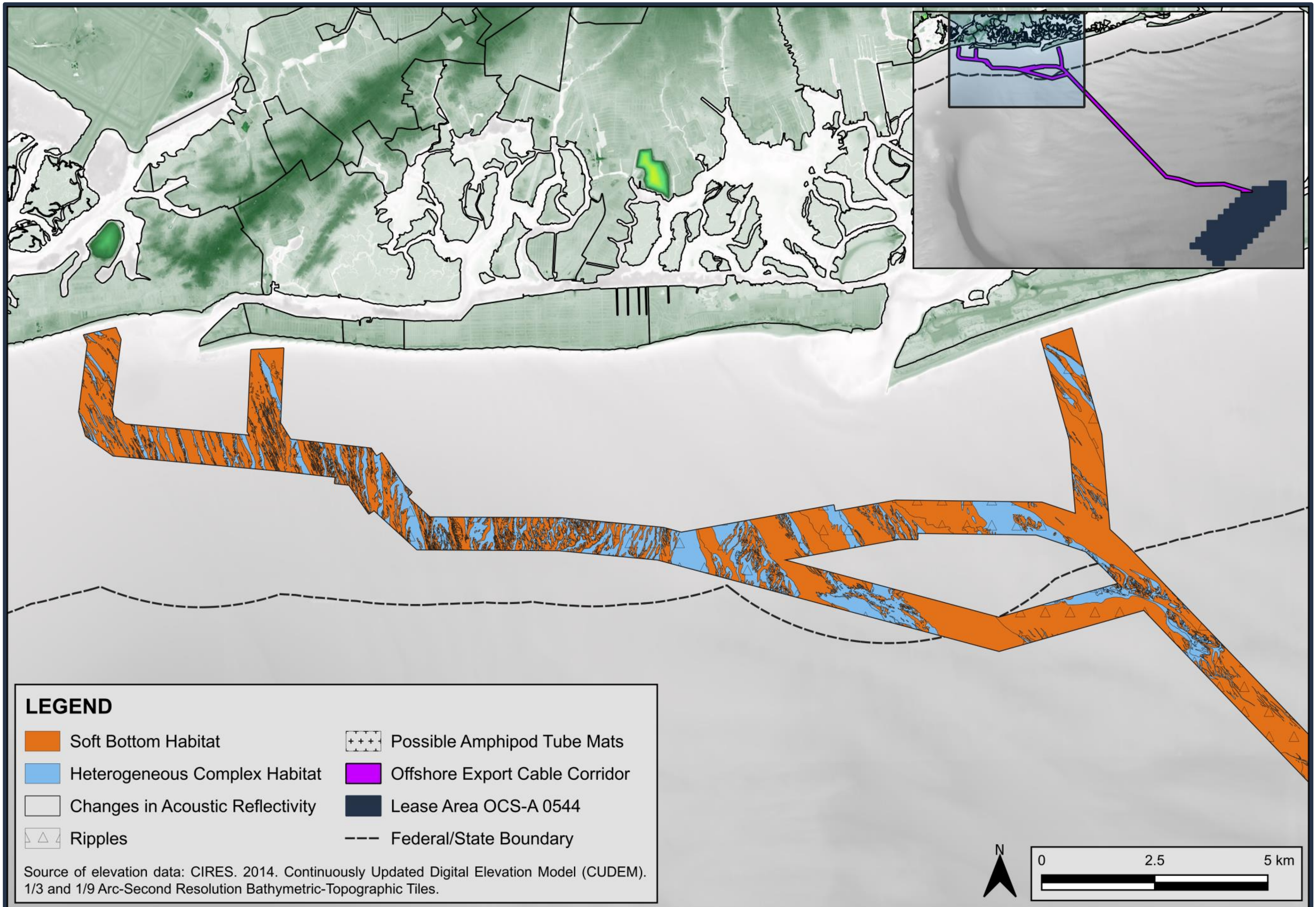


Figure 4.5-9
Habitat Mapping of Nearshore Portion of OECC

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

The NYSDEC provides a Statewide Seagrass Map for seagrasses and eelgrass found in New York state waters. There is no presence of seagrass or eelgrass near or within the OECC (see Section 4.4).

4.5.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect benthic resources during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.5-3.

Table 4.5-3 Impact Producing Factors for Benthic Resources

Impact Producing Factors[1]	Construction	Operations & Maintenance	Decommissioning
Seafloor Disturbance and Habitat Modification	•	•	•
Presence of Structures	•	•	•
Suspended Sediments and Deposition	•	•	•
Discharges/Intakes	•	•	•
Electromagnetic Fields and Cable Heat		•	
Noise	•	•	•
Fisheries Survey Gear Utilization	•	•	
Port Utilization	•	•	•

Note:

1. Artificial light was not included in this analysis of impacts to benthic resources as it is expected to only penetrate the top few centimeters of the water column.

Potential effects to benthic resources were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

4.5.2.1 Seafloor Disturbance and Habitat Modification

Temporary to long-term seafloor disturbance may occur from the installation, maintenance, and decommissioning of foundations (for the wind turbine generators [WTG] and electrical service platforms [ESP]), scour protection, offshore export cables, inter-array and inter-link cables, and cable protection (if required). Long-term habitat modification may result from installation of foundations, scour protection, and cable protection (if required). Additional temporary habitat modification may result from installation, maintenance, and decommissioning of offshore export, inter-array, and inter-link cables; pre-installation activities (such as pre-lay grapnel run, boulder clearance, etc.); and usage of equipment that contacts the seafloor (such as jack-up vessels, vessel anchors or spud legs). Table 4.5-4 provides the expected long-term and temporary seafloor impacts. Additional details are available in Section 3.11 of COP Volume I.

Table 4.5-4 Summary of Maximum Potential Seafloor Disturbance

Activity	Long-Term Seafloor Disturbance	Temporary Seafloor Disturbance	Total Seafloor Disturbance
Maximum Total Disturbance in the Lease Area	1.73 km^2 (428 acres)	6.17 km^2 (1,524 acres)	7.59 km^2 (1,875 acres)
Maximum Total Disturbance in the OECC	0.746 km^2 (184 acres)	5.12 km^2 (1,266 acres)	5.12 km^2 (1,266 acres)

Direct impacts from seafloor disturbance during construction, maintenance activities, or decommissioning include the physical displacement, injury, and mortality of organisms in both the Lease Area and OECC. Sessile and slow-moving benthic and demersal species such as shellfish and early life stages of invertebrates and fishes such as eggs and larvae are most at risk of injury and death from physical trauma as foundations, scour protection, cables, anchors, anchor lines, jack-up legs, and spud legs contact the seafloor. If construction occurs during cooler temperatures, species that bury themselves in the winter such as horseshoe crabs (Walls et al. 2002) and blue crabs (Millikin 1984) have greater risks of impact. Offshore export, inter-array, and inter-link cable installation and maintenance may affect organisms up to the target cable burial depth beneath the stable seafloor of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters,[40] and foundation installation may affect organisms up to the maximum foundation penetration depth as listed in Section 3.3 and 3.4 of COP Volume I. Overall, these impacts are expected to be localized and limited to the relatively small impact areas from construction (see Table 4.5–4). Mobile invertebrates are expected to be impacted temporarily as they move to avoid physical contact and motions perceived as threats. These temporary avoidance impacts occur over a relatively short time period and are comparable to existing disturbances by vessel traffic and fishing gear with organisms expected to return after the action ceases. Impacts from sedimentation during construction are discussed in Section 4.5.2.3.

Temporary habitat modifications, including temporary alterations to bathymetry, are expected to primarily affect benthic resources. Within the Lease Area, temporary habitat modifications may particularly affect benthic and demersal species that associate with Soft Bottom habitats because the Lease Area is primarily comprised of fine substrate as described in Section 4.5.1.1. Effects could range from minor ecological benefits to benthic species from increased hard substrate (scour and cable protection) to settle on in soft sediment dominant areas, to limited impacts from loss of key prey species due to mortality in affected areas. However, these effects

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40 Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

are considered temporary because habitats are expected to begin recovery once construction, maintenance, or decommissioning activities are completed, and the local severity of these impacts is comparable to ongoing fishing dredge impacts along the Northeast United States shelf and potential impacts are relatively small in spatial scale (see Table 4.5–4). Dynamic, sandy physical habitat begins to recover substantially within a few months of disturbance and can fully recover abundance within two years and recover biomass and diversity in two to four years (Van Dalfsen and Essink 2001; Dernie et al. 2003). Additionally, the Proponent will work to minimize temporary habitat effects. For vessels other than anchored cable laying vessels (which must maintain tension on anchor lines), the use of mid-line anchor buoys will be considered (where feasible and considered safe) as a potential measure to reduce impacts to sensitive seafloor habitat from anchor line sweep. There is no anchor line sweep from anchored cable laying vessels because the anchor lines are under tension. In addition, a benthic habitat monitoring plan framework has been developed (see Appendix II-R) to monitor recovery after construction in areas with sensitive habitats.

As discussed further in Section 4.5.2.2, long-term modification may affect benthic species through the alteration of habitat type. Foundations and scour protection will create structured habitat in the water column and along the seafloor that previously did not exist, and cable protection will cover existing habitat with anthropogenic hard bottom. Therefore, foundations, scour protection, and cable protection are expected to have localized ecological benefits for structure-associated species through the conversion of habitat, with potential localized adverse impacts to species that prefer fine substrates.

Any long-term changes due to the introduction of foundations, scour protection, and cable protection are only anticipated to affect a small percentage of the available habitat in the Lease Area and OECC. For example, long-term impacts are only approximately 1% of the total size of the Lease Area. Additionally, the Proponent's goal is to minimize the use of cable protection to the greatest extent possible through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route.

Additionally, deflagration or detonation of unexploded ordnances (UXO) and/or discarded military munitions (DMM) has the potential to affect benthic resources through seafloor disturbance, direct mortality, and underwater noise; this IPF is discussed further in Section 4.5.2.5. During decommissioning, all physical components will be removed, although the offshore cables may be retired in place or removed. Temporary effects from decommissioning are expected to be similar to those experienced during construction. The long-term modification of habitat is expected to be reversed upon decommissioning when offshore components on the seafloor and water column are removed such as foundations and scour protection (unless cable and scour protection are retired in place, in which case they will continue to function as structured bottom unless buried by sedimentation).

4.5.2.2 Presence of Structures

The presence of foundations (monopiles and piled jackets), scour protection, and cable protection will result in a conversion of the existing primarily sandy bottom habitat to a hard bottom habitat with areas of vertical structural relief (Wilhelmsson et al. 2006; Reubens et al. 2013; Bergström et al. 2014; Coates et al. 2014; Kaldellis et al. 2016; Degraer et al. 2020). The newly-created WTG and ESP foundation structures present throughout the water column can be compared to the addition of artificial reefs which have been shown to lead to ecological benefits (Langhamer 2012). These potential effects are anticipated to be similar for monopile or jacket foundations. Some of the benefits observed around foundations include increased biodiversity and abundances of fishes (Wilhelmsson et al. 2006; Andersson and Öhman 2010; Riefolo et al. 2016; Raoux et al. 2017; The Nature Conservancy and INSPIRE Environmental 2021). The addition of foundations may also alter trophic dynamics from the bottom up through the introduction of new surfaces for filter feeders to colonize and consume plankton (Coates et al. 2014; Slavik et al. 2017). Cable protection is expected to have similar impacts in places where it is placed on fine substrate, but, where it is placed on Heterogeneous Complex habitat, it may have temporary negative impacts to structure-oriented species until it is colonized by the benthic community. Both cable protection and scour protection have potential for providing long-term benefits via increased cobble/boulder-like habitat which is a key habitat for lobsters (Linnane et al. 1999; Selgrath et al. 2007) and other species.

Additional research focused on changes in community assemblages related to habitat around offshore wind farms found that species that prefer complex habitat became newly established after installation while communities in nearby soft-bottom habitats remained unchanged (Stenberg et al. 2015). Wind farms have also been found to have localized increases in abundances (Løkkeborg et al. 2002) and improved condition and growth rates (Reubens et al. 2013) of commercially valuable species. However, the habitat created by the addition of project components also has potential to benefit non-indigenous species and provide a mechanism for wider dispersal of potentially harmful non-indigenous species through a steppingstone effect (Glasby et al. 2007; Adams et al. 2014) resulting in localized impacts to sessile invertebrates through competition for space. Further, while the invasive colonial sea squirt (*Didemnum vexillum*) was recorded at the Block Island Wind Farm (HDR 2020), this species is already an established species in New England, including in subtidal areas such as Georges Bank that hosted several sites with 50 to 90 percent coverage by colonial sea squirt (Bullard et al. 2007; BOEM 2024a). Although the impacts of invasive species on EFH have the potential to be widespread and permanent if the species were to become established and outcompete native fauna or modify habitat, the increased risk from Vineyard Mid-Atlantic is low in comparison to the risk from ongoing activities, such as shipping and hull biofouling, aquaculture, and commercial and recreational fishing.

As discussed in Section 3.2, the presence of structures (WTGs, ESPs, and their associated foundations [monopiles for WTGs and monopiles or jackets for ESPs]) may alter physical oceanographic patterns at a fine scale. In addition to potentially reducing the wind-driven mixing of surface water; increasing vertical mixing as the water flows around the structure; introducing turbulence; and influencing local current speed and direction, there is a potential modification on benthic habitats through scour and deposition (Dannheim et al. 2020) from the swift water (BOEM 2024a). Cazenave et al. (2016) observed and modeled turbulent wakes at the scale of kilometers. However, these changes are expected to be on a fine scale and minimal due to the use of scour protection (BOEM 2024a).

The structures also create turbulence that transports nutrients toward the water surface thus increasing primary productivity at localized scales (Dannheim et al. 2020; BOEM 2024a). The changes may increase food availability for filter feeders on or near the structures, which would be result in a beneficial impact (Degraer et al. 2020; BOEM 2024a). The potential impacts on benthic resources on any changes in the physical oceanographic changes that may result from the presence of structures are anticipated to be localized and vary seasonally.

4.5.2.3 Suspended Sediments and Deposition

Temporary increases in suspended sediments and subsequent sediment deposition may occur in the Lease Area and OECC from the installation, maintenance, and decommissioning of offshore export cables, inter-array cables, inter-link cables, foundations (monopiles or jackets), and scour protection. Specifically, sediment is expected to be suspended into the water column during cable pre-installation activities (e.g., pre-lay grapnel run, boulder clearance, etc.), cable installation, seabed preparation prior to foundation installation (if needed), installation of cable protection (where required), the use of other equipment that contacts the seafloor (e.g., jack-up vessels, vessel anchors, or spud legs), and excavation and backfill of the temporary horizontal directional drilling (HDD) exit pit. These activities would occur during construction with potential for limited activities during O&M if cables require repair or maintenance; however, any maintenance impacts would be expected to be far less than those from construction activities. Impacts from suspended sediments and deposition would be temporary and confined to a small area close to the location of the installation activity.

Direct effects on benthic resources from suspended sediments can include burial, blockage of filter feeding apparatuses, and reducing filter feeding abilities. Although many benthic organisms have developed behavioral and physiological mechanisms to deal with the resuspension of sediments that often follow natural events (i.e., storms, tidal flows, and currents), the scope, timing, duration, and intensity of sediment-generating activities may create an environment that some species are less able to tolerate. Benthic suspension feeders are particularly sensitive because suspended particles can remain suspended in the water column for weeks and interfere with feeding and growth (Wilber et al. 2005; Smit et al. 2008). The severity of impacts from suspended sediments during construction, maintenance activities, or decommissioning would vary based on the concentration and duration of suspended material. Minimum threshold effects for various benthic organisms have been determined in laboratory settings and are shown in Table 4.5–5. As shown, the suspended sediment threshold for the most sensitive species is 10 milligrams per liter (mg/L) for 24 hours. The value for the most sensitive species is derived from studies of coral that are not present within the Offshore Development Area. The suspended sediment threshold for the next most sensitive benthic species that may be present within the Offshore Development Area, which likely provides a more reasonable conservative threshold, is either 100 mg/L for one day or 200 mg/L for 12 hours.

Table 4.5-5 Suspended Sediment Minimum Effects Threshold for Benthic Organisms

Organism Group (Life Stage)	Minimum Effects Threshold for Suspended Sediment
Mollusks (eggs)[1]	200 milligrams per liter (mg/L) for 12 hours
Mollusks (juveniles and adults)[2]	100 mg/L for 24 hours
Crustaceans (all life stages)[3]	100 mg/L for 24 hours
Corals (eggs)[4]	50 mg/L for 24 hours (preventing fertilization)
Corals (larvae)[4]	10 mg/L for 24 hours (altering larval settlement)
Corals (adults)[4]	25 mg/L for 24 hours (reducing calcification rate)

Notes:

1. Based on the concentration and duration at which sublethal effects were observed to the development of eastern oyster eggs (Cake 1983; Wilber and Clarke 2001).
2. Based on sublethal effects (i.e., reduced growth and reduced respiration) observed in northern quahog (*Mercenaria mercenaria*; Murphy 1985; Wilber and Clarke 2001).
3. Based on sublethal effects (i.e., reduced growth and reduced respiration) observed in copepods, and euphausiids (Anderson and Mackas 1986).
4. See Rogers 1990; Gilmour 1999; Fabricius 2005. Studies investigate tropical species that are not present within the Lease Area.

Direct effects on benthic resources from the resettlement of suspended sediments can include mortality or injury, particularly for immobile species or life stages from burial and smothering. Severity of impacts from deposited sediments during construction, maintenance activities, or decommissioning would vary based on the thickness of material. Taxonomic groups react differently and have varying levels of tolerance for sedimentation, with sessile and attached organisms having the lowest tolerance and highest mortality rate during sedimentation events (Wilber et al. 2005; Gates and Jones 2012). However, some attached bivalve species, such as mussels and oysters, have survived deposition levels of several millimeters (Wilber et al. 2005). Organisms that burrow or feed in subsurface sediments will likely be less sensitive to burial as they can unbury themselves.

The most sensitive life stage of the species considered for Vineyard Mid-Atlantic is demersal eggs. Several species of fish and invertebrates have demersal eggs, including the winter flounder (*Pseudopleuronectes americanus*), summer flounder (*Paralichthys dentatus*), longfin inshore squid, and whelk species. For demersal eggs, deposition greater than 1 mm (0.04 in) can result in the burial and mortality of that life stage (Berry et al. 2011). Therefore, 1 mm (0.04 in) of deposition is the lowest threshold of concern for Vineyard Mid-Atlantic.

A second threshold of concern was selected for shellfish. Reported thresholds for the lethal burial depths of bivalves vary among species, but it is currently understood that the most sensitive species are those that are sessile or surface-oriented, such as blue mussel, soft-shell clam, and oysters (*Ostrea* spp.) (Essink 1999). One of the more comprehensive studies available is an early lab and field experiment of the effect of sudden burial on 25 species of bivalves from eight different "life habit types" defined by habitat (infaunal, epifaunal), feeding method (suspension, deposit), and burrowing behavior (Kranz 1974). The author determined that epibenthic suspension-feeders that use byssal attachments (i.e., sessile and lack a digging foot) are less capable of escaping deposition via traveling through the sediment, while many deposit feeder mollusks (e.g., *Macoma* clams and others within the Tellinacea or Nuculacea superfamilies) and infaunal mucus tube feeders (e.g., Lucinidae family bivalves) can escape burial thicknesses in native sediment up to 400 mm (16 in) by rapidly burrowing and/or better tolerating anoxic conditions (Kranz 1974). While the literature has shown sensitivity of bivalves to sedimentation varies greatly among species and can range up to several hundred millimeters of deposition, a sedimentation threshold of 20 mm (0.8 in) was used as the general threshold for shellfish. This threshold is inclusive of thresholds for most species and life stages, including more sensitive subtidal mussel and oyster beds, and is conservatively based on the work of Colden and Lipcius (2015), Essink (1999), and Hendrick et al. (2016). While Kranz (1974) reported zero escape potential (i.e., cannot move through sediment) for attached epifauna, he also noted that mussels can withstand burial for several months, so the escape potential thickness is not synonymous with a sedimentation tolerance threshold. Therefore, while attached shellfish may be unable to escape burial by burrowing up to the sediment surface similar to other bivalve groups (Kranz 1974), they have other adaptive responses that enable survival under sedimentation. For example, oysters can clear themselves of sediment (Wilber and Clarke 2001) and partial burial can lead to increased shell growth rates to reach the sediment surface (Colden and Lipcius 2015). Thus, based on these findings and on the wide range of sedimentation thicknesses and durations tolerated by bivalves in general, a 20 mm (0.8 in) threshold is a reasonably conservative threshold for assessment of impacts.

To assess the impacts of suspended sediments and deposition, sediment transport modeling was completed for offshore export and inter-array cable installation and HDD exit pit construction[41] (see Appendix II-P). Activities were modeled separately within the Lease Area and the OECC. Model results provided the following estimates of the durations and concentrations of suspended sediment during construction:

- **Offshore export and inter-array cable installation:** Above-ambient total suspended solids (TSS) concentrations substantially dissipate within three hours and fully dissipate between six and 12 hours. The modeling analyses predict that suspended sediment concentrations induced by installation of the cables will largely be of short duration, confined to the near-bottom portion of the water column, and will return to ambient conditions within several hours after the installation device has passed. Additionally, if a pre-pass jetting run (using a jet plow or jet trencher) were to be conducted along the

[41] As described in Appendix II-P, the modeling for HDD exit pit construction focused on backfilling since it may result in greater water quality effects than excavation under the conservative assumption that excavated material is released at the water surface.

route (see Section 3.5.4 of COP Volume I), it is anticipated this would occur with sufficient time for any suspended sediment concentrations to return to ambient conditions prior to cable installation.

- **HDD exit pit construction:** Above-ambient TSS concentrations may be present throughout the entire water column because sediments were released at the water surface but are predicted to return to ambient conditions within six to 12 hours.

Since suspended sediments are expected to dissipate within 12 hours for all modeled scenarios and do not exceed the conservative effects threshold of concentrations of 100 mg/L for 24 hours (for fish eggs and larvae, all life stages of crustaceans, and juvenile and adult mollusks), suspended sediments from construction and operation activities are not expected to have lethal or sublethal effects to finfish and invertebrates in the Offshore Development Area. In addition, suspended sediments are expected to be localized, with high concentrations not expected to travel greater than a few kilometers (a couple of miles) from the centerline.

Model results also provided estimates of the extent, area, and range of thicknesses of deposited sediment during construction (Appendix II-P). Model results of sediment deposition for offshore export cable and inter-array cable installation and HDD exit pit construction provided the following estimates:

- **Offshore export and inter-array cable installation:** In most areas, the model predicted a depositional thickness between 1 mm (0.04 in) and 5 mm (0.2 in); small areas were predicted to have a depositional thickness between 5 mm (0.2 in) and 20 mm (0.8 in). For the maximum jetting scenario in the Lease Area, a small area of deposition was predicted to exceed 20 mm (0.8 in).

- **HDD exit pit construction:** The model predicted a depositional thickness greater than 100 mm (4 in), however, the areas associated with these thicknesses were relatively small (0.01 square kilometers [km^2] [2.5 acres]) and were local to the source.

For offshore export cable installation and HDD exit pit construction, the model predicted that deposition in most areas would be below the 20 mm (0.8 in) sensitivity threshold for shellfish, with only a small area (up to 0.03 km^2 [7.4 acres]) predicted to have deposition above 20 mm (0.8 in) for each HDD exit pit. If a pre-pass jetting run (using a jet plow or jet trencher) were to be conducted along the route (see Section 3.5.4 of COP Volume I), the predicted deposition is expected be similar to that of the offshore export cable installation scenario and remain below the 20 mm (0.8 in) threshold. Sufficient time is also anticipated between the pre-pass jetting run and cable installation to allow for some of this sediment deposition to be redistributed due to the forcing of surrounding currents.

Although there are expected to be primarily short-term impacts on the finfish and invertebrate resources along the OECC and Lease Area, these are not anticipated to result in population-level effects. In addition, a benthic habitat monitoring plan framework has been developed (see Appendix II-R) to monitor recovery after construction in areas with sensitive habitats where similar post-construction monitoring has not already been conducted for other projects (such as along the OECC).

4.5.2.4 Discharges/Intakes

Discharges and intakes that may affect benthic resources include entrainment and impingement and inadvertent releases or spills.

Localized entrainment and potentially impingement of pelagic life stages of demersal finfish and invertebrates may occur in the Lease Area and OECC from the installation, maintenance, and decommissioning of offshore export cables, inter-array cables, inter-link cables, foundations, and cable and scour protection. Short-term impacts may result from vessel cooling systems used during all phases and from other pump intakes such as the potential use of jetting equipment to install offshore export, inter-array, and inter-link cables. If the selected ESP includes high voltage direct current (HVDC) equipment, impacts may result from the seawater cooling water intake structure (CWIS) which may be required.

To estimate the impacts of entrainment from an HVDC CWIS, an assessment using anticipated flow rates and local zooplankton data was completed as described in Appendix II-N. Model results provided estimates of the composition and magnitude of intake mortality for ichthyoplankton and total other zooplankton. Additionally, the use of an HVDC CWIS involves the discharge of warmed seawater after it leaves the heat exchangers; this warmed seawater will be discharged below the water's surface through pipes that are attached to the foundation. Any thermal impacts are anticipated to be limited to the immediate area surrounding the discharge, leaving large areas of the surrounding water mass unaffected. Based on the magnitudes of the results, ecological and socioeconomic effects from entrainment or limited thermal impacts by the HVDC CWIS will likely be undetectable. See Section 4.6.2.3 for additional details.

Section 7.5 includes additional discussion of potential impacts to benthic resources from accidental releases and discharges (including marine debris), as well as measures that will be adopted to avoid, minimize, or mitigate potential impacts.

4.5.2.5 Electromagnetic Fields and Cable Heat

EMFs and cable heat will be produced by energized offshore export, inter-array, and inter-link cables during operation. EMFs consist of two components: electric fields and magnetic fields. The characteristics of the EMF can vary greatly depending on the energy flow of electricity and the type of current: high voltage alternate current (HVAC) vs. HVDC (Tricas 2012). Due to cable configuration and shielding, electric fields are not expected in the marine environment from Vineyard Mid-Atlantic's cables. Therefore, the following discussion describes EMF generally and then focuses on magnetic fields (MFs) when discussing the potential effects from Vineyard

Mid-Atlantic. As described further in Section 3.5 of COP Volume I, two to six offshore export cables installed within the OECC will transmit electricity from the ESP(s) to landfall sites on the southern shore of Long Island, New York.

The effects on benthic resources from EMF are not fully understood but can include disorientation and other behavioral responses (e.g., avoidance, changes in prey detection or feeding activity) (Riefolo et al. 2016). The severity of impacts from EMF during operation would vary based on the strength of the EMF and the electrosensitivity of organisms. Of species potentially present in the Offshore Development Area, electromagnetic sensitivity has been primarily documented in sea slugs and sea urchins; however, they have sensitivity thresholds above modeled electric fields and are therefore not expected to be impacted (Normandeau et al. 2011). The effects of EMF would be localized because EMFs produced by cables decrease with distance. In addition, at the target burial depth beneath stable seafloor of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters, EMFs at the seabed would be expected to be weak and likely only detectable by demersal species (Normandeau et al. 2011). In areas where seafloor type potentially prohibits cable burial, cable protection would serve as a similar although thinner barrier to exposure.

A white paper review study funded by BOEM determined that EMFs produced by HVDC/HVAC power transmission cables would result in negligible, if any, effects on six demersal invertebrates: Atlantic sea scallop, deep-sea red crab (*Chaceon quinquedens*), Atlantic surf clam, ocean quahog, American lobster, and Jonah crab (*Cancer borealis*; Snyder et al. 2019). Other reviews have concluded that effects of EMFs on invertebrates can be measurable but impacts from EMF are not expected as almost all cables will be buried (Albert et al. 2020; Gill and Desender 2020). For example, there is some evidence of attraction to EMF for a species of *Cancer* crab at an EMF strength hundreds of times greater than expected based on modeling for Vineyard Mid-Atlantic (Scott et al. 2021; see Appendix II-O). Similarly, although there were changes in the behavior of little skate, an elasmobranch, and American lobster in the presence of energized HVDC cables, EMFs from cables did not act as a barrier to movement in any way (Hutchison et al. 2018, 2020). In a laboratory study on a benthic polychaete (*Hediste diversicolor*), no avoidance or attraction to EMF levels (50 Hz, 1 mT) typically recorded near submarine cables was observed. Burrowing activity and ammonia excretion was increased in the EMF treatment, showing a potential bioturbation increase; however, the mechanisms of this effect are unknown (Jakubowska et al. 2019). Other research investigating habitat use around energized cables found no evidence that invertebrates were attracted to or repelled by EMFs emitted by cables (Love et al. 2017). Further, there are already subsea transmission cables present in the Offshore Development Area (see Section 5.8). Surveys in this area show benthic resources occur near cable burial sites, but EMF impacts are expected to be negligible as the cables will be buried.

For HVDC cables, other manmade sources of perturbations to Earth's steady direct current (DC) geomagnetic field in coastal environments include shore-based structures such as docks, jetties, and bridges; sunken ships; pipelines; and ferromagnetic mineral deposits (Normandeau et al. 2011; CSA Ocean Sciences Inc. and Exponent 2019). Additionally, Normandeau et al. (2011) reported that MF impacts nearby to these sources can be on the order of tens of milliGauss (mG), while CSA Ocean Sciences Inc. and Exponent (2019) observed that undersea sources of DC MFs including steel ships and bridges can create DC MFs up to 100 times greater than MFs from DC submarine cables.

For HVAC cables, a seven-year study reported the first findings in the United States of the responses of demersal fish and invertebrates to construction and operation of an offshore wind project (Wilber et al. 2022). This study analyzed catch data from monthly demersal trawl surveys conducted by local fisherman and scientists during construction and operation of the Block Island Wind Farm. This study did not identify harmful impacts of EMF from the 60-Hz alternating current (AC) submarine export cables or other offshore electrical infrastructure, and instead reported evidence of increased populations of several fish species near the wind farm during the operation time period relative to the reference areas.

To assess the potential effects of Vineyard Mid-Atlantic cables, modeling of MFs from HVDC and HVAC cables was completed (see Appendix II-O).[42] Model results provided estimates of the magnitude and extent of MFs from a range of loads during operation and for cables that are either buried at a depth of 1.2 m (4 ft) or surface-laid. Surface laid cables are assumed to have 0.5 m (1.6 ft) thick cable protection covering. Modeling demonstrated that MFs at the seafloor from the buried cables decline with distance, with a maximum MF directly above the centerline that decreases rapidly with distance. Tables 4.5-6 and 4.5-7 show the rapid drop-off in MF levels with increased lateral distance from the HVAC cables or HVDC cable bundles for each of the modeling scenarios. More specifically, the analysis shows >95 to >99% reductions in MF levels cables at lateral distances of ±25 feet (±7.6 meters) from the centerlines of HVAC cables or HVDC cable bundles. At lateral distances of ±25 feet, there is a negligible difference in MF levels for the buried versus the surface-laid cables. Based on the results, MFs are likely only able to be sensed, if at all, directly over the buried cable centerline. Therefore, any effects from EMF are expected to be localized with only behavioral impacts, if any at all, for most benthic species.

42 Modeling was focused on offshore export cables because inter-array cables are expected to have lower currents and MFs. Inter-link cables are expected to have similar or lower MFs.

Table 4.5-6 Summary of Modeled Magnetic Fields for HVDC Offshore Export Cables, as Deviations from Earth's Steady DC Magnetic Field

Cable Voltage	Installation Scenario[2]	DC Magnetic Field[1] Deviation (mG)[3]			
		Maximum (above cables)	± 10 ft	± 25 ft	± 50 ft
±320 kV	Buried	-395 to 407	-58.8 to 60.0	-11.6 to 11.7	-2.9 to 2.9
	Surface-laid	-267 to 2,039	-72.5 to 72.6	-11.5 to 11.5	-2.8 to 2.8
±525 kV	Buried	-431 to 450	-65.5 to 67.0	-13.0 to 13.0	-3.2 to 3.2
	Surface-laid	-270 to 2,207	-81.1 to 81.2	-12.9 to 12.9	-3.2 to 3.2

Notes:

1. Magnetic fields are presented as the deviation from the Earth's steady DC magnetic field of 508 mG and are maximum deviations across modeling cases that include two representative cable orientations (north-south and east-west) and both possible current flow direction scenarios for each representative cable orientation. Negative values are the maximum reductions below the Earth's steady DC magnetic field of 508 mG.
2. Magnetic fields at the seabed are reported for buried cables at 1.2 m (4 ft) depth. Surface-laid cables are assumed to have 0.5-m (1.6-ft) thick cable protection covering. For these scenarios, magnetic fields are reported at the top of the cable protection, specifically at 0.65 m (2.14 ft) for the ±320-kV cables, and 0.67 m (2.20 ft) for the ±525-kV cables.
3. Horizontal distance is measured from the center of the cable bundle.

Table 4.5-7 Summary of Modeled Magnetic Fields for HVAC Offshore Export Cables

Cable Voltage	Installation Scenario[1]	AC Magnetic Field (mG)[2]			
		Maximum	± 10 ft	± 25 ft	± 50 ft
220 kV	Buried	285	47.1	9.1	2.8
	Surface-laid	1,243	54.0	9.3	2.8
345 kV	Buried	319	53.7	10.4	3.2
	Surface-laid	1,354	61.6	10.7	3.2

Notes:

1. Magnetic fields at the seabed are reported for buried cables at 1.2 m (4 ft) depth. Surface-laid cables are assumed to have 0.5-m (1.6-ft) thick cable protection covering. For these scenarios, magnetic fields are reported on top of the cable protection, specifically at 0.79 m (2.58 ft) for 220-kV cables, and 0.82 m (2.68 ft) for 345-kV cables.
2. Horizontal distance is measured from the center of the cable bundle.
3. The offshore export cable MF modeling assumes straight-laid phase-conductor cable cores, as opposed to the actual helical or "twisted" phase-conductor cores. A helical design achieves a considerable degree of magnetic field cancellation; hence the modeled MF levels are expected to be overestimates of actual MF levels.

Inter-array and offshore export cables emit thermal radiation to the surrounding environment that may minimally increase water and sediment temperatures in the immediate vicinity of the cables (Boehlert and Gill 2010; Hogan et al. 2023). Buried cables have been found to increase the temperature of sediments, but such effects are limited to the surrounding sediments touching the cable (up to tens of centimeters) (Taormina et al. 2018). Similarly, any minimal increase in water temperature from cable heat is predicted to dissipate within a few centimeters of the cable (Boehlert and Gill 2010). As noted above, the target cable burial depth beneath stable seabed is 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters; cable protection will be installed in areas where a sufficient burial depth cannot be achieved. Although the effect on benthic communities is not fully understood, if cable heat were a stressor to benthic resources, any potential impacts are expected to be limited to small areas immediately surrounding the cables (BOEM 2024a). Potential impacts from EMF and cable heat will be minimized via cable shielding and cable burial depth (Normandeau et al. 2011).

4.5.2.6 Noise

Temporary to long-term increases in noise may occur in the Lease Area and OECC from the installation, O&M, and decommissioning of foundations, WTGs, and offshore cables. The intensity and duration of noises should vary based on activity, with construction producing the largest increase in sound exposure to benthic resources. Temporary construction noise is expected to be both repetitive, high-intensity (impulsive) sounds produced by pile driving, and continuous (non-impulsive), lower-frequency sounds produced by vessel propulsion, drilling, vibratory installation of foundations and cofferdams, and cable pre-installation/installation activities. Noise will also be produced during UXO detonation, if needed. Long-term operational noise is expected to be continuous (non-impulsive) noise from WTGs and vessel traffic. Some other continuous noise may be produced temporarily during cable maintenance or aircraft activities, however the intensity of produced operational sound pressure levels is expected to be lower than ambient noise from existing boat and air traffic.

There has also been a suite of air gun studies examining a variety of invertebrate life stages. New Zealand scallop (*Pecten novaezelandiae*) larvae exposed to extended periods of air gun signals during their ontogeny had increases in abnormality and mortality rates (Aguilar de Soto et al. 2013). André et al. (2011) and Solé et al. (2013) provide evidence of acoustic trauma in four cephalopod species—common cuttlefish (*Sepia officinalis*), common octopus (*Octopus vulgaris*), European squid (*Loligo vulgaris*), and southern shortfin squid (*Illex condietii*)—which they exposed (underwater) for two hours to low-frequency sound. Both studies reported permanent and substantial morphological and structural alterations of the sensory hair cells of the statocysts following noise exposure, with no indication of recovery.

Benthic invertebrates are mostly in constant contact with the sediment, and this type of sound pressure vibration is likely similar or greater than sound propagated through water (Roberts and Elliot 2017). The scientific literature on sound sensitivity in marine invertebrates is extremely scarce (Roberts et al. 2016), and only some studies have found sessile mollusks to close their siphons or mobile species to move away from the sound source (Ellers 1995; Kastelein et al. 2008). Although one study saw a 5 to 15% increase in scallop mortality when they were directly exposed to a seismic air gun array (Day et al. 2016), that level of sound exposure (191 to 213 dB re 1μPa peak-peak sound pressure level [SPL]) is not expected to occur from pile-driving and the mechanism that caused mortality in the study was not known. However, a different study in the Bass Strait, Australia showed no evidence of increases in scallop mortality, or effects on scallop shell size, gonad size, or gonad stage, attributable to the seismic survey conducted in the area (Przeslawski et al. 2018).

The installation of piles with impact hammers will be the largest sound source during the construction process, and peak sound pressure levels can exceed 180 dB re 1μPa (NRC 2012). In studies, blue mussel clearance (i.e., filtration rate) increased with pile driving sound, likely in response to increased metabolic demands triggered by stress (Spiga et al. 2016). Sediment vibration from pile driving activities can also cause responses from benthic invertebrates, although relatively little research on vibration effects has been conducted to date and the sensitivities of benthic invertebrates to vibration are unknown (Roberts et al. 2016). In a semi-field experiment using a small-scale pile driving located 295 ft (90 m) away at the edge of an enclosed dock, blue mussels exhibited behavioral and physiological variation in valve gape and oxygen demand (Roberts et al. 2016). Hermit crab behavior did not significantly change during this experiment, highlighting that impacts to benthic resources will be species-specific and that mobile individuals will be able to vacate the area. In this same experiment, the authors observed that the vibration signal propagated farther away in shallower water than in deep water; the signal in the sediment was low frequency (< 100 Hz) and concentrated around 25 to 35 Hz, and the signal was strongest along the vertical axis near the pile (Roberts et al. 2015, as cited in Roberts et al. 2016). Sound and vibration impacts to benthic resources from pile driving are expected to be temporary, localized, and non-lethal. Specific sound pressure levels modeled for Vineyard Mid-Atlantic activities are included in Appendix II-E.

Direct effects on invertebrates from noise can include behavioral changes, stress responses, and possibly injury. Responses to noise originate from the particle motion created from the noise source (BOEM 2024a). Impacts to invertebrates from particle motion (e.g., startle responses, valve closure, changes to respiration or oxygen consumption rates) are normally limited to within a few meters of the source (Payne et al. 2007; Hawkins and Popper 2014; Edmonds et al. 2016; Carroll et al. 2017). However, lab research indicating that longfin squid may sense and respond to vibrations from pile driving noise at a greater distance based on recorded sound exposure experiments (Jones et al. 2020; 2021) may suggest that benthic resources may also exhibit a behavioral response to vibrations at greater distances (BOEM 2024a). Any effect on benthic resources that may be caused by pile driving noise would be primarily limited to the area around each pile, although there is a potential for short-term stress behavioral changes to individuals over a greater area. It is expected that any affected areas would likely be recolonized in a short timeframe (BOEM 2024a).

Noise could also affect the functionality and sensitivity of the sensory systems of marine invertebrates but most studies on these effects have been performed *ex situ*, making it difficult to control and assess the acoustic conditions and typically only measure and report on the pressure component of sound. Although understanding of the impact of sound on invertebrates is extremely limited, there is no evidence based on current studies of significant impacts from expected sound, including pile driving, on benthic invertebrates.

If potential unexploded ordnances UXO and/or discarded military munitions DMM are discovered in the Lease Area or OECC, the Proponent will prioritize avoidance of UXO/DMM wherever possible by micro-siting structures and cables. Where avoidance is not possible (e.g., due to layout restrictions, presence of archaeological resources, etc.), UXO/DMM will be relocated or otherwise disposed of (e.g., via deflagration [burning without detonating], detonation, or dismantling the UXO/DMM to extract explosive components). The exact number and type of UXO/DMM that may be present, and which subset of those UXO/DMM cannot be avoided by micro-siting, are unknown at this time and further evaluation is ongoing. Deflagration or detonation of UXO/DMM has the potential to affect benthic resources through seafloor disturbance, direct mortality, and underwater noise. Such impacts would be short term and localized.

Vessel traffic associated with construction, operation, and decommissioning would result in temporary, transient, and continuous non-impulsive noise primarily originating from the vessel's propulsion system. Sound emission from vessels, especially from vessels using dynamic positioning, depends on vessel operational state and is strongly weather-dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 dB re 1 μPa for numerous vessels with varying propulsion power using dynamic positioning. Continuous, lower-level sources (e.g., vessel noise) are unlikely to cause injury to benthic resources but may elicit behavioral changes or acoustic masking.

Prior to offshore cable installation, pre-installation activities may include debris and boulder clearance and minimal to no sand bedform leveling. Boulder clearance (if required) is expected to be accompanied by a grab tool suspended from a vessel's crane, which lifts individual boulders clear of the alignment and relocates them elsewhere within the OECC. Alternatively, a route clearance plow may be towed by a vessel along the cable alignment to push boulders aside. Sand bedform leveling (if required) may be accomplished by one or a combination of the following techniques: controlled flow excavation, offshore excavator, or a route clearance plow. Following boulder clearance and sand bedform leveling (if necessary), pre-lay surveys and pre-lay grapnel runs will be performed to verify seafloor conditions and confirm that the cable alignments are suitable for installation (free of obstructions). The pre-lay surveys are expected to be performed using multibeam echosounders and potentially magnetometers. The offshore cable will then be buried beneath the stable seafloor, likely using jetting techniques or a mechanical plow. Further detail pertaining to the pre-installation activities is included in Section 3.5.3 of COP Volume I.

Sounds from pre-installation activities and cable installation activities are considered non-impulsive and are not expected to produce sounds above those of routine vessel activities. Specific to sand bedform leveling, the sounds produced during excavation vary depending on the sediment type—the denser and more consolidated the sediment is, the more force the equipment needs to impart, and the higher sound levels that are produced (Robinson et al. 2011). Sounds from mechanical dredges (such as an excavator) occur in intervals as the excavator lowers a bucket, digs, and raises the bucket.

Table 4.5-8 provides available sounds of various activities that are similar to some of the pre-installation and cable installation activities proposed for Vineyard Mid-Atlantic. Table 4.5-8 includes representative sounds from different types of dredging activities; however, minimal to no sand bedform leveling is anticipated and therefore this activity (if required) will be of a short duration.

Table 4.5-8 Examples of Broadband Sound Pressure Levels (SPL) of Some Anthropogenic Sounds

Activity	SPL (dB re 1µPa), 1 m from the source	Frequency range (kHz)	Reference
Plough trenching in sandy gravel	178.0	0.7-50	Taormina et al. (2018)
Trenching and cable installation	188.5	NA	
Dredging	168–186	0.03–20	Thomsen et al. (2009)
Drilling	145–190	0.01–10	
Hydraulic cutterhead dredge	168–178	0.02–1000	Reine et al. (2014)
Trailer Suction Hopper dredge during active dredging (1 kts speed)	172.6–179.9	NA	
Backhoe dredge, bottom grabs during removal of gravel and rock	179.4	NA	

Notes:

1. SPL is representative of a distance of 1 m (3.2 ft) from the source.
2. Not available (NA) in the cited references.

Table 4.5-8 shows that sounds from cable installation, drilling, and sand bedform leveling are broadly similar. Further, these sounds are quieter than sound from impact pile driving (as shown in Appendix II-E). Sounds from pre-installation and cable installation activities are also quieter than sound measured from transiting vessels (supertankers and frigates), based on measurements taken in Stellwagen Bank (Haver et al. 2019), which is a region with a similar acoustic soundscape as the Lease Area (both sites are in the shallow water portion of the continental shelf and both sites are in areas that have ports with high density traffic). Sound levels decrease as a receptor moves away from the source and would be reduced by about 40 dB at a distance of around 500 m (1,640 ft) (based on a common acoustic decay rate of 15log*10*(R)), which is similar to ambient noise. Accordingly, underwater sounds from pre-installation and cable installation activities are spatially localized and temporary and would only have limited effects, if any, to benthic organisms. Operating WTGs produce low levels of sound with source levels up to 151 dB SPL_{rms} in the 60 to 300 Hz frequency range (Dow Piniak et al 2012). The sound generated by WTGs is produced within the nacelle, the enclosed housing that stores the turbine generating parts, which is then transmitted through the foundation and radiated into the water. Measurements at the Block Island Wind Farm found that sound would likely decline to ambient levels at a distance of 1 km (0.5 nautical mile [NM]) from the WTGs and an average sound level was recorded to be between 112–120 dB when wind speed was 2–12 m/s (6.5–39.4 feet per second [ft/s]]) (HDR 2019). These measurements and the available literature indicate that noise generated during the operational phase of wind farms is minor and does not cause injury (Wahlberg and Westerberg 2005; Bergström et al. 2013). The WTGs used by Vineyard Mid-Atlantic WTGs may be larger in size than those studied at the Block Island Wind Farm; however, larger turbines are expected to produce similar sound. As the size of turbines increases so does the mechanical forces working on gears and bearings. However, an increased turbine size means an increase in distance from the noise source in the nacelle to the water (Tougaard et al. 2020).

4.5.2.7 Fisheries Survey Gear Utilization

A draft preliminary fisheries monitoring plan for pre-, during, and post-construction fisheries surveys has been developed for Vineyard Mid-Atlantic and is included as Appendix II-U. A preliminary list of potential surveys includes:

- Seasonal trawl survey following the NEAMAP survey protocol;
- Baited remote underwater video;
- Highly migratory species acoustic telemetry;
- Drop camera survey;
- Hydraulic surfclam dredge survey; and/or
- Ecosystem monitoring plankton survey.

The number of fisheries monitoring surveys to be conducted is expected to be a subset of those listed above and in Appendix II-U. Further refinement will be based on future research and agency and stakeholder feedback. Fisheries monitoring surveys are anticipated to be carried out by qualified scientists.

Several of these potential monitoring survey types include remote or minimally disruptive techniques that are unlikely to meaningfully affect benthic resources. The survey gear used in fisheries surveys that would affect benthic invertebrate communities are those that disturb the seafloor (e.g., bottom trawls and dredges). During trawl surveys, a net is towed behind a vessel along the seafloor and expanded horizontally by a pair of otter boards or trawl doors. During hydraulic surf clam surveys, high-pressure jets direct water into the seafloor to push sediments aside and allow a metal blade to pass through the upper portion of the seafloor and scoop up clams into a metal cage. The use of bottom trawl and surf clam dredge surveys may also result in limited resuspension of sediments (including any pollutants, although they are not expected to be present given the predominantly sandy surficial sediments in the Lease Area).

Dredging and trawling are methods used to land clams, scallops, and other benthic species, and these dredge and trawl surveys would be expected to have similar effects as existing commercial fishing activities. However, as scallop dredge, bottom trawl, and clam dredge are ranked the top three in landings within the Lease Area (see Section 5.4), the benthic resources in the area are exposed to this level of disturbance. Disturbance of benthic invertebrate communities by commercial fishing activities can adversely affect community structure and diversity and limit recovery from offshore wind farms (Avanti Corporation and Industrial Economics 2019), although this impact is less prevalent in sandy areas that are strongly influenced by tidal currents and waves, such as the Lease Area (Nilsson and Rosenberg 2003; Sciberras et al. 2016; BOEM 2024b). Any potential impacts to benthic resources from biological monitoring surveys would be similar to disturbance from existing activities and would be minimized by short tow times for trawl surveys. These intermittent impacts would be temporary and localized, and these areas would be expected to undergo relatively fast recovery (Dernie et al. 2003; Brooks et al. 2006), with no population-level effects expected.

4.5.2.8 Port Utilization

The Proponent has identified several ports in the United States (US) or Canada (for potential construction ports only) that may be used during construction or operations. See Sections 3.10.1 and 4.4.1 of COP Volume I for more information about potential construction or operations ports. Only a subset of the ports described in Sections 3.10.1 and 4.4.1 of COP Volume I would ultimately be used. Each port under consideration for Vineyard Mid-Atlantic is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction proceeds. The Proponent does not expect to implement any port improvements. Although port utilization and vessel activity would increase at the potential ports utilized by Vineyard Mid-Atlantic (with the greatest activity occurring during construction), such increases in port utilization would be consistent with the intended use of each port. As described further under the various IPF sections above, vessel activity will generally have minimal impacts on benthic resources. Given the reasons detailed above, impacts from port utilization on benthic resources are expected to be minimal.

4.5.2.9 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to benthic resources during Vineyard Mid-Atlantic are summarized below:

- Offshore export cable installation will avoid sensitive habitats[43] where feasible.

[43] Eelgrass, Complex habitat, and Large Grained Complex habitat are absent from the Lease Area and OECC.

- The Proponent will require the cable installation contractor to prioritize the least environmentally impactful cable installation alternative(s) that are practicable for each segment of cable.

- For vessels other than anchored cable laying vessels (which must maintain tension on anchor lines), the use of mid-line anchor buoys will be considered (where feasible and considered safe) as a potential measure to reduce impacts to sensitive seafloor habitat from anchor line sweep. There is no anchor line sweep from anchored cable laying vessels because the anchor lines are under tension.

- Near the potential landfall sites, HDD is expected to be used to minimize disturbance to benthic habitats by drilling underneath.

- The target cable burial depth beneath the stable seafloor is 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters, which will reduce effects of EMFs and cable heat. In areas where seafloor type or cable crossings potentially prohibit cable burial, cable protection would serve as a barrier to exposure.

- The Proponent's goal is to minimize the use of cable protection to the greatest extent possible through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route.

- The Proponent will apply a soft-start procedure to the pile driving process, which delivers initial pile drives at a lower intensity, allowing mobile species to move out of the activity area before the full-power pile driving begins.

- Noise abatement system(s) will be used to reduce sound levels by a target of approximately 10 dB during pile driving.

- A benthic habitat monitoring plan framework has been developed (see Appendix II-R) to monitor recovery after construction in areas with sensitive habitats.

- A fisheries monitoring plan has been developed to monitor key indicators before and after construction (see Appendix II-U); such monitoring may be part of regional monitoring efforts. Several of the potential fisheries monitoring survey types include remote or minimally disruptive techniques that are unlikely to meaningfully affect benthic resources. For other types of survey gear that disturb the seafloor, effects would be spatially limited and the benthic resources in the area would be expected to recover in a short timeframe.

- Large portions of the Lease Area will not be disturbed by WTG and ESP installation.

4.6 Finfish and Invertebrates

This section addresses the potential impacts and benefits of Vineyard Mid-Atlantic on finfish and invertebrates in the Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to finfish and invertebrates during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Essential Fish Habitat (EFH) is discussed in Appendix II-D and a zooplankton and ichthyoplankton entrainment assessment is included as Appendix II-N. Recreational fisheries are described in Section 5.3 and commercial and for-hire recreational fisheries are described in Section 5.4.

4.6.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

This description of finfish and invertebrate resources is based on a review of existing literature and survey data. Surveys, datasets, studies, and literature were identified and then assessed for applicability. The most relevant data and sources for characterizing finfish and invertebrates in the affected environment include:

- Northeast Fisheries Science Center (NEFSC) multispecies bottom trawl surveys (NEFSC 2022a, 2022b)
- NEFSC Atlantic surfclam and ocean quahog surveys (NEFSC 2022c)
- NEFSC Atlantic sea scallop dredge surveys (NEFSC 2022d)
- New York State Department of Environmental Conservation (NYSDEC) 2006-2012 Atlantic Ocean Surfclam Population Assessment (NYSDEC 2013)
- NYSDEC Nearshore Ocean Trawl Survey (NYSDEC 2023)
- Northeast Area Monitoring and Assessment Program (NEAMAP) spring and fall trawl surveys (NEAMAP 2022)
- Vineyard Mid-Atlantic 2022/2023 benthic grab and video survey data
- Northeast Ocean Data Portal (NEODP; NROC 2009)

- Bureau of Ocean Energy Management's (BOEM) Final Environmental Assessment for the New York Bight Wind Energy Area (BOEM 2021a)
- New York State Energy Research & Development (NYSERDA) Fisheries Study 2017 (NYSERDA 2017)
- NYSERDA/Normandeau Digital Aerial Baseline Surveys (NYSERDA 2021; Robinson et al. 2021)

4.6.1.1 Offshore Development Area

Several survey programs (NEAMAP, NEFSC, NYSDEC, and Vineyard Mid-Atlantic) have conducted biological and optical fishery independent surveys in and around the Offshore Development Area. Figure 4.6-1 shows the locations of surveys that occurred within the Lease Area and the vicinity of the OECC.

The NEFSC has conducted surveys annually since 1963 and the NEFSC spring and fall bottom trawl surveys have the most complete coverage in the Offshore Development Area across the 2010 to 2022 time series. Two metrics—total biomass and species richness—derived from this survey show the distribution of fish assemblages in the Offshore Development Area relative to surrounding locations (see Figure 4.6-2 through Figure 4.6-7). The total biomass of fish is low to moderate across the Offshore Development Area (see Figure 4.6-2), while species richness is moderate to high (see Figure 4.6-3). For forage fish, these surveys found that alewife (*Alosa pseudoharengus*), Atlantic herring (*Clupea harengus*), and blueback herring (*Alosa aestivalus*) had the highest biomass of forage fish in the spring NEFSC bottom trawls in the New York Bight region (see Figure 4.6-4). According to the NYSERDA (2017) fisheries survey, alewife and blueback herring are listed as species of concern in this region. Round herring (*Spiralloides gracilis*), Atlantic herring, and butterfish (*Peprilus triacanthus*) had the highest biomass of forage fish in the fall bottom trawls in the New York Bight region (see Figure 4.6-5). Seasonal variations in biomass were apparent for all three species, with alewife observed at higher biomass in the spring trawl surveys (conducted primarily from February to April) and round herring observed at higher biomass in the fall trawl surveys (conducted primarily from September to November) (NROC 2009)[44] (see Figure 4.6-4 and 4.6-5). Demersal fish biomass was low to moderate in the spring NEFSC bottom trawl surveys, with highest abundance of little skate, silver hake (*Merluccius bilinearis*), and spotted hake (*Urophycis regius*) (see Figure 4.6-6). Demersal fish biomass was low to moderate in the fall NEFSC bottom trawl surveys with highest abundance of little skate, silver hake, and spot (*Leiostomus xanthurus*) (see Figure 4.6-7). Seasonal trawl surveys conducted by NEFSC from 2010 to 2019 found that longfin squid (*Loligo pealeii*) (see Figures 4.6-8 and 4.6-9), sea scallop (*Placopecten magellanicus*) (see

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44 Data accessed on Northeast Ocean Data Portal in 2023.

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

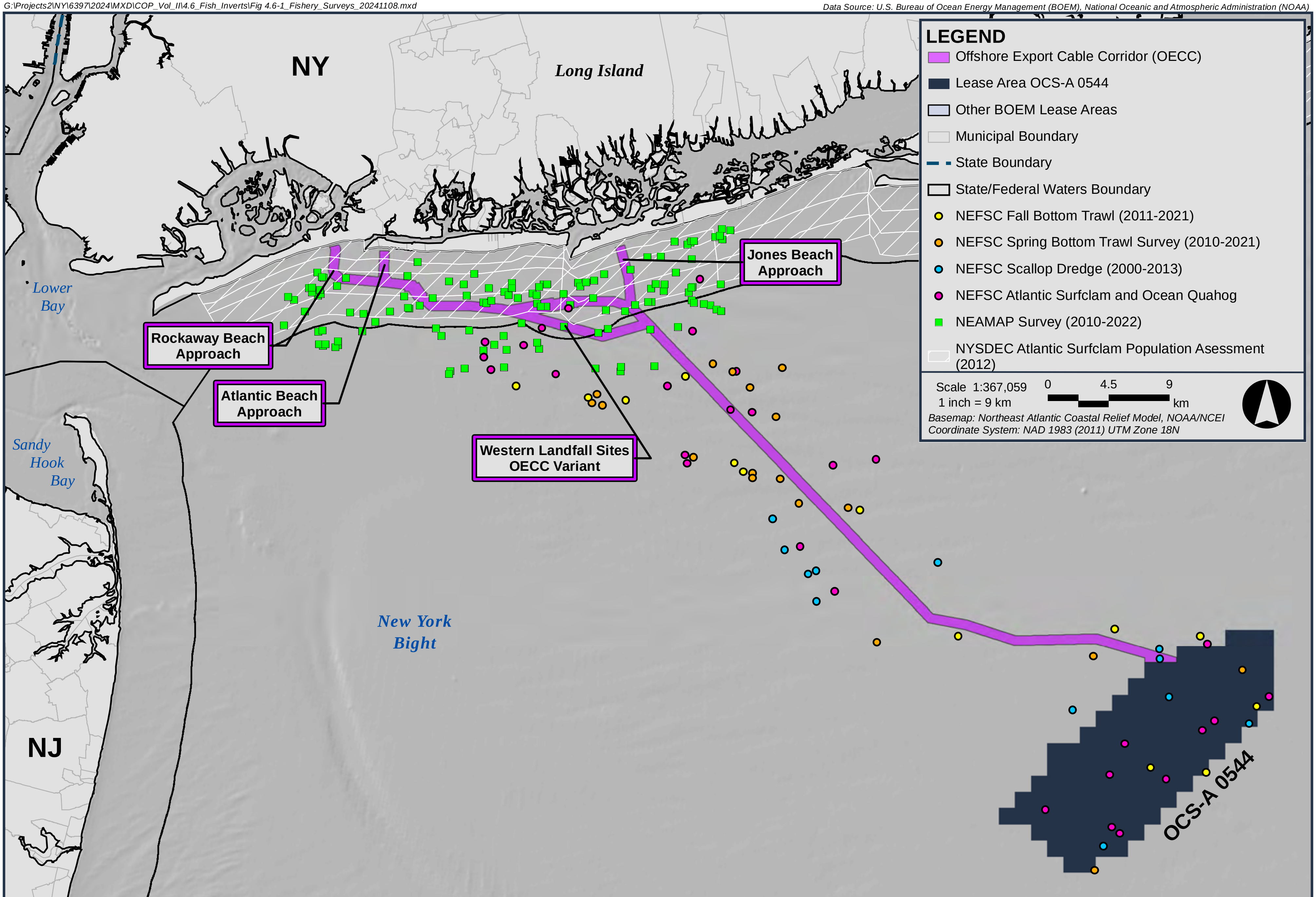
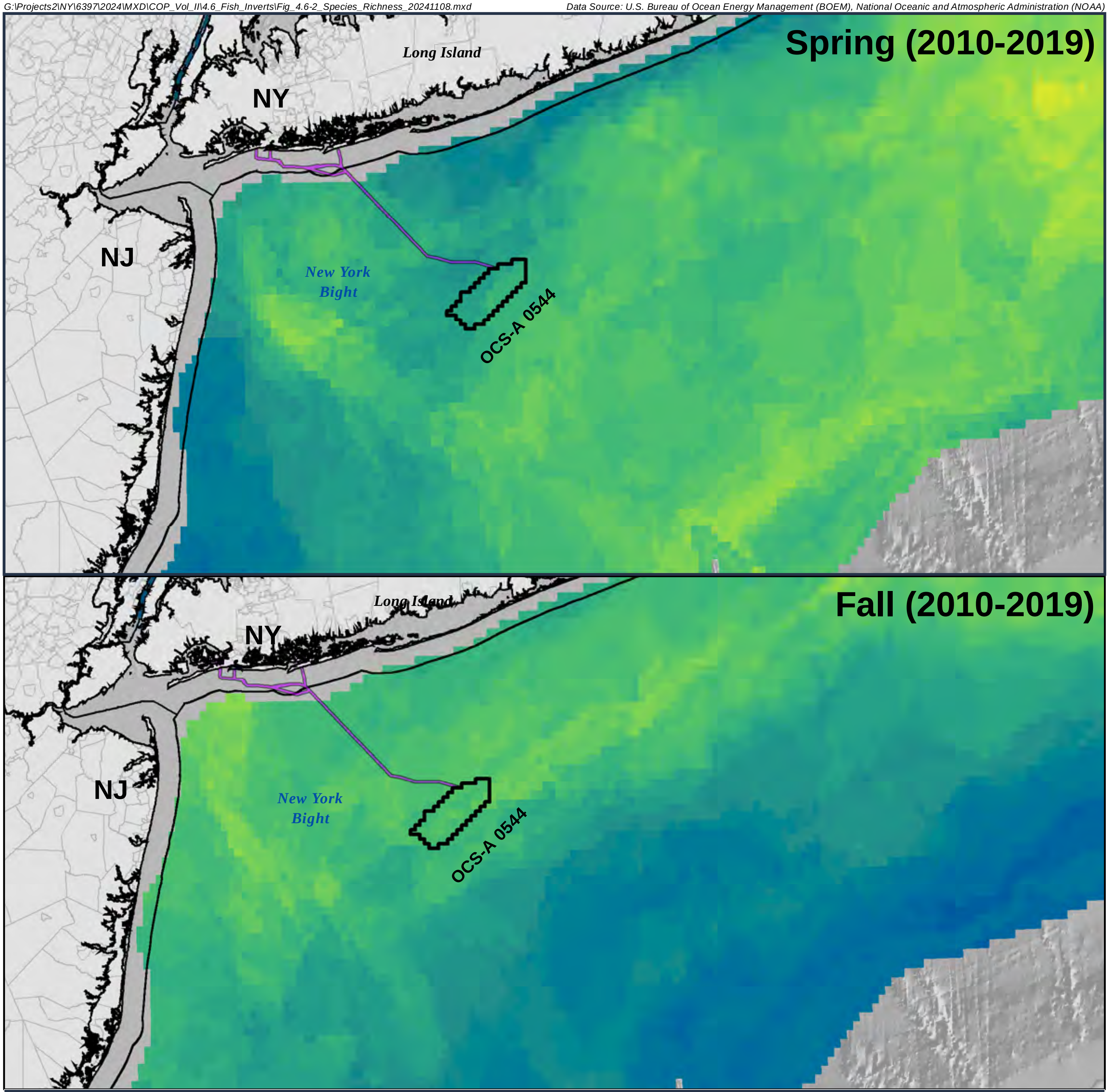


Figure 4.6-1
Locations of Various Fishery Surveys in the Offshore Development Area

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-2_Species_Richness_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Species Richness (2010-2019)

High

Low

Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

Basemap: Northeast Atlantic Coastal Relief Model, NOAA/NCEI
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.6-2

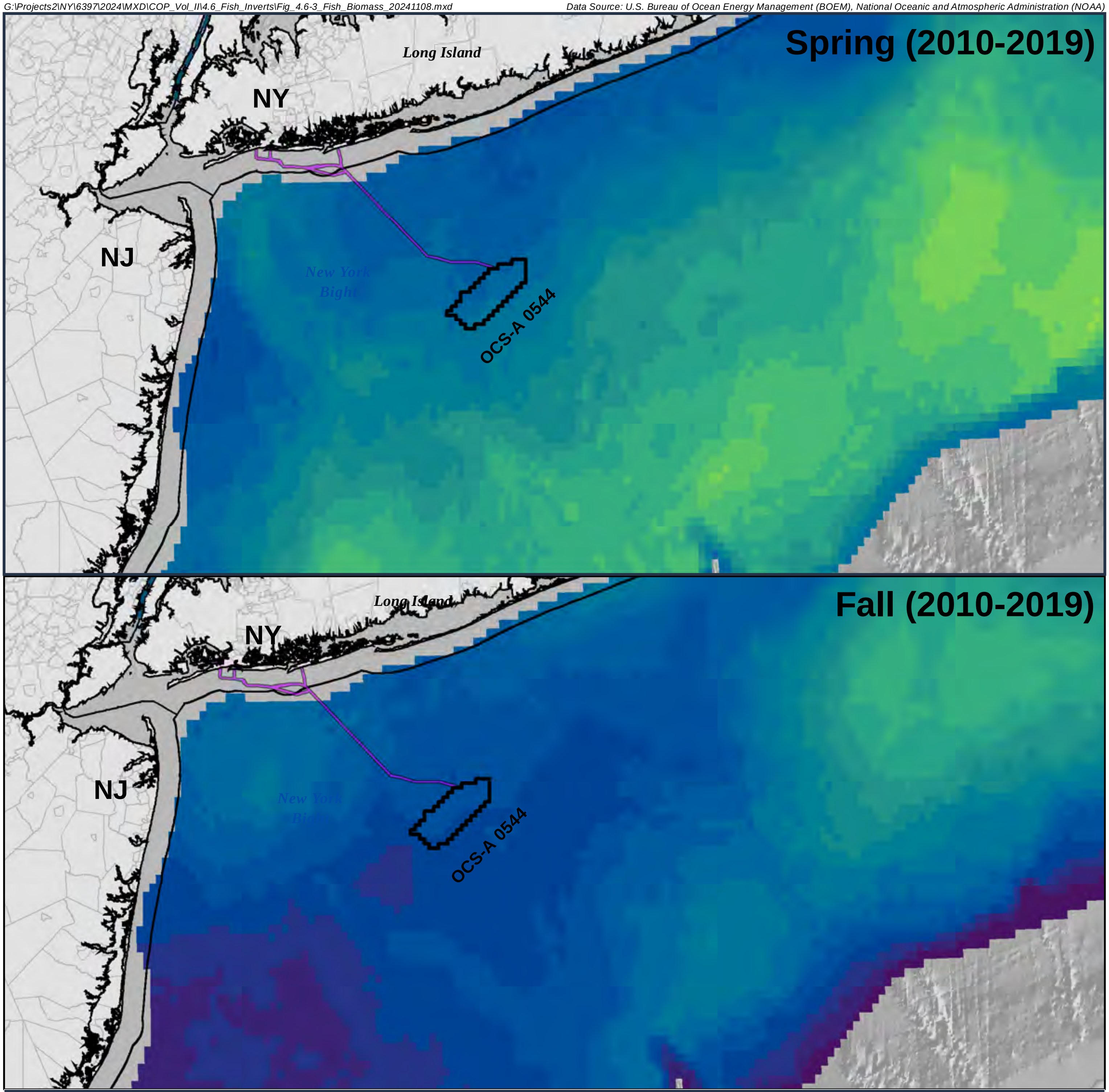
Expected Species Richness of the Fish Captured in Spring and Fall NEFSC Bottom Trawl Surveys (NROC 2009)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-3_Fish_Biomass_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Forage Fish Biomass (2010-2019)

High

Low

Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

Basemap: Northeast Atlantic Coastal Relief Model, NOAA/NCEI
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.6-3

Expected Biomass of the Fish Captured in Spring and Fall NEFSC Bottom Trawl Surveys (NROC 2009)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-4_Herring_Spring_20241108.mxd

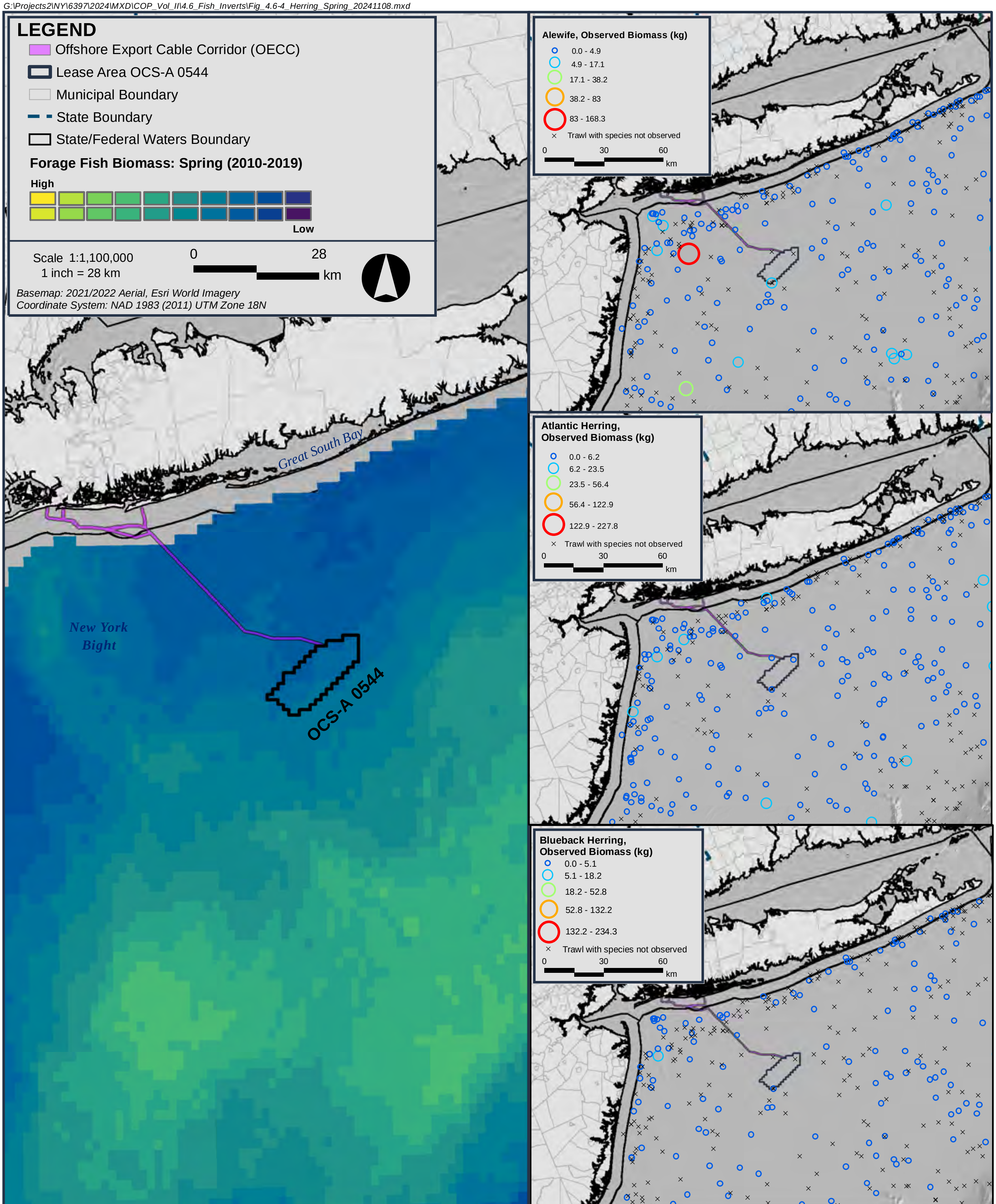


Figure 4.6-4

Expected Forage Fish Biomass and Individual Biomass for Alewife, Atlantic Herring, and Blueback Herring Species Captured in Spring NEFSC Bottom Trawl Surveys from 2010-2019 (NROC 2009)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-5_Herring_Fall_20241108.mxd

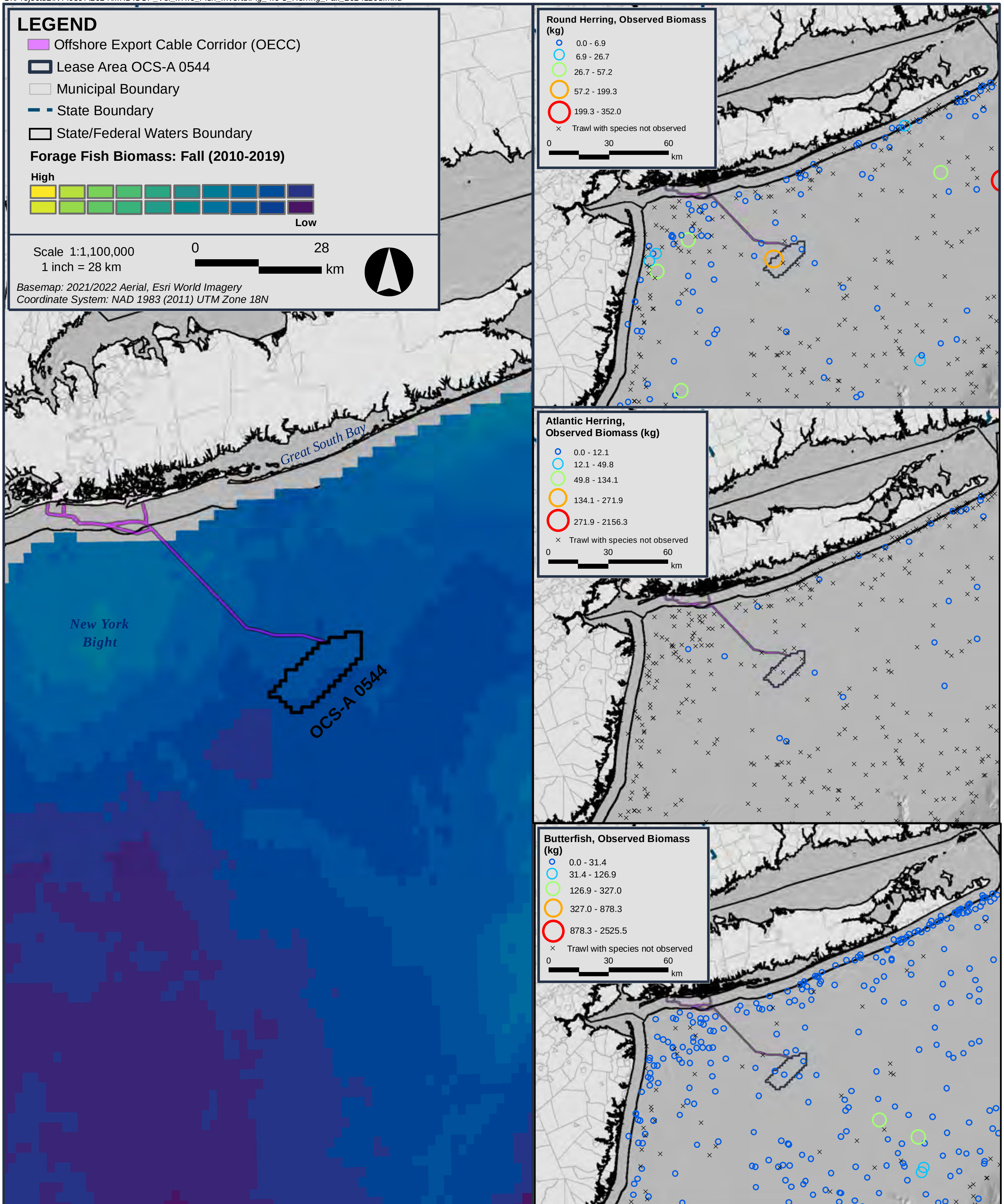


Figure 4.6-5

Expected Forage Fish Biomass and Individual Biomass for Round Herring, Atlantic Herring, and Butterfish Species Captured in Fall NEFSC Bottom Trawl Surveys from 2010-2019 (NROC 2009)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-6_Demersal_Fish_Biomass_Spring_20241108.mxd

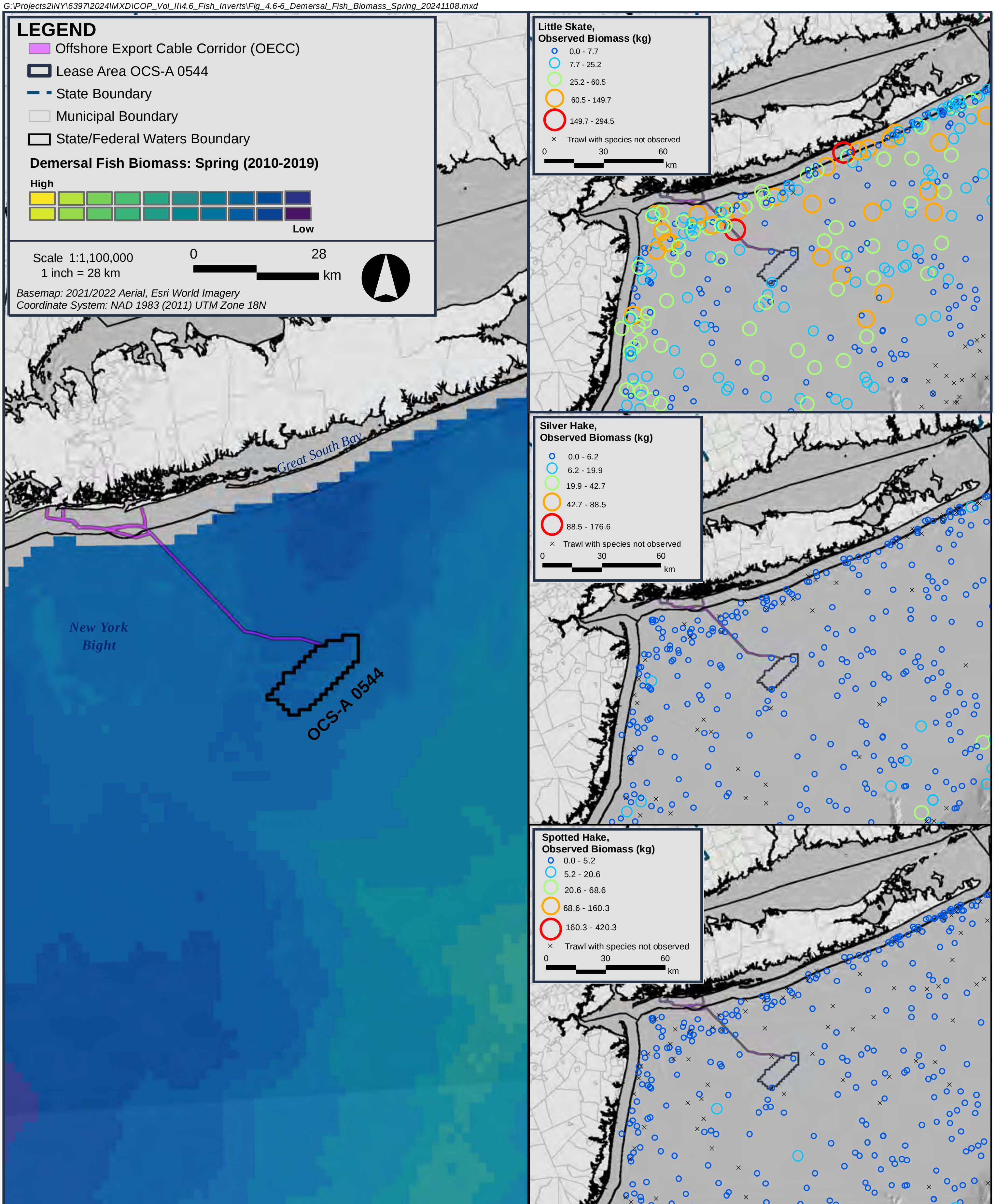


Figure 4.6-6

Expected Demersal Fish Biomass and Individual Biomass for Little Skate, Silver Hake, and Spot Species Captured in Spring NEFSC Bottom Trawl Surveys from 2010-2019 (NROC 2009)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-7_Demersal_Fish_Biomass_Fall_20241108.mxd

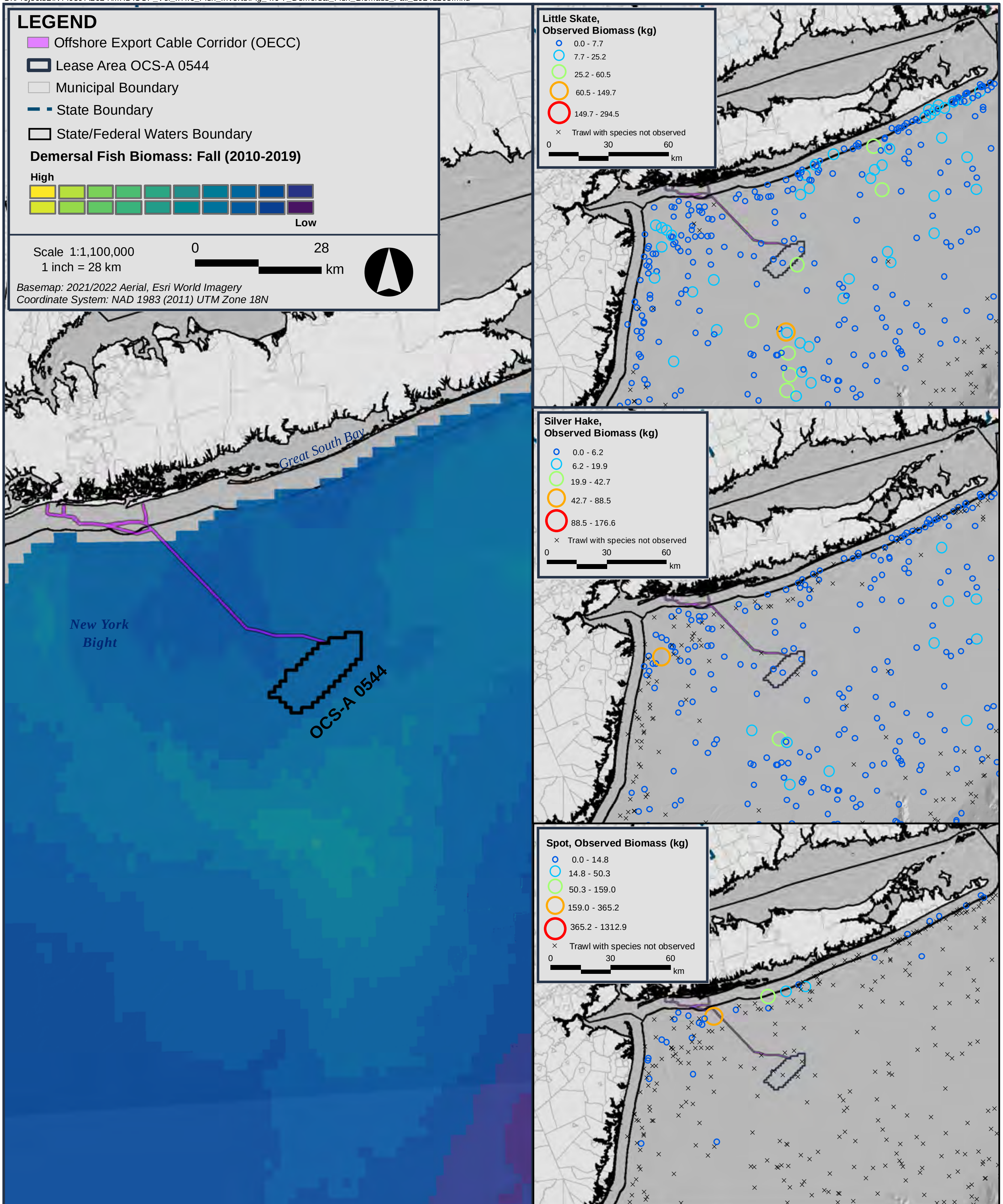


Figure 4.6-7

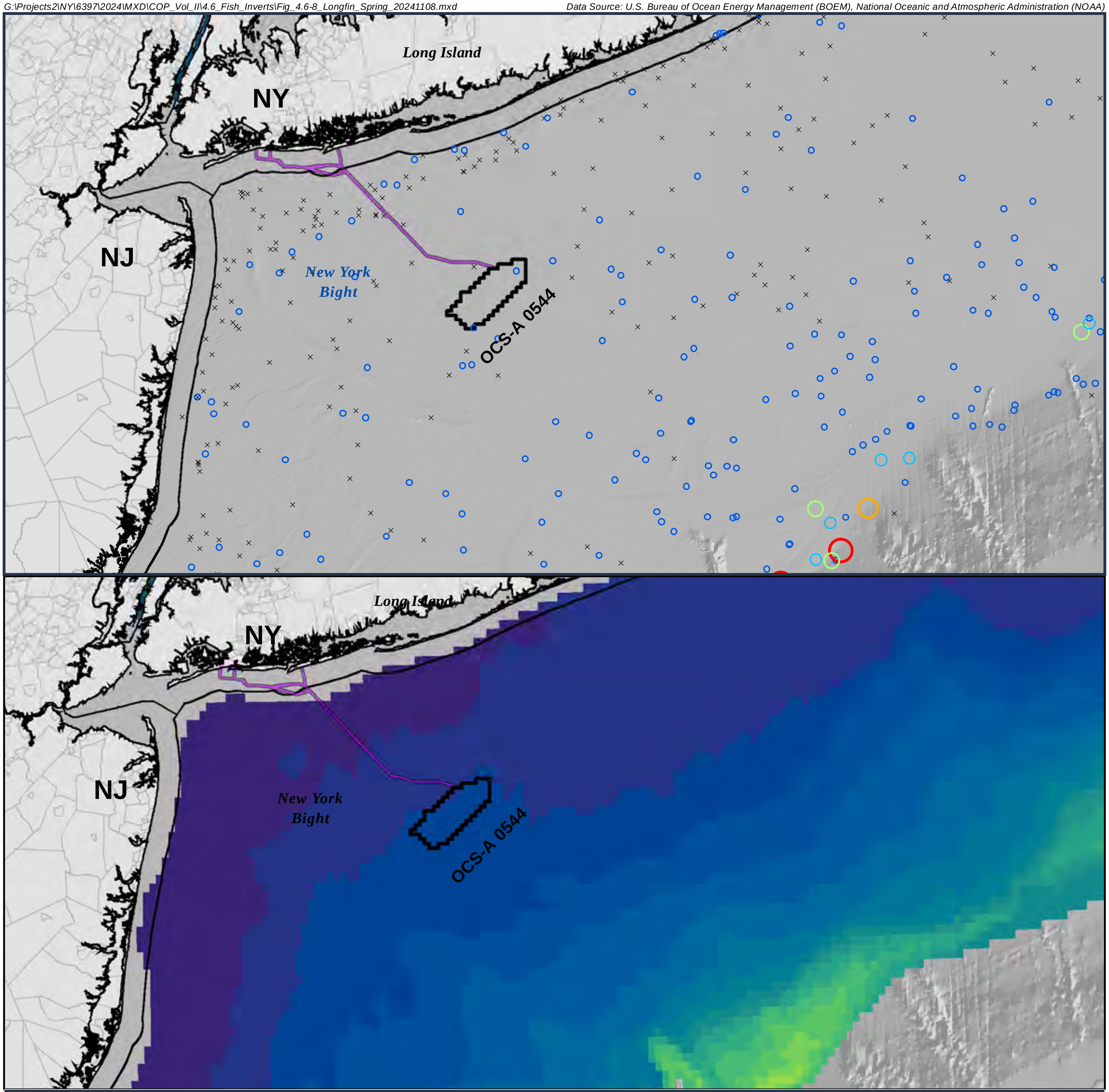
Expected Demersal Fish Biomass and Individual Biomass for Little Skate, Silver Hake, and Spot Species Captured in Fall NEFSC Bottom Trawl Surveys from 2010-2019 (NROC 2009)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-8_Longfin_Spring_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Interpolated Biomass: Spring (2010-2019)

High

Low

Observed Biomass: Spring (2010-2019)

- 0.0 - 6.3
- 6.3 - 19.5
- 19.5 - 42.7
- 42.7 - 88.9
- 88.9 - 277.5
- × Trawl with species not observed

Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

Basemap: Northeast Atlantic Coastal Relief Model, NOAA/NCEI
Coordinate System: NAD 1983 (2011) UTM Zone 18N

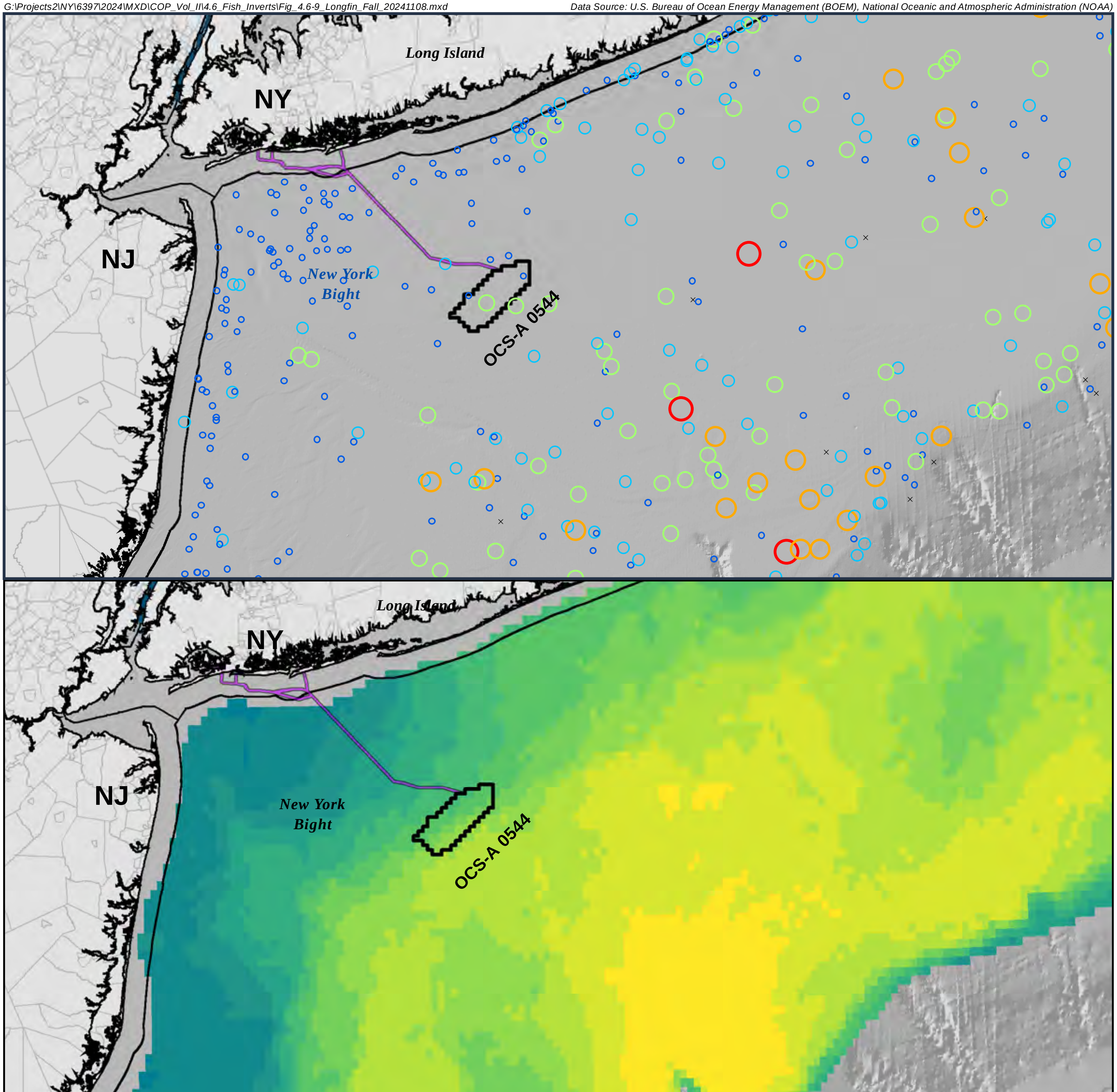
Figure 4.6-8

Longfin Squid (2010-2019) Catch Data from NEFSC Bottom Trawl Spring Surveys

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Interpolated Biomass: Fall (2010-2019)

High

Low

Observed Biomass: Fall (2010-2019)

- 0.0 - 6.3
- 6.3 - 19.5
- 19.5 - 42.7
- 42.7 - 88.9
- 88.9 - 277.5
- × Trawl with species not observed

Scale 1:1,417,320
1 inch = 36 km

0 12 24 36 km

Basemap: Northeast Atlantic Coastal Relief Model, NOAA/NCEI
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.6-9

Longfin Squid (2010-2019) Catch Data from NEFSC Bottom Trawl Fall Surveys

VINEYARD MID-ATLANTIC

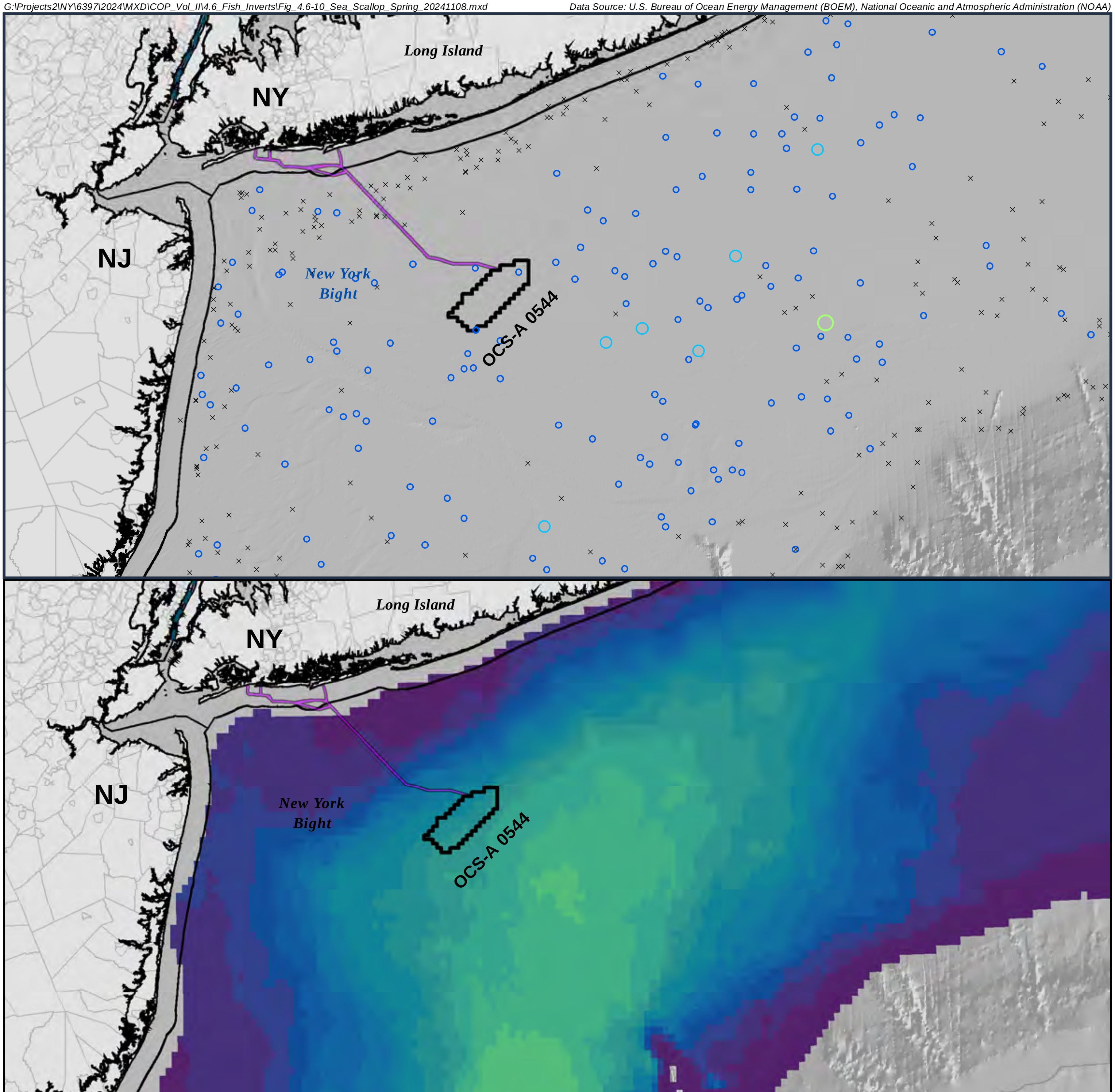
VINEYARD OFFSHORE

Figures 4.6-10 and 4.6-11), and little skate (*Leucoraja erinacea*) (see Figures 4.6-6 and 4.6-7) were consistently dominant in catches from the New York Bight (Guida et al. 2017; NROC 2009).

Table 4.6-1 provides a summary of the species with ecological, recreational, and commercial significance likely found in the Offshore Development Area based on NEFSC trawl data, NEAMAP trawl data, NYSERDA fisheries studies (NYSERDA 2017), NYSERDA and Normandeau digital aerial baseline surveys (NYSERDA 2021; Robinson et al. 2021), and the New York Bight Wind Energy Area (WEA) Revised Environmental Assessment (BOEM 2021a). In general, the New York Bight WEA was selected by BOEM because it contains relatively little sensitive finfish and invertebrate habitat (Guida et al. 2017). Species that comprised the top 99% of commercial landings value or top 99% of recreational landings weight in 2021-2022 from New York or New Jersey (NOAA Fisheries 2023 were listed as commercially and recreationally important in Table 4.6-1.

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-10_Sea_Scallop_Spring_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Interpolated Biomass: Spring (2010-2019)

High

Low

Observed Biomass: Spring (2010-2019)

- 0.0 - 10.6
- 10.6 - 40.8
- 40.8 - 96.4
- 96.4 - 178.1
- 178.1 - 348.7
- Trawl with species not observed

Scale 1:1,407,095

1 inch = 36 km

0 12 24 36 km

Basemap: Northeast Atlantic Coastal Relief Model, NOAA/NCEI

Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.6-10

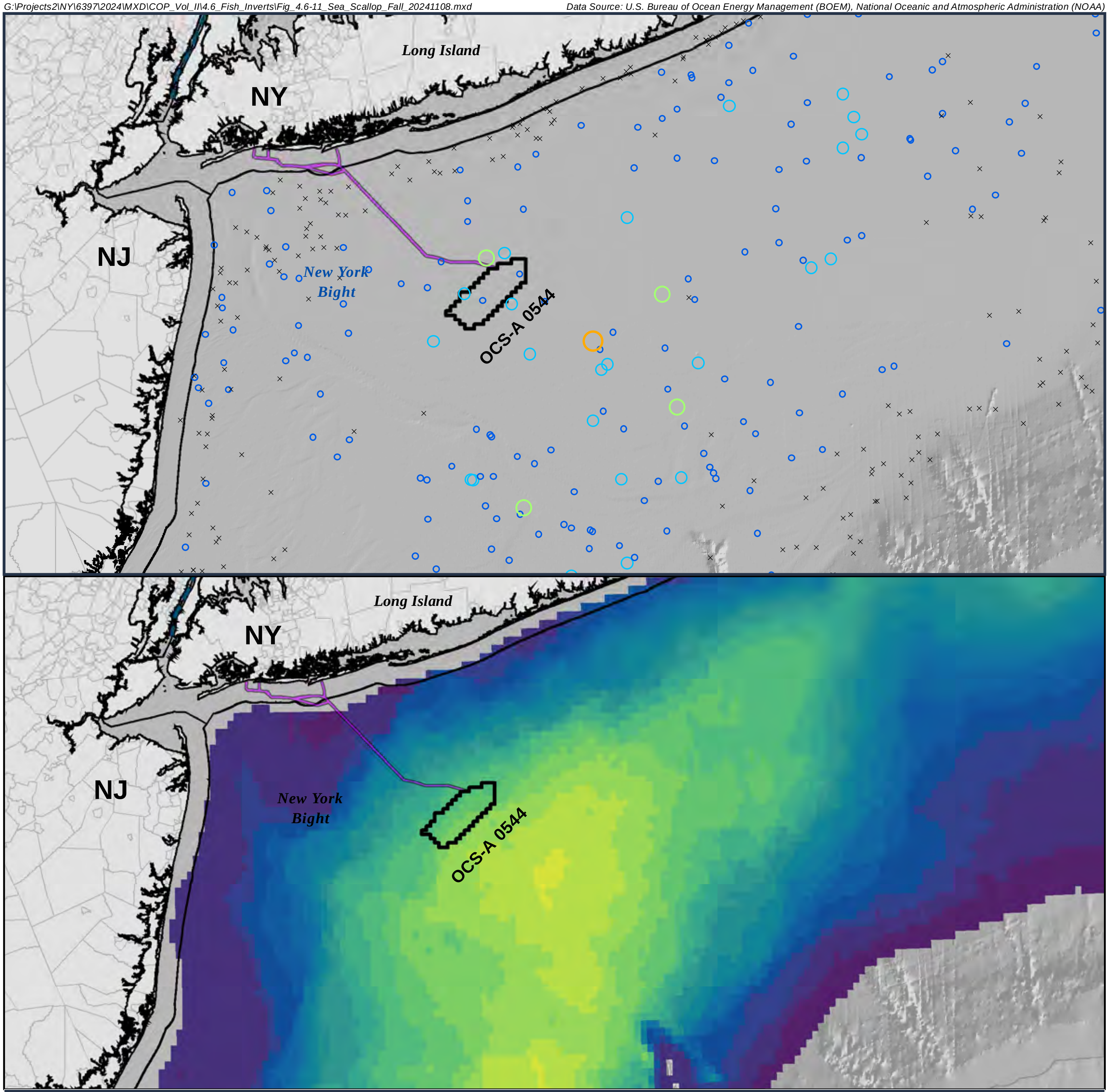
Sea Scallop (2010-2019) Catch Data from NEFSC Bottom Trawl Spring Surveys

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\4.6_Fish_Inverts\Fig_4.6-11_Sea_Scallop_Fall_20241108.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)



LEGEND

- Offshore Export Cable Corridor (OECC)
- Lease Area OCS-A 0544
- Municipal Boundary
- State Boundary
- State/Federal Waters Boundary

Interpolated Biomass: Fall (2010-2019)

High

Low

Observed Biomass: Fall (2010-2019)

- 0.0 - 10.6
- 10.6 - 40.8
- 40.8 - 96.4
- 96.4 - 178.1
- 178.1 - 348.7
- Trawl with species not observed

Scale 1:1,407,095
1 inch = 36 km

0 12 24 36 km

Basemap: Northeast Atlantic Coastal Relief Model, NOAA/NCEI
Coordinate System: NAD 1983 (2011) UTM Zone 18N

Figure 4.6-11

Sea Scallop (2010-2019) Catch Data from NEFSC Bottom Trawl Fall Surveys

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Table 4.6-1 Finfish and Significant Invertebrates Recently Recorded Within the Offshore Development Area

Common Name	Species Name	Listing Status	Commercial/ Recreational Importance	Adult Lifestyle	EFH Presence
Alewife	*Alosa pseudoharengus*			Pelagic	
American eel	*Anguilla rostrata*		•	Pelagic	
American lobster	*Homarus americanus*		•	Benthic	
American shad	*Alosa sapidissima*			Pelagic	
American sand lance	*Ammodytes americanus*			Demersal	
Atlantic albacore tuna	*Thunnus alalunga*		•	Pelagic	•
Atlantic bluefin tuna	*Thunnus thynnus*		•	Pelagic	•
Atlantic brief squid	*Lolliguncula brevis*			Pelagic	
Atlantic butterfish	*Peprilus triacanthus*		•	Demersal/ Pelagic	•
Atlantic cod	*Gadus morhua*		•	Demersal	•
Atlantic croaker	*Micropogonias undulatus*			Demersal	
Atlantic cutlassfish	*Trichiurus lepturus*			Pelagic	
Atlantic mackerel	*Scomber scombrus*		•	Pelagic	•
Atlantic menhaden	*Brevoortia tyrannus*		•	Pelagic	
Atlantic moonfish	*Selene setapinnis*			Pelagic	
Atlantic rock crab	*Cancer irroratus*			Benthic	
Atlantic skipjack tuna	*Katuwonus pelamis*			Pelagic	•
Atlantic sea herring	*Clupea harengus*		•	Pelagic	•
Atlantic sea scallop	*Placopecten magellanicus*		•	Benthic	•
Atlantic sturgeon	*Acipenser oxyrhynchus*	T/E		Demersal	
Atlantic surfclam	*Spisula solidissima*		•	Benthic	•

Table 4.6-1 Finfish and Significant Invertebrates Recently Recorded Within the Offshore Development Area (Continued)

Common Name	Species Name	Listing Status	Commercial/ Recreational Importance	Adult Lifestyle	EFH Presence
Atlantic thread herring	*Opisthonema oglinum*			Pelagic	
Atlantic yellowfin tuna	*Thunnus albacares*		•	Pelagic	•
Banded drum	*Larimus fasciatus*			Demersal	
Barndoor skate	*Dipturus laevis*			Demersal	
Bay scallops	*Argopecten irradians*		•	Benthic	
Bigeye scad	*Selar crumenophthalmus*			Pelagic	
Big-eye tuna	*Thunnus obesus*		•	Pelagic	
Black drum	*Pogonias cromis*		•	Pelagic	
Black sea bass	*Centropristis striata*		•	Demersal	•
Blue crab	*Callinectes sapidus*		•	Benthic	
Blue mussels	*Mytilus edulis*			Benthic	
Blue runner	*Caranx crysos*			Pelagic	
Blue shark	*Prionace glauca*		•	Pelagic	•
Bluefish	*Pomatomus saltatrix*		•	Pelagic	•
Blueback herring	*Alosa aestivalis*			Pelagic	
Brown shrimp	*Farfantepenaeus aztecus*			Pelagic	
Bullnose ray	*Myliobatis freminvillii*			Demersal	
Channeled whelk	*Busycotypus canaliculatus*			Benthic	
Clearnose skate	*Raja eglanteria*			Demersal	•
Cobia	*Rachycentron canadum*		•	Pelagic	
Common spider crab	*Libinia emarginata*			Benthic	
Common thresher shark	*Alopias vulpinus*			Pelagic	•
Cownose ray	*Rhinoptera bonasus*			Demersal	
Cunner	*Tautogalabrus adspersus*			Demersal	
Dusky shark	*Carcharhinus obscurus*	S		Pelagic	•
Eastern oyster	*Crassostrea virginica*		•	Benthic	
Fourspot flounder	*Hippoglossina oblonga*			Demersal	

Table 4.6-1 Finfish and Significant Invertebrates Recently Recorded Within the Offshore Development Area (Continued)

Common Name	Species Name	Listing Status	Commercial/ Recreational Importance	Adult Lifestyle	EFH Presence
Giant manta ray	*Mobula birostris*	T		Pelagic	
Golden tilefish	*Lopholatilus chamaeleonticeps*		•	Demersal	
Gray mullets	*Mugil spp.*			Demersal	
Great hammerhead	*Sphyrna mokarran*			Pelagic	
Gulfstream flounder	*Citharichthys arctifrons*			Demersal	
Haddock	*Melanogrammus aeglefinus*		•	Demersal	•
Harvestfish	*Peprilus paru*			Pelagic	
Hickory shad	*Alosa mediocris*		•	Pelagic	
Horse-eye jack	*Caranx latus*			Pelagic	
Horseshoe crab	*Limulus Polyphemus*		•	Benthic	
Inshore lizardfish	*Synodus foetens*			Demersal	
Iridescent swimming crab	*Portunus gibbesii*			Demersal/ Benthic	
Jonah crab	*Cancer borealis*		•	Benthic	
Lady crab	*Ovalipes ocellatus*			Benthic	
Lined seahorse	*Hippocampus erectus*			Benthic	
King mackerel	*Scomberomorus cavalla*			Pelagic	
Knobbed whelk	*Busycon carica*			Benthic	
Little skate	*Leucoraja erinacea*			Demersal	•
Longfin squid	*Doryteuthis pealeii*		•	Pelagic	•
Longhorn sculpin	*Myoxocephalus octodecemspinosus*			Demersal	
Mantis shrimp	*Squilla empusa*			Demersal	
Menhaden	*Brevoortia tyrannus*		•	Pelagic	
Monkfish	*Lophius americanus*		•	Demersal	•
Moon snail	*Polinices heros*			Benthic	
Northern kingfish	*Menticirrhus saxatilis*			Demersal	
Northern puffer	*Sphoeroides maculatus*			Demersal	
Northern quahog	*Mercenaria mercenaria*		•	Benthic	

Table 4.6-1 Finfish and Significant Invertebrates Recently Recorded Within the Offshore Development Area (Continued)

Common Name	Species Name	Listing Status	Commercial/ Recreational Importance	Adult Lifestyle	EFH Presence
Northern sand lance	*Ammodytes dubius*			Demersal	
Northern searobin	*Prionotus carolinus*			Demersal	
Northern sennet	*Sphyraena borealis*			Pelagic	
Northern shortfin squid	*Illex illecebrosus*		•	Pelagic	•
Northern stargazer	*Astroscopus guttatus*			Demersal	
Ocean pout	*Macrozoarces americanus*			Demersal	•
Ocean quahog	*Artica islandica*		•	Benthic	•
Oceanic whitetip shark	*Carcharinus longimanus*	T		Pelagic	
Orange filefish	*Aluterus schoepfii*			Pelagic	
Pigfish	*Orthopristis chrysoptera*			Pelagic	
Pinfish	*Lagodon rhomboides*			Pelagic	
Planehead filefish	*Stephanolepis hispida*			Pelagic	
Pollock	*Pollachius virens*			Demersal	•
Porbeagle shark	*Lamna nasus*	S		Pelagic	
Red hake	*Urophycis chuss*		•	Demersal	•
Rough scad	*Trachurus lathami*			Pelagic	
Roughtail stingray	*Dasyatis centroura*			Demersal	
Round herring	*Etrumeus teres*			Pelagic	
Sand dollar	*Echinarachnius parma*			Benthic	
Sand tiger shark	*Carcharias taurus*	S		Pelagic	•
Sandbar shark	*Carcharhinus plumbeus*			Pelagic	•
Sea raven	*Hemitripterus americanus*			Demersal	
Scalloped hammerhead	*Sphyrna lewini*	E		Pelagic	

Table 4.6-1 Finfish and Significant Invertebrates Recently Recorded Within the Offshore Development Area (Continued)

Common Name	Species Name	Listing Status	Commercial/ Recreational Importance	Adult Lifestyle	EFH Presence
Scup	*Stenotomus chrysops*		•	Demersal/ Pelagic	•
Shortfin mako	*Isurus oxyrinchus*	C		Pelagic	•
Shortfin squid	*Illex illecebrosus*		•	Pelagic	
Silver hake	*Merluccius bilinearis*		•	Demersal	•
Silver perch	*Bairdiella chrysoura*			Pelagic	
Six spine spider crab	*Libinia dubia*			Benthic	
Smallmouth flounder	*Etropus microstomus*			Demersal	
Smooth dogfish	*Mustelus canis*		•	Demersal	•
Spanish mackerel	*Scomberomorus maculatus*			Pelagic	
Spot	*Leiostomus xanthurus*			Demersal	
Spotted hake	*Urophycis regius*			Demersal	
Spiny dogfish	*Squalus acanthias*			Demersal	•
Striped anchovy	*Anchoa hepsetus*			Pelagic	
Striped bass	*Morone saxatilis*		•	Pelagic	
Striped burrfish	*Chilomycterus schoepfii*			Pelagic	
Striped cusk-eel	*Ophidion marginatum*			Pelagic	
Striped searobin	*Prionotus evolans*		•	Demersal	
Summer flounder	*Paralichthys dentatus*		•	Demersal	•
Tautog	*Tautoga onitis*		•	Demersal	
Tiger shark	*Galeocerdo cuvier*			Pelagic	•
Weakfish	*Cynoscion regalis*		•	Demersal	
White hake	*Urophycis tenuis*			Demersal	•
White shark	*Carcharadon carcharias*			Pelagic	•
White shrimp	*Litopenaeus setiferus*			Pelagic	
Windowpane flounder	*Scopthalmus aquosus*			Demersal	•
Winter flounder	*Pseudopleuronectes americanus*			Demersal	•
Winter skate	*Leucoraja ocellata*		•	Demersal	•

Table 4.6-1 Finfish and Significant Invertebrates Recently Recorded Within the Offshore Development Area (Continued)

Common Name	Species Name	Listing Status	Commercial/ Recreational Importance	Adult Lifestyle	EFH Presence
Witch flounder	*Glyptocephalus cynoglossus*			Demersal	•
Yellowtail flounder	*Limanda ferruginea*			Demersal	•

Notes:

1. BOEM 2016; NYSERDA 2017; NYSERDA 2021; NEAMAP 2022; NOAA Fisheries 2023
2. C= candidate, S= species of concern, T= threatened, E = endangered
3. There are five distinct population segments (DPSs) of Atlantic sturgeon along the Atlantic coast: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. The Gulf of Maine DPS is listed as threatened whereas the remaining four DPSs are listed as federally endangered (ASSRT 2007; NOAA Fisheries 2017).

Threatened and Endangered Fish

Six federally listed threatened or endangered fish species may occur off the northeast Atlantic coast: shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Atlantic salmon (*Salmo salar*), giant manta ray (*Manta birostris*), oceanic whitetip shark (*Carcharhinus logimanus*), and scalloped hammerhead (*Sphyrna lewini*). Of these, only the Atlantic sturgeon and giant manta ray are anticipated to potentially occur within the Offshore Development Area and surrounding waters. Shortnose sturgeon, Atlantic salmon, oceanic whitetip shark, and scalloped hammerhead are not expected to occur within the Offshore Development Area; thus, these species are discounted for further analysis.

Atlantic Sturgeon – Federal Endangered Species

The Atlantic sturgeon is an anadromous species that spends much of its life in estuarine and marine waters throughout the Atlantic Coast, but adults ascend coastal rivers in spring (May – July) to spawn in flowing freshwater. Atlantic sturgeon eggs are adhesive and attach to gravel or other hard substrata. Larvae develop as they move downstream to the estuarine portion of the spawning river, where they reside as juveniles for several months before migrating to coastal areas. Subadults will move into coastal ocean waters where they may undergo extensive movements alongshore, usually confined to < 20 meters [m] (< 66 feet [ft]) water depths (Dunton et al. 2010). Atlantic sturgeon distribution in the marine environment varies by season, with the highest catches occurring within the New York Bight in waters 10–15 m (33–49 ft) deep during the spring and fall, based on an analysis of the National Marine Fisheries Service (NMFS) bottom trawl, New Jersey Department of Environmental Protection (NJDEP) trawl, and New York bottom trawl survey data (Dunton et al. 2010). Atlantic sturgeon are however not limited to these depths and have been captured as bycatch or in gillnet surveys in continental shelf waters at depths of 75 m to 100 m (250 ft to 328 ft) (Timoshkin 1968; Collins and Smith 1997; Colette and Klein-MacPhee 2002; Stein et al. 2004; Erickson et al. 2011).

There are five distinct population segments (DPSs) of Atlantic sturgeon along the Atlantic coast: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. Atlantic sturgeon from all five DPSs undertake seasonal, nearshore (i.e., in water depths typically less than 50 m [164 ft]), and coastal marine migrations along the US East coast including waters of southern New England (Dunton et al. 2010; Erickson et al. 2011). The Atlantic sturgeon New York Bight distinct population segment (DPS) is listed as endangered under the Endangered Species Act (ESA) and critically imperiled in New York (NY Natural Heritage Program 2019). The Gulf of Maine DPS is listed as threatened whereas the remaining four DPSs are listed as federally endangered (ASSRT 2007; NOAA Fisheries 2017). National Oceanic and Atmospheric Administration (NOAA) Fisheries (also referred to as the NMFS) presumed that Atlantic sturgeon in the New York Bight WEA would most likely be from the New York Bight DPS; however, genetic analyses and tagging studies indicated that the ranges of all five DPSs overlap and extend from Canada to Florida (ASSRT 2007; NOAA Fisheries 2017). In addition, Atlantic sturgeon have been found as bycatch along the coastline of New York and New Jersey in areas located near the OECC and Lease Area (Dunton 2014; Dunton et al. 2015; NYSERDA 2017). NOAA Fisheries Greater Atlantic Regional Fisheries Organization (GARFO) maps the estuarine coastal and salt marsh waters between Jones Beach, Long Beach, Fire Island, and the mainland as habitat for migrating and foraging subadult and adult Atlantic sturgeon. The Atlantic sturgeon is strongly associated with specific coastal areas, including the Hudson River and estuary, as well as the mouths of Narragansett Bay and Chesapeake Bay, and the inlets of the North Carolina Outer Banks, and it also occurs in the Cooper River estuary of South Carolina (Stein et al. 2004; Ingram et al. 2019).

For the New York Bight DPS, Critical Habitat is designated in 547 kilometers [km] (340 miles [mi]) of aquatic habitat in the Connecticut River, Housatonic River, Hudson River, and Delaware River. Spawning is only known to occur in the Delaware and Hudson Rivers (ASSRT 2007; NOAA Fisheries 2017). In the Hudson River, Atlantic sturgeon travel up to a maximum of 147 river miles (237 km) to spawn between late May and late July (Breece et al. 2021). Federally-regulated Critical Habitat for Atlantic sturgeon in the Hudson River is designated from River Mile 1 to the Troy Lock and Dam north of Albany, which does not spatially overlap with the Lease Area or the OECC (NOAA Fisheries 2017).

Critical Habitat within the Chesapeake Bay DPS includes approximately 773 km (480 mi) of aquatic habitat in the Potomac, Rappahannock, York, Pamunkey, Mattaponi, James, and Nanticoke Rivers, and the Marshyhope Creek waterbody. Historically, the Chesapeake Bay supported at least six historical spawning subpopulations; however, today the Bay is believed to support, at the most, only two spawning subpopulations in the James and York Rivers (ASSRT 2007; NMFS GARFO 2017). Within the Chesapeake DPS, spring spawning occurs in approximately April and May with fall spawning occurring from August to October (Balazik et al. 2012; Hager et al. 2014; Balazik and Musick 2015; Richardson and Secor 2016; NMFS GARFO 2017).

Critical Habitat within the Carolina DPS includes approximately 1,939 km (1,205 mi) of aquatic habitat in the Roanoke, Tar-Pamlico, Neuse, Cape Fear, Northeast Cape Fear, Waccamaw, Pee Dee, Black, Santee, North Santee, South Santee, and Cooper Rivers, and the Bull Creek waterbody. Adult Atlantic sturgeon have been documented in the Pinopolis Dam tailrace of the Cooper River, South Carolina (Ruddle 2018; BOEM 2023a). However, there is no substantial evidence of Atlantic sturgeon spawning in the Cooper River (Ruddle 2018; BOEM 2023a).

Currently, there are multiple abundance estimates available for different life stages of Atlantic sturgeon based on presence in some of the 22 confirmed spawning rivers. Estimates in individual rivers in the United States range from 0–23 individuals in the Neuse River, North Carolina to 1,000–2,000 juvenile Atlantic sturgeon in the Altamaha River, Georgia (NOAA Fisheries 2019). There were an estimated 18,000–21,000 adult Atlantic sturgeon between 2013–2015 in the St. John River, Canada, which is the largest population of Atlantic sturgeon on the East Coast (Dadswell et al. 2017). In the Hudson River, the 2014 spawning run abundance was estimated at 466 individuals with a 95% confidence interval of between 310 and 745 individuals, suggesting that the adult abundance has not shown significant recovery since the fishery was closed in 1998.

Primary threats to Atlantic sturgeon include bycatch in trawl and gillnet fisheries, habitat degradation and loss, ship strikes, and general depletion from historical fishing. Atlantic sturgeon are known to be along the coastline of New York and New Jersey, on the south side of the barrier beaches of Long Island and have been captured in commercial fisheries or fisheries-independent surveys in the New York Bight WEA (Dunton 2014; Dunton et al. 2015). Habitat and life characteristics indicate that small numbers of Atlantic sturgeon may be found year-round, but in higher concentrations in spring and fall, in shallow waters near the potential landfall sites on Long Island, particularly in the Rockaway region / western Long Island (NROC 2009; Dunton et al. 2010; Dunton et al. 2015; NYSERDA 2017).

Based on their anticipated distribution in water depths primarily 50 m (164 ft) or less, Atlantic sturgeon are not expected to occur within the deep, open-ocean portion of the Offshore Development Area or in the waters that would be transited by Vineyard Mid-Atlantic vessels traveling to and from the distant ports. However, some of the potential ports to be utilized by Vineyard Mid-Atlantic could overlap with or be in the vicinity of the New York Bight and Carolina DPSs. See Section 3.10 of COP Volume I for additional details on potential ports to be utilized by Vineyard Mid-Atlantic. Thus, vessels may travel through migratory, spawning, and early life stage Atlantic sturgeon habitat while transiting to and from these potential ports.

For the New York Bight DPS, six potential ports (Port of Albany-Rensselaer, NYS Offshore Wind Port, Port of Coeymans Marine Terminal, and Port of Tompkins Cove, New Jersey Wind Port, and Paulsboro Marine Terminal) overlap with Atlantic Sturgeon Critical Habitat but will be utilized only during construction. Other potential ports that may be used during construction and O&M (GMD Shipyard, Port of Newark Container Terminal and Other Areas in Newark Bay, South Brooklyn Marine Terminal, Homeport Pier) are in the vicinity of, but do not overlap with, the Atlantic sturgeon Critical Habitat. No potential ports overlap with the Chesapeake Bay DPS.

For the Carolina DPS, three potential ports that may be used only during construction (Union Pier Terminal, Columbus Street Terminal, and Hugh K. Leatherman Terminal) are in the vicinity of, but do not overlap with, the Atlantic sturgeon Critical Habitat.

Shortnose Sturgeon – Federal Endangered Species

The shortnose sturgeon is an anadromous species found in larger rivers and estuaries on the east coast of North America from the St. Johns River in Florida to the St. Johns River in Canada. The shortnose sturgeon was listed as endangered in 1967 because the United States Fish and Wildlife Service (USFWS) concluded that the fish had been eliminated from the rivers in its historic range (except the Hudson River) and was in danger of extinction because of pollution, loss of access to spawning habitats, and direct and incidental overfishing in the commercial fishery for Atlantic sturgeon (NOAA 2015). Shortnose sturgeon DPSs are currently identified in North Carolina, South Carolina, Georgia, and northern Florida river systems (NOAA 2015).

In the northern portion of its range, shortnose sturgeon are found in the Chesapeake Bay system, Delaware River, Hudson River, Connecticut River, Housatonic River, the lower Merrimack River, and the Kennebec River northward to the St. John River in New Brunswick, Canada. The closest populations to the Offshore Development Area are the Hudson and Delaware rivers, which drain into the New York Bight (NOAA Fisheries 2023). Shortnose sturgeon occur primarily in fresh and estuarine waters and occasionally enter the coastal ocean. Adults ascend rivers to spawn from February to April, and eggs are deposited over hard bottom, in shallow, fast-moving water (Dadswell et al. 1984). Because of their preference for mainland rivers and fresh and estuarine waters, shortnose sturgeon are unlikely to be found near the Offshore Development Area. This species may transit through the landfall area and portions of the nearshore OECC in state waters. However, the short-nose sturgeon is not expected to be found within the Lease Area and therefore will not be affected by Vineyard Mid-Atlantic activities in either the Lease Area or the offshore portions of the OECC (NOAA Fisheries 2013).

While Vineyard Mid-Atlantic vessels could encounter shortnose sturgeon when traveling from the Lease Area to some of the ports, such as those in the Cooper River in South Carolina, the likelihood of the vessel striking a shortnose sturgeon is low (BOEM 2024b). Therefore, this species is discounted for further analysis.

Atlantic Salmon – Federal Endangered Species; Regional Endangered Species

Atlantic salmon is an anadromous species that historically ranged from northern Quebec southeast to Newfoundland and southwest to Long Island Sound. The Gulf of Maine DPS of the Atlantic salmon, which spawns within eight coastal watersheds within Maine, is federally listed as endangered. In 2009, the geographic range of the Gulf of Maine DPS was expanded to include all areas of the Gulf of Maine between the Androscoggin River and the Dennys River (NOAA 2016).

The life history of Atlantic salmon consists of spawning and juvenile rearing in freshwater rivers to extensive feeding migrations in the open ocean. Adult Atlantic salmon ascend the rivers of New England in the spring through fall to spawn. Suitable spawning habitat consists of gravel or rubble in areas of moving water. Juvenile Atlantic salmon remain in the rivers for one to three years before migrating to the ocean. The adults will undertake long marine migrations between the mouths of United States [US] rivers and the northwest Atlantic Ocean, where they are widely distributed seasonally over much of the region. Typically, most Atlantic salmon spend two winters in the ocean before returning to freshwater to spawn (NOAA 2016).

It is possible that adult Atlantic salmon may occur off the New York coast while migrating to rivers to spawn. However, only certain Gulf of Maine populations are listed as endangered, and Gulf of Maine salmon are unlikely to be encountered south of Cape Cod (BOEM 2014).

Giant Manta Ray - Federal Threatened Species

The giant manta ray is a global pelagic species listed as threatened throughout its range in 2018 under the ESA with scattered individual populations found both offshore and along productive coastlines (CITES 2013). The species is highly migratory and inhabits mostly tropical and subtropical waters with occasional presence in temperate waters. Giant manta rays can tolerate temperatures from 15-30 °Celsius (C) (59-86 °Fahrenheit [F]) and sightings primarily occur nearshore at shelf-edges (Farmer et al. 2021). Giant manta rays are viviparous, producing live neonate offspring about 1 m (3.3. ft) in length capable of swimming, so there is no potential for effects on eggs or larvae in the Offshore Development Area (Miller and Klimovich 2017; NYSERDA 2021). Giant manta rays undergo seasonal migrations, which may coincide with the movement of zooplankton, ocean current circulation and tidal patterns, seasonal upwelling, sea surface temperature, and possibly mating behavior (NOAA Fisheries 2024; BOEM 2024b). Giant manta rays use a wide range of depths during feeding likely driven by vertical shifts in their prey location, which results in feeding aggregations in waters depths less than 10 m (33 ft) and dives from 200-450 m (656-1,476 ft) (NOAA Fisheries 2024; BOEM 2024b).

Individuals are typically observed as far north as New Jersey in the Western Atlantic basin. While the Offshore Development Area contains habitat that can support giant manta rays, occurrence is unlikely as it is at the northern edge of the species' range and sightings north of New Jersey occur farther offshore, along the continental shelf edge (Farmer et al. 2021; NOAA Fisheries 2021). Seven giant manta rays were found during the aerial surveys conducted on behalf of NYSERDA within the New York Bight area from summer 2016 through spring 2019, though sightings were only during the summer and only occurred along the shelf break in depths greater than 400 m (1,312 ft) thus farther offshore than the Lease Area (NYSERDA 2021).

While there is a lack of observance data of giant manta ray within the Offshore Development Area, Farmer et al. (2022) integrated manta ray[45] sightings and survey effort data across numerous sources from decades of sampling over a broad geographic range (spanning from the Gulf of Mexico to southern New England) and evaluated the distance-weighted sampling data in a comprehensive species distribution modeling framework to assess the environmental drivers of manta ray occurrence. Modeling output was then compared with independent confirmed sightings data. Using monthly average environmental conditions from 2017, the modeling analysis predicted a greater than zero probability of giant manta rays in the vicinity of the Offshore Development Area between the months of June and October. Therefore, while the probability is quite low, the giant manta ray could potentially occur within the Offshore Development Area and surrounding waters during their seasonal migration.

While manta rays are not targeted in US fisheries, potential threats to giant manta rays include commercial and recreational fishing bycatch, boat strikes, oil and gas activities, contaminants and pollutants, military activities and climate change (Farmer et al. 2022; NOAA Fisheries 2024).

Oceanic Whitetip Shark – Federal Threatened Species

The oceanic whitetip shark is a global pelagic and highly migratory species listed as threatened throughout its range under the ESA in 2018 (NOAA Fisheries 2018). These sharks are found in tropical to subtropical waters, typically offshore in deeper waters of the outer continental shelf. The long, rounded pectoral, dorsal, and tail fins of this shark are highly distinctive with white markings near the tip of the fins. These sharks prey primarily on bony fish and cephalopods such as squid, and occasionally tuna, marlin, other sharks and rays, seabirds, and marine mammals. Oceanic whitetips are estimated to live approximately 25 years, with reproductive age of females between 6 and 9 years. Reproduction is biennial, every other year, for a period of 10-12 months gestation to give live birth to 1-14 pups in each litter. The primary threat to oceanic whitetip sharks is capture as bycatch in longline, purse seine, and gillnet fisheries with a high degree of mortality (NYSERDA 2017; BOEM 2021a; NOAA Fisheries 2018). They are typically a surface-dwelling species, preferring water of 20 °C (68 °F) or above; however, these species are capable of deep dives up to 1,082 m (3,549 ft) deep. Oceanic whitetip shark adults primarily occur on the outer edge of the shelf and prefer deep waters to at least depths of 200 m (656 ft) thus in areas farther offshore than the Lease Area (NOAA Fisheries 2018). It is thought that juvenile oceanic white tip sharks utilize shallow reef habitats that do not occur in the Offshore Development Area (Passerotti et al. 2020). Therefore, this species is not expected to be affected by Vineyard Mid-Atlantic activities.

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[45] Given the lack of recognized visually distinguishing characteristics between manta ray species, Farmer et al. (2022) state their analysis should be considered inclusive of the giant manta ray.

Scalloped Hammerhead - Federal Threatened Species

The scalloped hammerhead shark is a global pelagic and highly migratory species listed as threatened in the central Atlantic under the ESA in 2014 (NOAA Fisheries 2014). This species, characterized by the distinctive hammer-shaped head with indentions in a scallop shape across the nose, is typically a tropical to subtropical species. These species typically prey on bony fish, cephalopods, invertebrates, and seabirds (NOAA Fisheries 2023). Most commonly found in the central Atlantic, this species migrates north to waters off North Carolina and as far north as New York and New England in the summer months, following the jet stream. The primary threat to scalloped hammerhead sharks is capture as bycatch in longline, purse seine, and gillnet fisheries with a high degree of mortality (NYSERDA 2017; BOEM 2021a; NOAA Fisheries 2023). From the aerial digital surveys conducted on behalf of NYSERDA from summer 2016 through spring 2019, scalloped hammerhead sharks were only very sparsely observed in the vicinity of the Offshore Development Area during the summer showing a slight preference for shelf slope waters in depths greater than 100 m (328 ft) thus farther offshore than the Lease Area, and not observed within the New York Bight during spring, fall, or winter (NYSERDA 2021). Therefore, this species is not expected to be affected by Vineyard Mid-Atlantic activities.

4.6.1.2 Lease Area OCS-A 0544

There were six NEFSC spring trawl tows within the boundaries of the Lease Area from 1963-2021, two of which occurred between 2010 and 2021, specifically in 2012 and 2016. These two years combined produced a total of 1,084 individuals captured. The highest catch numbers, with 723 individuals captured across 20 species, occurred in 2012, and 361 individuals across 14 species were caught in 2016. The dominant species captured within both years were longfin squid, sea scallop, spiny dogfish (*Squalus acanthias*), Atlantic herring, and alewife. The total catch consisted of 292 longfin squid, representing 27% of the total catch. There were six times as many longfin squid caught in 2012 than in 2016. Sea scallop represented 18% of the total catch, and spiny dogfish represented 17% of the total catch between 2010 and 2021.

Within the boundaries of the Lease Area, there were seven NEFSC fall trawl tows conducted from 1963 to 2021, three of which occurred within the Lease Area between 2010 and 2021, specifically in 2011, 2014, and 2015. These three years combined produced a total of 6,730 individuals captured. There was significant variability between the three survey years with 463 individuals caught across 15 species in 2011; 3,894 individuals caught across 16 species in 2014; and 2,373 individuals caught across 13 species in 2015. The dominant species captured between 2010 and 2021 were longfin squid, sea scallop, little skate, butterfish, and spotted hake (*Urophysis regia*). The catch between 2010 and 2021 was dominated by longfin squid, with 5,077 individuals captured, representing 75% of the total catch from three tows within the Lease Area from 2010 to 2021. In 2014, the number of longfin squid captured was 20 times greater than in 2011, and nearly eight times greater in 2015 than in 2011; however, catch of longfin squid dropped by 60% from 2014 to 2015. Sea scallops represented 13% of the total catch, and little skate represented 7% of the total catch from 2010 to 2021.

There were eight NEFSC Sea Scallop dredge survey tows within the boundaries of the Lease Area between 1966 and 2022, five of which occurred between 2000 and 2022. A total of 1,027 individuals were captured within the Lease Area between 2000 and 2022. The dominant species captured were sea scallops, slender sea star (*Leptasterias tenera*) and northern sea star (*Asterias rubens*). Sea scallops represented 37% of the catch between 2000 and 2022, with 386 individuals captured. *Leptasterias* spp. sea stars represented 22% of the catch, and *Asterias* spp. sea stars represented 11% of the catch between 2000 and 2022.

There were 13 NEFSC Atlantic surfclam and ocean quahog dredge survey tows within the boundaries of the Lease Area between 1963 and 2022, 11 of which occurred between 2000 and 2022. A total of 4,056 individuals were captured between 2000 and 2022. The dominant species captured were ocean quahog (*Arctica islandica*), Atlantic surfclam (*Spisula solidissima*), and sea scallop. The catch was dominated by ocean quahog, with a total of 3,380 individuals captured, representing 83% of the total catch from 2000 to 2022. Atlantic surfclam represented 13%, and sea scallops represented 2% of the total catch between 2000 and 2022.

The Vineyard Mid-Atlantic 2022 benthic environmental survey for Lease Area OCS-A 0544 was conducted from August 2022 to September 2022. This study consisted of still imagery and high-resolution digital video collected along 35 transects within the Lease Area at a depth of 40 to 46 m (131 to 151 ft). The relative abundance of invertebrate and vertebrate fauna in Lease Area video transects is summarized in Table 4.6-2. Note that longfin squid were observed frequently throughout 11 transects, with one group of over 50 juvenile individuals, but are not included in the percentage of observations presented in Table 4.6-2 since they are a highly mobile species.

Table 4.6-2 Ranked Abundance of Invertebrate Fauna in Lease Area Video Transects

Taxa Group	% of Invertebrate Observations in the Lease Area	Example Species Within the Taxa Group
Echinodermata	93.75%	sand dollars (*Echinoarachnius parma*), sea cucumbers (*Dendrochirotida* spp.), northern sea stars (*Asterias rubens*), blood stars (*Henricia* spp.)
Crustacea	4.14%	hermit crabs (*Pagarus* spp.), walking crabs (*Cancer* spp.), barnacles (Cirripedia)
Gastropoda	0.83%	snails
Bivalvia	0.51%	Atlantic surfclams, ocean quahogs, sea scallops
Porifera	0.33%	sponges
Non-Scleractinia Anthozoa	0.20%	anemones, sea fans
Annelids	0.10%	worms
Hydrozoa	0.05%	hydrozoans
Nudibranchia	0.06%	nudibranchs
Bryozoa	0.01%	bryozoans

The relative abundance of invertebrate and vertebrate fauna in Lease Area video transects is summarized in Table 4.6-3.

Table 4.6-3 Ranked Abundance of Vertebrate Fauna in Lease Area Video Transects

Vertebrate Species	% of Vertebrate Observations in the Lease Area[1]
American butterfish *(Peprilus triacanthus)*	76.01%
Lizardfish (*Snyodus* spp.)	11.68%
Witch flounder *(Glyptocephalus cynoglossus)*	4.85%
Little skate *(Leucoraja erinaceus)*	1.59%
Smooth skate *(Malacoraja senta)*	1.35%

Note:

1. Total does not add up to 100% due to only representing top five most common vertebrate observations. Additionally, raw observation counts of motile fauna may cause inflated numbers.

As described further in Appendix II-B, the most frequently observed species from the video transects within the Lease Area were Atlantic butterfish, Atlantic sea scallop, longfin squid, and witch flounder. Other species observed include Atlantic surfclam, little skate, ocean quahog, red hake (*Urophycis chuss*), summer flounder (*Paralichthys dentatus*), winter flounder (*Pseudopleuronectes americanus*), and winter skate (*Leucoraja oceallata*).

4.6.1.3 Offshore Export Cable Corridor

NEFSC spring trawl data showed 145 tows from 1963 to 2021 within 5 km (3.1 miles [mi]) of the OECC, with 16 tows occurring between 2010 and 2021. A total of 5,956 individuals were caught between 2010 and 2021. The dominant species were little skate, silver hake, Atlantic herring, winter flounder, and spotted hake. Little skate dominated every tow with a total of 3,929 individuals, representing roughly two-thirds (66%) of the total catch between 2010 and 2021. Silver hake represented 8% of the catch, and Atlantic herring represented 5% of the total catch from 2010 to 2021.

For NEFSC fall trawl data within a 5 km (3.1 mi) buffer of the OECC, there were 131 tows conducted from 1968 to 2021, with 10 of these tows occurring from 2010 to 2021. The dominant species captured from 2010 to 2021 were longfin squid, spot, sea scallop, silver hake, and scup (*Stenotomus chrysops*). Generally, catch was much higher in the fall than in the spring with a total of 19,834 individuals captured between 2010 and 2021. There were 6,700 longfin squid caught from 2010 to 2021. Therefore, a third (33%) of the total catch for 2010 to 2021 consisted of longfin squid, roughly a third (32%) consisted of spot, and 15% sea scallop.

The NEAMAP survey collects data biannually (spring and fall) in nearshore waters (Bonzek et al. 2014). Similar to the other surveys, NEAMAP follows a stratified random design using the same depth strata as the NEFSC trawl survey. At each station, a bottom trawl is towed for 20 minutes at 3 knots [kts] (3.5 miles per hour [mph]) (Bonzek et al. 2015). A total of 121 tows occurred from 2010 to 2022 within a 5 km (3.1 mi) buffer of the OECC in New York State waters, collecting a total of 269,386 individuals across 100 species between 2010 to 2022. However, there were no surveys conducted during the spring of 2020, coinciding with the onset of the COVID-19 pandemic. Scup, butterfish, longfin squid, weakfish (*Cynoscion regalis*), and bay anchovy (*Anchoa mitchilli*) were the dominant species captured during the spring and fall across all years, with average annual catches of 5,600, 5,446, 3,248, 1,944, and 1,845 individuals, respectively, which made up approximately 80% of the total catch. Annual catch varied significantly from a low of 2,449 individuals in 2020 to a high of 41,024 individuals in 2014. Annual catch was 10 times greater in 2014 than 2013 and eight times greater in 2021 than 2020. A total of 84,999 individuals were captured in the spring across all years, with an average annual catch of 7,083 individuals per year, excluding the spring of 2020. Overall, NEAMAP fall catch was significantly higher than the spring with a total of 184,387 individuals captured across all years and an average annual catch of 14,184 individuals per year in the fall. Catch was dominated by scup, longfin squid, butterfish, bay anchovy, and little skate in the spring making up 78% of the total catch, with the lowest catch in 2015 with a total of 1,537 individuals (excluding the spring of 2020) and highest catch in the spring of 2021 with a total of 13,089 individuals. Fall catch was dominated by butterfish, scup, weakfish, longfin squid, and bay anchovy, making up 85% of the total catch, with the lowest total catch in the fall of 2013 with 1,727 individuals and the highest catch in the fall of 2014 with a total of 39,487 individuals. Additionally, there were 34 Atlantic sturgeon captured in the spring and eight Atlantic sturgeon captured in the fall for a total of 42 individuals captured within 5 km (3.1 mi) of the OECC in New York state waters.

Between 1966 and 2022, there were 21 NEFSC Sea Scallop Dredge Survey tows within 5 km (3.1 mi) of the OECC, with 10 tows occurring between 2000 and 2022. A total of 4,125 individuals were captured between 2000 and 2022. The dominant species captured during this time period were northern sea star, sea scallop, and slender sea star. *Asterias* spp. sea stars dominated the catch with 2,435 individuals captured, representing 59% of the total catch from 2000 to 2022. Sea scallops represented 20%, and *Leptasterias* sea stars represented 6% of the total catch from 2000 to 2022. A high abundance of Asteroidea is indicative of a large population of mollusks, likely sea scallops, ocean quahogs, and Atlantic surfclams in the area as these are the primary prey for sea stars.

Between 1966 and 2022, there were 42 tows from the NEFSC Atlantic Surfclam and Ocean Quahog Dredge Survey within 5 km (3.1 mi) surrounding the OECC, with 18 tows occurring between 2000 and 2022. A total of 5,220 individuals were captured between 2000 and 2022. The dominant species captured during this time period were Atlantic surfclam, ocean quahog, and sea scallop. The total catch was dominated by Atlantic surfclam with 4,849 individuals caught, representing 92% of the catch between 2000 and 2022. Ocean quahog represented 6%, and sea scallops represented 0.04% of the total catch from 2000 to 2022.

The NYSDEC conducts a Nearshore Ocean Trawl Survey, a ten-year survey starting in the fall of 2017, that samples the Atlantic Ocean from Breezy Point, New York to Block Island Sound year-round and tags adult striped bass in the fall as they migrate through the marine waters of New York (NYSDEC 2023). This survey collects abundance and biological data from adult and subadult finfish and macroinvertebrates in the nearshore waters (up to 30 m [98 ft]). The NYSDEC conducted 85 Nearshore Ocean Trawl surveys within 5 km (3.1 mi) of the OECC in New York State waters between 2018 to 2023. The surveys were conducted seasonally across spring, summer, fall, and winter, with various numbers of trawls within each season. The total catch for all years was 157,288 individuals across 96 species of fish and invertebrates. The total catch was dominated by scup, butterfish, little skate, longfin squid, and northern searobin, which comprised approximately 68% of the total catch. Scup abundance was significantly higher than any other species with a total of 48,383 individuals captured between 2018 and 2023, comprising approximately 30% of the total catch. Butterfish was the second most abundant species, with 29,252 individuals captured, and little skate, longfin squid, and northern searobin with 10,766, 10,349, and 8,896 individuals captured, respectively. Data analysis considered December through February as winter, March through May as spring, June through August as summer, and September through November as fall. Spring and summer catches were significantly higher with 51,746 and 51,536 individuals captured, respectively, as compared to 43,069 and 10,935 individuals in fall and winter, respectively. Spring was dominated by scup, little skate, butterfish, longfin squid, and winter skate. Summer was dominated by scup, butterfish, clearnose skate, longfin squid, and northern searobin. Fall was dominated by scup, butterfish, little skate, spiny dogfish, and longfin squid. Winter was dominated by silver hake, little skate, and Atlantic herring. Additionally, there were 29 Atlantic sturgeon captured across all four seasons between 2018 and 2022 and 58 sand lance captured in the winter and spring between 2019 and 2021.

The NYSDEC also conducted studies in 2002, 2005, 2006, 2008, and 2012 on Atlantic Ocean surfclam population within 4.8 km (3 mi) of the coast in New York state waters (NYSDEC 2013). Sampling for these studies consisted of 238 stations between Rockaway Peninsula and Montauk Point, divided into 10 sub-areas for sampling. The location of the OECC and potential landfall sites are within the six sampling areas from Rockaway Inlet to Fire Island Inlet. Population estimates from the 2012 study indicate a population of 5.2 million bushels of surfclams, or an estimated 470 million individual clams, within New York State waters (NYSDEC 2013). Results from these studies indicate a significant decline in population since 2002 in the number of individual surfclams and their total biomass. Additionally, declines in harvestable size of the surfclam population decreased from 34% to 2% between 2002 and 2006, a slight increase in 2008 to 10%, and a decline again in 2012 to 6%, indicating reduced potential for reproduction and recruitment of juvenile populations. These studies indicate significant decline in population size and biomass in the New York State waters near the OECC due to other factors such as overfishing, ecosystem dynamics, and climate change.

The Vineyard Mid-Atlantic 2022 benthic environmental survey for the OECC was conducted from May to July 2023. This study consisted of still imagery and continuous high-definition video collected along 62 offshore and 5 nearshore transects within the OECC at depths of 0.2 to 2 m (0.6-6 ft). Table 4.6-4 provides a summary of the most abundant invertebrate taxa observed in the OECC video transects.

Table 4.6-4 Ranked Abundance of Invertebrate Taxa in OECC Video Transects

Taxa Group	% of Invertebrate Observations in the OECC[1]	Example Species Within the Taxa Group
Arthropoda	60.31%	hermit crabs, horseshoe crabs, spider crabs, rock crabs
Cnidaria	15.28%	burrowing anemone, hydrozoa, sea pen
Gastropoda	7.38%	northern moon snail
Chordata	5.89%	mud tunicates
Echinodermata	2.83%	common sea star, sea cucumber
Cephalopoda	2.15%	northern shortfin squid, longfin squid
Bryozoa	2.06%	Bugula spp. colony
Porifera	1.73%	boring sponge, red beard sponge
Bivalvia	0.77%	Atlantic sea scallop, blue mussel
Phoronida	0.39%	Phoronid tube builder
Ctenophora	0.19%	comb jelly
Annelida	0.17%	spoon worms

Note:

1. Percentages may not add up to 100% due to rounding and exclusion of unidentified invertebrates.

Sand dollars (*Echinarachnius parma*) and decorator worms (*Diopatra* spp.) were also very abundant in transects, due to the cluster and large abundance, these species were quantified as separate biological communities and not included in the percentage of echinoderms and annelids presented in Table 4.6-4. In addition, tubes created by the amphipods (*Ampelisca vadorum*), while not living organisms, were classified as communities due to their high abundance and creation of a unique seafloor. These biological communities were classified every 30 seconds to create areas of abundance. Decorator worms were observed at the highest quantity at 31 transects or 46.27% of transects observed. Sand dollars and amiphipod tubes were seen less frequently at 25 and 8 transects or 37.31% and 11.94% of the taxa observed, respectively.

Numerous species of fish were frequently observed within the video transects, yet less abundant than the invertebrates within the OECC. The relative abundance of invertebrate and vertebrate fauna in OECC video transects is summarized in Table 4.6-5.

Table 4.6-5 Ranked Abundance of Vertebrate Fauna in OECC Video Transects

Vertebrate Species	% of Vertebrate Observations in the Lease Area[1]	Number of Transects Observed
Northern sea robin *(Prionotus carolinus)*	36.70%	46
Scup *(Stenotomus chrysops)*	16.55%	15
Little skate *(Leucoraja erinacea)*	11.49%	22
Butterfish *(Peprilus triacanthus)*	10.32%	8
Unidentified flounder *(Pleuronectiformes* spp.*)*	6.19%	20

Note:

1. Total does not add up to 100% due to only representing top five most common vertebrate observations.

Other species of fish identified in the OECC but seen at lesser percentages include bluefish (*Pomatomus saltatrix)*, clearnose skate (*Raja eglanteria*), northern kingfish (*Menticirrhus saxatilis*), spiny dogfish (*Squalus acanthias*), striped sea robin (*Prionotus evolans*), sandperch (*Diplectrum formosum*), and summer flounder (*Paralichthys dentatus*).

4.6.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect finfish and invertebrates during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.6-6.

Table 4.6-6 Impact Producing Factors for Finfish and Invertebrates

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Seafloor Disturbance and Habitat Modification	•	•	•
Presence of Structures	•	•	•
Suspended Sediments and Deposition	•	•	•
Discharges/Intakes	•	•	•
Electromagnetic Fields and Cable Heat		•	

Table 4.6-6 Impact Producing Factors for Finfish and Invertebrates (Continued)

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Noise	•	•	•
Artificial Light	•	•	•
Fisheries Survey Gear Utilization	•	•	
Port Utilization	•	•	•

Potential effects to finfish and invertebrates were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5. For each IPF, an analysis of potential impacts to Atlantic sturgeon is provided. For giant manta ray, a species that would only be in the Offshore Development Area during migratory movements, an analysis is provided for the primary IPFs from offshore wind activities that could impact the giant manta ray: survey gear utilization, noise impacts from foundation installation, and potential vessel strikes from port utilization (BOEM 2023a, 2024b). Therefore, the other IPFs are discounted for analysis as causing potential effects to giant manta rays.

4.6.2.1 Seafloor Disturbance and Habitat Modification

Temporary to long-term seafloor disturbance and habitat modification may occur from the installation, maintenance, and decommissioning of Vineyard Mid-Atlantic components in the Lease Area and OECC. These components include foundations (for the wind turbine generators (WTGs), electrical service platforms (ESP[s]), scour protection, offshore export cables, inter-array and inter-link cables, and cable protection (if required). Long-term habitat modification may result from the installation of foundations, scour protection, and cable protection (if required). Additional temporary habitat modification may result from the installation, maintenance, and decommissioning of offshore export, inter-array, and inter-link cables; pre-installation activities (such as a pre-lay grapnel run, boulder clearance, etc.); and usage of equipment that contacts the seafloor (such as jack-up vessels, vessel anchors or spud legs). Table 4.6-7 provides the expected long-term and temporary seafloor impacts. Additional details are available in Section 3.11 of COP Volume I.

Table 4.6-7 Summary of Maximum Potential Seafloor Disturbance

Activity	Long-Term Seafloor Disturbance	Temporary Seafloor Disturbance	Total Seafloor Disturbance
Maximum Total Disturbance in the Lease Area	1.73 km^2 (428 acres)	6.17 km^2 (1,524 acres)	7.59 km^2 (1,875 acres)
Maximum Total Disturbance in the OECC	0.746 km^2 (184 acres)	5.12 km^2 (1,266 acres)	5.12 km^2 (1,266 acres)

Direct impacts from seafloor disturbance during construction, maintenance activities, or decommissioning include the physical displacement, injury, and mortality of organisms in both the Lease Area and OECC. Sessile and slow-moving benthic and demersal species, such as shellfish, and early life stages of invertebrates and fishes, such as eggs and larvae, are most at risk of injury and death from physical trauma as foundations, scour protection, cables, anchors, anchor lines, jack-up legs, and spud legs contact the seafloor. If construction occurs during cooler temperatures, species that bury themselves in the winter such as horseshoe crabs (Walls et al. 2002) and blue crabs (Millikin 1984) have greater risks of impact. Offshore export, inter-array, and inter-link cable installation and maintenance may affect organisms up to the target cable burial depth beneath stable seabed of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters, [46] and foundation installation may affect organisms up to the maximum foundation penetration depth as listed in Sections 3.3 and 3.4 of COP Volume I. Overall, these impacts are expected to be localized and limited to the relatively small impact areas from construction (see Table 4.6-7). To further limit these potential impacts, offshore export cable installation will avoid sensitive habitats,[47] where feasible; and in nearshore areas where sensitive resources may be located near the potential landfall sites, horizontal directional drilling (HDD) may be used to minimize disturbance to coastal habitats by drilling underneath them instead of through them. Mobile species and life stages including demersal and pelagic fishes and benthic and pelagic invertebrates are expected to be impacted temporarily as they move to avoid physical contact and motions perceived as threats. These temporary avoidance impacts occur over a relatively short time period and are comparable to existing disturbances by vessel traffic and fishing gear with organisms expected to return after the action ceases. Impacts from sedimentation during construction are discussed in Section 4.6.2.2. Deflagration or detonation of unexploded ordnances (UXO) and/or discarded military munitions (DMM) has the potential to affect fish and invertebrates through seafloor disturbance, direct mortality, and underwater noise; this IPF is discussed further in Section 4.6.2.5.

Temporary habitat modifications, including temporary alterations to bathymetry, are expected to primarily affect benthic and demersal fishes and invertebrates. Effects could range from minor benefits of increased available prey immediately after disturbance (Hiddink et al. 2008) or increased seafloor relief to limited impacts from loss of key prey species due to mortality in affected areas. However, these effects are considered temporary because habitats are expected to begin recovery once construction, maintenance, or decommissioning activities are completed. The local severity of these impacts is comparable to ongoing fishing dredge impacts along the Northeast US shelf and potential impacts are relatively small in spatial scale

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[46] Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

[47] Eelgrass, Complex habitat, and Large Grained Complex habitat are absent from the Lease Area and OECC.

(see Table 4.6-7). Dynamic, sandy physical habitat begins to recover substantially within a few months of disturbance and can fully recover abundance within two years and recover biomass and diversity in two to four years (Van Dalfsen and Essink 2001; Dernie et al. 2003). Additionally, the Proponent will work to minimize temporary habitat effects. For vessels other than anchored cable laying vessels (which must maintain tension on anchor lines), the use of mid-line anchor buoys will be considered (where feasible and considered safe) as a potential measure to reduce impacts to sensitive seafloor habitat from anchor line sweep. There is no anchor line sweep from anchored cable laying vessels because the anchor lines are under tension. In addition, a benthic habitat monitoring plan framework has been developed (see Appendix II-R) to monitor recovery after construction in areas with sensitive habitats. A fisheries monitoring plan will be developed to monitor key indicators before and after construction; such monitoring may be part of regional monitoring efforts.

As discussed further in Section 4.6.2.2, long-term modification may affect benthic/demersal and pelagic fishes and invertebrates through the alteration of habitat type. Foundations and scour protection will create hard, complex structure in the water column and along the seafloor that previously did not exist, and cable protection will cover existing habitat with anthropogenic hard bottom. Therefore, foundations, scour protection, and cable protection are expected to have localized benefits for structure-associated species through the conversion of habitat, with potential localized adverse impacts to species that prefer fine substrates.

Any potential long-term changes due to the introduction of foundations, scour protection, and cable protection are only anticipated to affect a small percentage of the available habitat in the Lease Area and OECC. For example, long-term impacts are only approximately 1% of the total size of the Lease Area. Additionally, the Proponent's goal is to minimize the use of cable protection to the greatest extent possible through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route.

During decommissioning, all offshore components will be removed to a depth of 4.5 m (15 ft) below the mudline, unless otherwise authorized by the Bureau of Safety and Environmental Enforcement. In particular, the offshore cables may be retired in place or removed. Temporary effects from decommissioning are expected to be similar to those experienced during construction. The long-term modifications of habitat are expected to be reversed upon decommissioning when offshore components are removed below the mudline (unless cable and scour protection are retired in place, in which case they will continue to function as hard, complex bottom unless buried by sedimentation).

The general impacts described above are also applicable to Atlantic sturgeon (BOEM 2024a). Given that Atlantic sturgeon are anadromous, inhabit brackish estuaries as juveniles, and move into coastal areas as adults (as detailed in Section 4.6.1), potential habitat disturbance would occur primarily to any juveniles and adults in these nearshore areas, if present. Although the loss of soft-bottom habitat may result in limited prey reduction (infaunal organisms and benthic fishes [i.e. sand lance]), impacts are expected to be insignificant for Atlantic sturgeon, given the small and localized reduction in prey and opportunistic feeding strategies (Stenberg et al 2015; NMFS 2024).

4.6.2.2 Presence of Structures

The presence of foundations (monopiles and piled jackets), scour protection, and cable protection will result in a conversion of the existing primarily sandy bottom habitat to a hard bottom habitat with areas of vertical structural relief (Wilhelmsson et al. 2006; Reubens et al. 2013; Bergström et al. 2014; Coates et al. 2014; Kaldellis et al. 2016; Degraer et al. 2020). The newly-created WTG and ESP foundation structures present throughout the water column can be compared to the addition of artificial reefs which have been shown to lead to ecological benefits (Langhamer 2012). These potential effects are anticipated to be similar for monopile or jacket foundations. Some of the benefits observed around foundations include increased biodiversity and abundances of fishes (Wilhelmsson et al. 2006; Andersson and Öhman 2010; Riefolo et al. 2016; Raoux et al. 2017; The Nature Conservancy and INSPIRE Environmental 2021). Addition of foundations may also alter foodweb dynamics from the bottom up through the introduction of new surfaces for filter feeders to colonize and consume plankton (Coates et al. 2014; Slavik et al. 2017). Cable protection is expected to have similar impacts in places where it is placed on fine substrate, but, where it is placed on hard, complex habitat, it may have temporary negative impacts to structure-oriented species until it is colonized by the benthic community. Both cable protection and scour protection have potential for providing long-term benefits via increased cobble/boulder-like habitat which is a key habitat for lobsters (Linnane et al. 1999; Selgrath et al. 2007) and other species.

Additional research focused on changes in community assemblages related to habitat around offshore wind farms found that species that prefer complex habitat became newly established after installation while communities in nearby soft-bottom habitats remained unchanged (Stenberg et al. 2015). Wind farms have also been found to have localized increases in abundance (Løkkeborg et al. 2002) and improved condition and growth rates (Reubens et al. 2013) of commercially valuable species. However, the habitat created by the addition of offshore components also has potential to benefit non-indigenous species and provide a mechanism for wider dispersal of potentially harmful non-indigenous species through a steppingstone effect (Glasby et al. 2007) resulting in localized impacts to the finfish and invertebrates, such as blue mussels and fishes, that consume them. Further, while the invasive colonial sea squirt (*Didemnum vexillum*) was recorded at the Block Island Wind Farm (HDR 2020), this species is already an established species in New England, including in subtidal areas such as Georges Bank that hosted several sites with 50 to 90 percent coverage by colonial sea squirt (Bullard et al. 2007; BOEM 2024a). Although the impacts of invasive species on EFH have the potential to be widespread and permanent if the species were to become established and outcompete native fauna or modify habitat, the increased risk from Vineyard Mid-Atlantic is low in comparison to the risk from ongoing activities, such as shipping and hull biofouling, aquaculture, and commercial and recreational fishing.

As discussed in Section 3.2, the presence of structures (WTGs, ESPs, and their associated foundations [monopiles for WTGs and monopiles or jackets for ESPs]) may alter physical oceanographic patterns at a fine scale. The presence of offshore wind structures can cause potential effects on the ocean due to 1) the physical presence of the turbines within the water column, and 2) the effects of wind energy extraction on wind-driven ocean circulation (NAS 2024). Studies have found that foundations induce vertical mixing in the water column as water flows around the structure (van Berkel et al. 2020); these potential alterations are broadly similar for monopile and jacket foundations. Though individual structures installed as part of Vineyard Mid-Atlantic are expected to have highly localized physical oceanographic effects, this vertical mixing may have some effects on carbon and nutrient cycling, phytoplankton, and overall production (Gill 2005; Dorrell et al. 2022; BOEM 2023a). Local disturbances in the wake of the turbines may modify the stratification within the water column, thereby increasing vertical mixing and potentially turbidity, which in turn would either increase the phytoplankton primary production due to higher nutrient availability or lower it due to decreases in light availability due to increased turbidity (Floeter et al. 2017; Dannheim et al. 2019; Copping et al. 2020). Variation in mixing layer depth may also affect distributions of larval assemblages in the water column (Chen et al. 2021).

The presence of scour and cable protection (if used) could potentially alter bottom current patterns, leading to increased movement, suspension, and deposition of sediments (BOEM 2023a; BOEM 2024a). Any hydrodynamic effects from scour and cable protection are expected to be extremely localized (i.e., only in the immediate vicinity of the structures themselves), and are not expected to have regional effects on finfish and invertebrates.

In addition to potential direct effects from the presence of underwater offshore wind structures, wind-driven ocean circulation may also be affected by above-water turbine-induced reductions in wind speed (BOEM 2023a). Turbines are expected to generate a leeward wind speed deficit, or wind wake, that could extend downstream of wind farms for up to 10 km (5.4 nautical miles [NM]) for strongly convective conditions to 40 km (22 NM) during very stable conditions, with the extent dependent on the number of turbines and array configuration (Platis et al. 2020; Akhtar et al. 2021; Christiansen et al. 2022). Wind wakes can potentially reduce wind-driven mixing of surface waters, which transfers atmospheric changes to hydrodynamics (Paskyabi 2015), and wave energy is reduced at the sea surface (Bärfuss et al. 2021). Other physical oceanographic processes that could be affected include surface flow, surface layer mixing, bottom shear stress, and water column stratification (Christiansen et al. 2022; Daewel et al. 2022).

Changes in physical oceanographic patterns from the presence of offshore wind structures may affect the Mid-Atlantic Cold Pool, a seasonally present water mass of colder water trapped on the ocean floor that extends from Nantucket, Massachusetts to Cape Hatteras, North

Carolina and is an important feature to the dispersal and survival of early life stages of many fish and invertebrates (BOEM 2021a; BOEM 2023a). While the Mid-Atlantic Cold Pool has been described (Lentz 2017; Chen et al. 2018), its year-to-year dynamics are not fully understood and research is ongoing (BOEM 2021a; BOEM 2023a). In areas where wind farms overlap with areas of stratification including the Mid-Atlantic Cold Pool, such stratification could be weakened by wind wakes (Paskyabi 2015; Djath et al. 2018) and underwater structures (Carpenter et al. 2016). In their modeling study investigating the impacts of offshore wind structures on large-scale stratification in the North Sea, Carpenter et al. (2016) did not find a significant reduction in stratification from small-scale installations (i.e., modeled wind farm length of 8 km [4.3 NM]) but did find localized reductions in stratification in large-scale installations (i.e., modeled wind farm length of 100 km [54 NM]). There are several fish and invertebrate species (e.g., yellowtail flounder, winter flounder, and Atlantic surfclam) identified as being dependent on the presence of the Mid-Atlantic Cold Pool (Able et al. 2014; Sha et al. 2015; Miller et al. 2016; Xu et al. 2018; Hofmann et al. 2018; Timbs et al. 2018; BOEM 2023a). The populations of these species could be vulnerable to changes in the natural dynamics of the Mid-Atlantic Cold Pool. However, it should be noted that predicted warming of sea temperatures, a phenomenon that offshore wind farms aim to help alleviate, is expected to increase the long-term uncertainty associated with the dynamics and presence of the Mid-Atlantic Cold Pool (Miles et al. 2021). Therefore, any potential effects of the presence of offshore wind structures on the distribution of early life stages of fish and invertebrates are expected to be localized and are not expected to generate population-level effects.

New underwater structures can present a potential risk of entanglement; however, entanglement is not expected as a direct result of Vineyard Mid-Atlantic activities. The Proponent will use steel anchor cables on construction vessels, which will be taut during deployment, eliminating the potential for entanglement. Additionally, metocean buoys and anchor or tow lines used during cable installation will be kept taut at all times, thereby further reducing the risk of entanglement. No underwater offshore cables are expected to result in entanglement risk; these cables have large diameters and will be buried to target cable burial depth beneath the stable seafloor of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters.

The WTG and ESP structures may cause a secondary entanglement risk to marine organisms (such as fish and invertebrates) through ghost gear and/or marine debris caught on the structures themselves. However, the structures have large monopile or piled jacket diameters, without protrusions, which prevents much of the ghost gear and/or marine debris from being snagged on the structures. The Proponent will inspect the foundations and scour protection at regular intervals for the presence of marine debris (see Section 4.2.2 of COP Volume I) and will remove ghost gear and/or marine debris which may result in the entanglement of fish and invertebrates.

The general impacts described above are also applicable to Atlantic sturgeon (BOEM 2024a). This IPF is not expected to impact Atlantic sturgeon eggs, larvae, and juveniles because they occur upstream in riverine and estuarine habitats; therefore, any potential impacts would only affect adults and subadults. Atlantic sturgeon (likely juveniles, subadults and adults) have been documented to commonly navigate past structures of variable size in riverine environments, in many cases between distances smaller than that of closest distance between WTGs (AKRF 2012; NMFS 2024). Atlantic sturgeon's demonstrated ability to swim past structures, combined with the short periods of time that Atlantic sturgeon may pass through the Offshore Development Area (Ingram et al. 2019; Rothermel et al. 2020), collectively suggest that the presence of structures is unlikely to affect Atlantic sturgeon distributions or mobility of individuals. Further, any potential physical oceanographic effects are not expected to significantly impact prey availability, specifically of benthic invertebrates and fishes (i.e. sand lance) (Smith 1985, Dadswell 2006).

4.6.2.3 Suspended Sediments and Deposition

Temporary increases in suspended sediments and subsequent sediment deposition may occur in the Lease Area and OECC from the installation, maintenance, and decommissioning of offshore export cables, inter-array cables, inter-link cables, foundations (monopiles or jackets), and scour protection. Specifically, sediment is expected to be suspended into the water column during cable pre-installation activities (e.g., a pre-lay grapnel run, boulder clearance, etc.), cable installation, seabed preparation prior to foundation installation (if needed), installation of cable protection (where required), the use of other equipment that contacts the seafloor (e.g., jack-up vessels, vessel anchors, or spud legs), and excavation and backfill of the temporary HDD exit pit. Most of these activities would occur during construction, with potential for limited activities during O&M if cables require repair or maintenance; however, any effects would be expected to be far less impactful than those from construction activities. Impacts from suspended sediments and deposition would be temporary and confined to a small area close to the location of the installation activity.

Direct effects on finfish and invertebrates from suspended sediments can include visual impairment, asphyxiation, and reduced filter feeding abilities. The severity of impacts from suspended sediments during construction, maintenance activities, or decommissioning would vary based on the concentration and duration of suspended material. Sediment is suspended regularly by storm events so many species are adapted to periodic impacts from suspended sediment. Reduced growth and oxygen consumption of bivalves can occur when sediment concentrations of 100 milligrams per liter (mg/L) persist for two days (Wilber and Clarke 2001). Sublethal effects (i.e., non-lethal asphyxiation) were observed for adult white perch (*Morone americana*) when 650 mg/L of suspended sediments persisted for five days (Sherk et al. 1974). Lethal effects for other adult fish species can occur at concentrations greater than 1,000 mg/L that persist for at least 24 hours (Sherk et al. 1974; Wilber and Clarke 2001). Fish eggs and larvae are typically more sensitive, with delayed hatching observed for white perch at a sediment concentration of 100 mg/L for one day (Sherk et al. 1974). Therefore, 100 mg/L for 24 hours is considered a conservative threshold for impacts from suspended sediments. As described in Section 4.5, concentrations of 10 mg/L for 24 hours could potentially affect settlement of extremely sensitive life stages (i.e., coral larvae) and is therefore considered an extremely conservative threshold.

Direct effects on finfish and invertebrates from the resettlement of suspended sediments can include mortality or injury, particularly for immobile species or life stages from burial and smothering. Severity of impacts from deposited sediments during construction, maintenance activities, or decommissioning would vary based on the thickness of material. As discussed in Section 4.5, some infaunal bivalves can withstand deposition levels up to 300 millimeters (mm) (12 inches [in]) (Essink 1999). Sessile or seafloor surface-dwelling species, such as blue mussels and queen scallops (*Aequipecten opercularis*), are more sensitive to deposition levels and lethal effects have been observed with burial depths between 20–100 mm (0.8–4 in) (Essink 1999; Hendrick et al. 2016). For demersal eggs (fish [e.g., summer flounder (*Paralichthys dentatus*), Atlantic herring, and winter flounder], squid [e.g., longfin inshore squid], and whelk species), deposition greater than 1 mm (0.04 in) can result in the burial and mortality of that life stage (Berry et al. 2011). Therefore, sediment deposition thicknesses of 1 mm (0.04 in) and 20 mm (0.8 in) are considered the conservative thresholds for demersal eggs and shellfish, respectively.

The general impacts described above are also applicable to Atlantic sturgeon (BOEM 2024a). Atlantic sturgeon are frequently exposed to elevated turbidity through processes such as water runoff and storm events in riverine habitats, as well as through feeding behavior that stirs up bottom sediments (Hastings 1983; ECOPR Consulting 2009; NMFS 2024). Studies with similar sturgeon species found that increased turbidity did not lead to mortality and that impacts from sediment plumes associated with dredging were minimal when fish had the ability to move away from the disturbance (Garakouei et al. 2009; Wilkens et al. 2015; NMFS 2024). Exposure to total suspended solids (TSS) would be below levels expected to affect subadults or adult Atlantic sturgeon (NMFS 2024), and eggs would be unaffected to deposition as they are laid upstream. Thus, impacts to Atlantic sturgeon across life stages are expected to be insignificant.

To assess the impacts of suspended sediments and deposition, sediment transport modeling will be completed for offshore export cable and inter-array cable installation and HDD exit pit construction[48] (see Appendix II-P). Activities were modeled separately within the Lease Area and the OECC. Model results provided the following estimates of the durations and concentrations of suspended sediment during construction:

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48 As described in Appendix II-P, the modeling for HDD exit pit construction focused on backfilling since it may result in greater water quality effects than excavation under the conservative assumption that excavated material is released at the water surface.

- **Offshore export and inter-array cable installation:** Above-ambient TSS concentrations substantially dissipate within three hours and fully dissipate between six and 12 hours. The modeling analyses predict that suspended sediment concentrations induced by installation of the cables will largely be of short duration, confined to the near-bottom portion of the water column, and will return to ambient conditions within several hours after the installation device has passed. Additionally, if a pre-pass jetting run (using a jet plow or jet trencher) were to be conducted along the route (see Section 3.5.4 of COP Volume I), it is anticipated this would occur with sufficient time for any suspended sediment concentrations to return to ambient conditions prior to cable installation.

- **HDD exit pit construction:** Above-ambient TSS concentrations may be present throughout the entire water column because sediments were released at the water surface but are predicted to return to ambient conditions within six to 12 hours.

Since suspended sediments are expected to dissipate within 12 hours for all modeled scenarios and do not exceed the conservative effects threshold of concentrations of 100 mg/L for 24 hours (for fish eggs and larvae, all life stages of crustaceans, and juvenile and adult mollusks; see Table 4.5-5), suspended sediments from construction and operation activities are not expected to have lethal or sublethal effects to finfish and invertebrates in the Offshore Development Area. In addition, suspended sediments are expected to be localized, with high concentrations not expected to travel greater than a few kilometers (a couple of miles) from the centerline.

Model results also provided estimates of the extent, area, and range of thicknesses of deposited sediment during construction (Appendix II-P). Model results of sediment deposition for offshore export cable and inter-array cable installation and HDD exit pit construction provided the following estimates:

- **Offshore export and inter-array cable installation:** In most areas, the model predicted a depositional thickness between 1 mm (0.04 in) and 5 mm (0.2 in); small areas were predicted to have a depositional thickness between 5 mm (0.2 in) and 20 mm (0.8 in). For the maximum jetting scenario in the Lease Area, a small area of deposition was predicted to exceed 20 mm (0.8 in).

- **HDD exit pit construction:** The model predicted a depositional thickness greater than 100 mm (4 in), however, the areas associated with these thicknesses were relatively small (0.01 km^2 [2.5 acres]) and were local to the source.

For offshore export cable installation and HDD exit pit construction, the model predicted that deposition in most areas would be below the 20 mm (0.8 in) sensitivity threshold for shellfish, with only a small area (up to 0.03 km^2 [7.4 acres]) predicted to have deposition above 20 mm (0.8 in) for each HDD exit pit. If a pre-pass jetting run (using a jet plow or jet trencher) were to be conducted along the route (see Section 3.5.4 of COP Volume I), the predicted deposition is expected be similar to that of the offshore export cable installation scenario and remain below the 20 mm (0.8 in) threshold. Sufficient time is also anticipated between the pre-pass jetting run and cable installation to allow for some of this sediment deposition to be redistributed due to the forcing of surrounding currents.

For this reason, although there are expected to be short-term to longer term (several years) impacts on the finfish and invertebrate resources along the OECC and Lease Area, these are not anticipated to result in population-level effects. In addition, a benthic habitat monitoring plan framework has been developed (see Appendix II-R) to monitor recovery after construction in areas with sensitive habitats where similar post-construction monitoring has not already been conducted for other projects (such as along the OECC).

Although there are expected to be primarily short-term impacts on the finfish and invertebrate resources along the OECC and Lease Area, these are not anticipated to result in population-level effects. In addition, a benthic habitat monitoring plan framework has been developed (see Appendix II-R) to monitor recovery after construction in areas with sensitive habitats where similar post-construction monitoring has not already been conducted for other projects (such as along the OECC).

4.6.2.4 Discharges/Intakes

Discharges and intakes that may affect finfish and invertebrates include entrainment and impingement and inadvertent releases or spills.

Localized entrainment and potentially impingement of planktonic life stages of finfish and invertebrates may occur in the Lease Area and OECC from the installation, maintenance, and decommissioning of offshore export cables, inter-array cables, inter-link cables, foundations, and cable and scour protection. Short-term impacts may result from vessel cooling systems used during all phases and from other pump intakes including the potential use of jetting equipment to install offshore export, inter-array, and inter-link cables. If the selected ESP includes high voltage direct current (HVDC) equipment, impacts may result from the seawater cooling water intake structure (CWIS) which may be required.

Direct impacts from entrainment could be mortality of entrained organisms in the Lease Area and OECC. Impacts from impingement can range from injury to mortality. The rate of entrainment and impingement are dependent on the physical characteristics of the intake and composition of the local finfish and invertebrate community. The size of the intake screen controls the maximum size of organisms that can be entrained while intake flow velocities determine the capability of organisms to avoid entrainment and impingement. The intake flow volume influences the total number of organisms that may be impacted. Planktonic organisms, such as some egg and larval fish and invertebrates, are most at risk of mortality from entrainment due to their small size and zero to limited swimming ability. Although survival rates of entrained organisms may vary (Mayhew et al. 2000), it is conservatively assumed that entrained eggs and larvae would experience 100% mortality rates.

An HVDC CWIS is expected to intake up to a maximum design intake of 47,200 cubic meters per day (m^3/day) (12,500,000 gallons per day [gal/day]) throughout the operational period, which is roughly 0.0006% of the volume of water within the Lease Area assuming an average depth of 42.5 m (138 ft). It is important to note this is a very conservative estimate as the amount of cooling water used will vary with the amount of electricity being produced by the wind farm, and with seasonal variations in water temperature (see Appendix II-N). In addition, based on this volume and because more than 25% of the intake volume will be used for cooling, this new facility will be subject to the National Pollutant Discharge Elimination System permit requirements for new facilities defined in 40 CFR §125.81 as it pertains to Section 316(b) of the Clean Water Act. Therefore, an additional permitting process will be performed in coordination with the Environmental Protection Agency (EPA) prior to construction of a CWIS that will further evaluate the potential impacts from entrainment and impingement. Through this process, best available technology for minimizing impacts will be further considered. For example, intake screen designs can be modified to reduce intake velocities, so it is expected that impingement will not be a significant impact for most species.

To estimate the impacts of entrainment from an HVDC CWIS, an assessment using anticipated flow rates and local zooplankton data was completed as described in Appendix II-N. Model results provided estimates of the composition and magnitude of intake mortality for ichthyoplankton and other zooplankton. Based on seasonal plankton densities and entrained water volumes, annual estimated ichthyoplankton losses from HVDC CWIS entrainment are expected to range from a maximum of 1,583 fish larvae to 4.1 million fish larvae per season, or 8.7 million fish larvae annually. Annual estimated losses of other zooplankton are expected to be a maximum of 65 billion individuals. It is important to highlight again the conservative nature of these results and note that this analysis may be updated at a later date with a more realistic range of expected flow rates as that technical information becomes available. As described further in Appendix II-N, the water usage rate and total intake volume used for the initial entrainment analysis are still considerably lower than most similarly-sized traditional fossil fuel power plants. Based on the magnitudes of the results, ecological and socioeconomic effects from entrainment by the HVDC CWIS will likely be minimal.

According to the Electric Power Research Institute (EPRI), 99.9% of young spawned by a typical female fish can be expected to die prior to adulthood (EPRI 2004). Similarly for the fish entrained at a CWIS, only a fraction would have survived to reproduce or be harvested by fishermen. Therefore, if the annual number of equivalent adults (age 1) lost to entrainment were calculated using the forward projection approach as described in EPRI (2004), it is expected that tens to thousands of times fewer age-one equivalent fish would be lost to entrainment when compared to larvae lost due to high early-life stage mortality. Based on the magnitudes of the results, ecological effects from entrainment of EFH resources by the HVDC CWIS will likely be undetectable.

Since Atlantic sturgeon spawn and their larvae grow to the juvenile stage in freshwater rivers, they will not be directly impacted by any potential impingement or entrainment that may result from Vineyard Mid-Atlantic.

Additionally, the use of an HVDC CWIS involves the discharge of warmed seawater after it leaves the heat exchangers; this warmed seawater will be discharged below the water's surface through pipes that are attached to the foundation. The Proponent will be conducting an assessment of any potential thermal impacts as part of the National Pollutant Discharge Elimination System (NPDES) permitting process for the cooling water intake structure. Any thermal impacts are anticipated to be limited to the immediate area surrounding the discharge, leaving large areas of the surrounding water mass unaffected. Drifting plankton in the vicinity may experience stress or mortality primarily due to water temperature changes; however, any impacts to finfish and invertebrates, including Atlantic sturgeon, are expected to be spatially limited (BOEM 2024a).

Section 7.5 includes additional discussion of potential impacts to finfish and invertebrates from accidental releases and discharges (including marine debris), as well as measures that will be adopted to avoid, minimize, or mitigate potential impacts.

4.6.2.5 Electromagnetic Fields and Cable Heat

Electromagnetic fields (EMFs) will be produced by energized offshore export, inter-array, and inter-link cables during operation. EMFs consist of two components: electric fields and magnetic fields. The characteristics of the EMF can vary greatly depending on the energy flow of electricity and the type of current: high voltage alternate current (HVAC) vs. HVDC (Tricas 2012). Due to cable configuration and shielding, electric fields are not expected in the marine environment from Vineyard Mid-Atlantic cables. Therefore, the following discussion describes EMF generally and then focuses on magnetic fields (MFs) when discussing the potential effects from Vineyard Mid-Atlantic. As described further in Section 3.5 of COP Volume I, two to six offshore export cables installed within the OECC will transmit electricity from the ESP(s) to landfall site(s) on the southern shore of Long Island, New York.

The effects on finfish and invertebrates from EMF are not fully understood but can include disorientation and other behavioral responses (e.g., avoidance, changes in prey detection or feeding activity) (Riefolo et al. 2016). The severity of impacts from EMF during operation would vary based on the strength of the EMF and the electromagnetic sensitivity of organisms. Of species potentially present in the Offshore Development Area, electromagnetic sensitivity has been primarily documented in elasmobranchs (sharks, skates, and rays), as well as some teleost fish species (ray-finned fishes), and invertebrates such as *Cancer* crabs. Other species such as Atlantic sturgeon are suspected to have sensitivity to EMF, given their magnetosensitive or electrosensitive tissues that aid while using electrical signals in prey location or the magnetic field of the Earth for navigation (NMFS 2024). The effects of EMF would be localized because EMFs produced by cables decrease with distance. In addition, at the target cable burial depth beneath stable seabed of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters, EMFs at the seabed would be expected to be weak and likely only detectable by demersal species (Normandeau et al. 2011). In areas where seafloor type potentially prohibits cable burial, cable protection would serve as a similar although thinner barrier to exposure.

A white paper review study funded by BOEM determined that HVAC EMFs produced by power transmission cables would result in negligible, if any, effects on bottom-dwelling commercial and recreational fish species and no negative effects on pelagic commercial and recreational fish species (Rein et al. 2013; Copping et al. 2016; Love et al. 2017; Hutchinson et al. 2018; Snyder et al. 2019). Other reviews have concluded that effects of HVDC and HVAC EMFs on invertebrates can be measurable but generally not at the EMF strengths of offshore wind projects (Albert et al. 2020; Gill and Desender 2020). For example, there is some evidence of attraction to HVDC EMF for a species of *Cancer* crab at an EMF strength hundreds of times greater than expected based on modeling for Vineyard Mid-Atlantic (Scott et al. 2021; see Appendix II-O). Similarly, although there were changes in the behavior of little skate, an elasmobranch, and American lobster in the presence of energized HVDC cables, EMFs from cables did not act as a barrier to movement in any way (Hutchison et al. 2018, 2020). Other research investigating habitat use around energized cables found no evidence that fishes or invertebrates were attracted to or repelled by EMFs emitted by HVAC cables (Love et al. 2017).

For HVDC cables, other manmade sources of perturbations to Earth's steady direct current (DC) geomagnetic field in coastal environments include shore-based structures such as docks, jetties, and bridges; sunken ships; pipelines; and ferromagnetic mineral deposits (Normandeau et al. 2011; CSA Ocean Sciences Inc. and Exponent 2019). Additionally, Normandeau et al. (2011) reported that MF impacts nearby to these sources can be on the order of tens of milliGauss (mG), while CSA Ocean Sciences Inc. and Exponent (2019) observed that undersea sources of DC MFs including steel ships and bridges can create DC MFs up to 100 times greater than MFs from DC submarine cables.

For HVAC cables, a seven-year study reported the first findings in the US of the response of demersal fish and invertebrates to construction and operation of an offshore wind project (Wilber et al. 2022). This study reported findings for analyses of catch data from monthly demersal trawl surveys conducted by local fisherman and scientists during construction and operation of the Block Island Wind Farm. This study did not report findings supporting harmful impacts of EMF from the project's 60-Hz alternating current (AC) submarine export cables or other offshore electrical infrastructure on local demersal fish and invertebrates, and instead reported evidence of increased populations of several fish species near the wind farm during the operation time period relative to the reference areas. Similarly, as part of the US Offshore Wind Synthesis of Environmental Effects Research (SEER) effort, researchers at the US Department of Energy's Wind Energy Technologies Office, National Renewable Energy Laboratory, and Pacific Northwest Laboratory found "no conclusive evidence that EMFs from a subsea cable creates any negative environmental effect in individuals or populations" (SEER 2022). While behavioral responses have been observed in some species, they concluded that a reaction to EMFs does not necessarily relate to negative impacts. The researchers also discuss how factors such as cable burial depth, cable shielding, and the limited range of EMFs result in "a highly localized environmental condition that does not affect the entire habitat range for an animal" (SEER 2022).

To assess the potential effects of Vineyard Mid-Atlantic, modeling of MFs from HVDC and HVAC cables was completed (see Appendix II-O).[49] Model results provided estimates of the magnitude and extent of MFs from a range of loads and burial depths during operation and for cables that are either buried at a depth of 1.2 m (4 ft) or surface-laid. Surface laid cables are assumed to have 0.5 m (1.6 ft) thick cable protection covering. These conservative modeling results demonstrate that MFs at the seafloor from the buried cables decline with distance, with a maximum MF directly above the centerline that decreases rapidly with distance (see Tables 4.6-8, 4.6-9, and Appendix II-O). Tables 4.6-8 and 4.6-9 show the rapid drop-off in MF levels with increased lateral distance from the HVAC cables or HVDC cable bundles for each of the modeling scenarios. More specifically, the analysis shows > 95 to > 99% reductions in MF levels at lateral distances of ±25 ft (±7.6 m) from the centerlines of HVAC cables or HVDC cable bundles. At lateral distances of ±25 ft (±7.6 m), there is a negligible difference in MF levels for the buried versus the surface-laid cables. Based on the results, MFs are likely only able to be sensed, if at all, directly over the buried cable centerline. Therefore, any effects from EMF are expected to be localized with only behavioral impacts, if any at all, for most finfish and invertebrate species.

Table 4.6-8 Summary of Modeled Magnetic Fields for HVDC Offshore Export Cables, as Deviations from Earth's Steady DC Magnetic Field

Cable Voltage	Installation Scenario[2]	DC Magnetic Field[1] Deviation (mG)[3]			
		Maximum (above cables)	± 10 ft	± 25 ft	± 50 ft
±320 kV	Buried	-395 to 407	-58.8 to 60.0	-11.6 to 11.7	-2.9 to 2.9
	Surface-laid	-267 to 2,039	-72.5 to 72.6	-11.5 to 11.5	-2.8 to 2.8
±525 kV	Buried	-431 to 450	-65.5 to 67.0	-13.0 to 13.0	-3.2 to 3.2
	Surface-laid	-270 to 2,207	-81.1 to 81.2	-12.9 to 12.9	-3.2 to 3.2

Notes:

1. Magnetic fields are presented as the deviation from the Earth's steady DC magnetic field of 508 mG and are maximum deviations across modeling cases that include two representative cable orientations (north-south and east-west) and both possible current flow direction scenarios for each representative cable orientation. Negative values are the maximum reductions below the Earth's steady DC magnetic field of 508 mG.
2. Magnetic fields at the seabed are reported for buried cables at 1.2 m (4 ft) depth. Surface-laid cables are assumed to have 0.5-m (1.6-ft) thick cable protection covering. For these scenarios, magnetic fields are reported at the top of the cable protection, specifically at 0.65 m (2.14 ft) for the ±320-kV cables, and 0.67 m (2.20 ft) for the ±525-kV cables.
3. Horizontal distance is measured from the center of the cable bundle.

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49 Modeling was focused on offshore export cables because inter-array cables are expected to have lower currents and MFs. Inter-link cables are expected to have similar or lower MFs.

Table 4.6-9 Summary of Modeled Magnetic Fields for HVAC Offshore Export Cables

Cable Voltage	Installation Scenario[1]	AC Magnetic Field (mG)[2]			
		Maximum	± 10 ft	± 25 ft	± 50 ft
220 kV	Buried	285	47.1	9.1	2.8
	Surface-laid	1,243	54.0	9.3	2.8
345 kV	Buried	319	53.7	10.4	3.2
	Surface-laid	1,354	61.6	10.7	3.2

Notes:

1. Magnetic fields at the seabed are reported for buried cables at 1.2 m (4 ft) depth. Surface-laid cables are assumed to have 0.5-m (1.6-ft) thick cable protection covering. For these scenarios, magnetic fields are reported on top of the cable protection, specifically at 0.79 m (2.58 ft) for 220-kV cables, and 0.82 m (2.68 ft) for 345-kV cables.
2. Horizontal distance is measured from the center of the cable bundle.
3. The offshore export cable MF modeling assumes straight-laid phase-conductor cable cores, as opposed to the actual helical or "twisted" phase-conductor cores. A helical design achieves a considerable degree of magnetic field cancellation; hence the modeled MF levels are expected to be overestimates of actual MF levels.

Inter-array and offshore export cables emit thermal radiation to the surrounding environment that may minimally increase water and sediment temperatures in the immediate vicinity of the cables (Boehlert and Gill 2010; Hogan et al. 2023). Buried cables have been found to increase the temperature of sediments, but such effects are limited to the surrounding sediments touching the cable (up to tens of centimeters) (Taormina et al. 2018). Similarly, any minimal increase in water temperature from cable heat is predicted to dissipate within a few centimeters of the cable (Boehlert and Gill 2010). As noted above, the target cable burial depth beneath stable seabed is 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters; cable protection will be installed in areas where a sufficient burial depth cannot be achieved. Accordingly, if cable heat were a stressor to finfish and invertebrates, any potential impacts are expected to be limited to small areas immediately surrounding the cables (BOEM 2024a). Potential impacts from EMF and cable heat will be minimized via cable shielding and cable burial depth (Normandeau et al. 2011).

The general impacts from EMF and cable heat described above are also applicable to Atlantic sturgeon (BOEM 2024a). As stated earlier, Atlantic sturgeon likely have the ability to detect EMF (NMFS 2024); however, the magnetic fields produced by HVAC cables is several orders of magnitude under levels that elicited a behavioral response from similar sturgeon species (Bevelhimer et al. 2013; NMFS 2024). Thus, it is unlikely that EMF will negatively impact any life stage of Atlantic sturgeon at a population level.

4.6.2.6 Noise

Temporary to long-term increases in noise may occur in the Lease Area and OECC from the installation, O&M, and decommissioning of foundations, WTGs, and offshore cables. The intensity and duration of noises is expected to vary based on activity. Temporary construction noise is expected to include both repetitive, high-intensity (impulsive) sounds produced by pile driving, and continuous (non-impulsive), lower-frequency sounds produced by vessel propulsion, drilling, vibratory installation of foundations, and cable pre-installation/installation activities. Noise will also be produced during UXO detonation, if needed. Long-term operational noise is expected to be continuous (non-impulsive) noise from WTGs and vessel traffic. Additional continuous noise may also be produced temporarily during cable maintenance or aircraft activities.

Effects of Sound on Finfish and Invertebrates

Direct effects on finfish and invertebrates from noise can include behavioral changes, stress responses, injury, and mortality. Severity of impacts from noise during construction, maintenance activities, or decommissioning would vary based on the duration and intensity of sound and biology (e.g., auditory system and swim bladder presence) of the fish. Impulsive sounds can lead to mortality, ruptured gas bladders and damage to surrounding organs, damage to auditory processes, and altered behavior in some fish species (Popper and Hastings 2009; Casper et al. 2012; Riefolo et al. 2016). Continuous noise typically has lower sound pressure levels but can result in avoidance behavior that interferes with feeding and breeding, alter schooling behaviors and migration patterns, and can mask important environmental auditory cues (CBD 2012; Barber 2017). In general, the presence of a swim bladder makes a fish more susceptible to injury from sounds because loud, usually impulsive, noises (i.e., impact pile driving, explosions) can cause swim bladders to vibrate with enough force to inflict damage to tissues and organs around the bladder (Halvorsen et al. 2011; Casper et al. 2012). Risk of injury occurs at the lowest noise levels in fishes with swim bladders connected to the inner ear, such as Atlantic herring and Atlantic cod. Least sound sensitive fish species which do not have a swim bladder include both flatfishes and elasmobranchs (Thomsen et al. 2006; Popper et al. 2014). Hearing generalists, such as the Atlantic sturgeon and giant manta ray, are relatively insensitive to sound in comparison to fish with specialized hearing (BOEM 2023a). Noise could also affect the functionality and sensitivity of the sensory systems of marine invertebrates, but most studies on these effects have been performed *ex situ*, making it difficult to control and assess the acoustic conditions and typically only measure and report on the pressure component of sound. Additionally, most crustacean species lack swim bladders and are considered less sensitive to sound; however, understanding of the impact of sound and vibration on invertebrates is limited by a dearth of data (Edmonds et al. 2016).

In a cooperative effort between federal and state transportation and resource agencies, interim criteria were developed to assess the potential for injury to fish exposed to pile driving sounds (Stadler and Woodbury 2009) and described by the Fisheries Hydroacoustic Working Group (FHWG 2008). The injury and behavioral response levels for fish were compiled and listed in NMFS (2023) for assessing the potential effects to ESA-listed fish exposed to elevated levels of underwater sound from pile driving. Impulsive criteria were used for both impulsive and non-impulsive sources since there is limited research available for non-impulsive fish injury thresholds.

A technical report by an American National Standards Institute (ANSI)-registered committee (Popper et al. 2014) reviewed available data and suggested metrics and methods for estimating acoustic impacts for fish. Their report includes thresholds for potential injury but does not define sound levels that may result in behavioral response, though it does indicate a high likelihood of response near impact pile driving (tens of meters), a moderate response at intermediate distances (hundreds of meters), and a low response far (thousands of meters) from the pile (Popper et al. 2014).

Table 4.6-10 provides the acoustic thresholds that were used to evaluate impacts to fish exposed to construction noise.

Table 4.6-10 Acoustic Thresholds Used to Evaluate Impacts to Fish

Hearing group	Injury, impulsive signals (L_{pk})[1,2]	Injury, impulsive signals ($L_{E,24h}$)[1,2]	Behavior (L_p)[1]
Fish greater than or equal 2 grams (g) [0.07 ounces (oz)][3]	206	187	150
Fish less than 2 g (0.07 oz)[3]	206	183	150
Fish without swim bladder[4]	213	216	-
Fish with swim bladder[4]	207	203	-

Notes:

1. L_{pk} – peak sound pressure level (dB re 1 μPa), $L_{E,24h}$ – sound exposure level (dB re 1 μPa^2·s), L_p – root mean square sound pressure level (dB re 1 μPa^2). A dash indicates that there are no thresholds for the category.
2. Fish injury thresholds from impulsive sources were used for both source types since non-impulsive injury criteria do not exist for fish.
3. NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
4. Popper et al. (2014).

Foundation Installation

Foundation installation is expected to require impact pile driving and may also require the use of a vibratory hammer and/or drilling. Potential effects from each of these activities are described below. Results of the acoustic modeling for foundation installation activities (i.e., impact pile driving and vibratory pile setting), provided in Appendix II-E, were used to calculate modeled distances to potential fish injury and behavioral thresholds (see Table 4.6-10).

Impact Pile Driving

Impact pile driving would result in temporary, transient, repetitive, and discontinuous high intensity impulsive noise during construction. Field measurements of pile driving show that source, or near-source, levels are typically in the range of 210 to 250 dB re 1 μPa (McHugh 2005; Tougaard et al. 2009; Bailey et al. 2010) and frequencies are predominantly <1 kilohertz (kHz) (Robinson et al. 2007; Tougaard et al. 2009), although they can extend to higher frequencies (MacGillivray 2018), including at least 100 kHz (Tougaard et al. 2009).

Sound thresholds derived from Popper et al. (2014) indicate that pile driving sound above 207 dB peak can lead to mortality of the most sensitive fish species, such as Atlantic herring, while noise above 186 dB can lead to impairment. In their experiments, Jones et al. (2020) found that longfin squid, an invertebrate, had no physical harm but exhibited a startle response to recorded pile driving sound played at 190–194 dB but habituated quickly and startle responses typically diminished within the first eight strikes, but the response returned when the squid were tested again 24 hours later (Jones et al. 2020). In their more recent study, when playing pile driving noise to mating squid, Jones et al. (2023) found no significant effects on the occurrence rates of agnostic behaviors, mate guarding, mating and egg laying, when compared to silent control trials. From this study, Jones et al. (2023) conclude that while there can be some disturbance to some non-reproductive behaviors, the results of their study show that species with limited opportunity to reproduce can tolerate intense stressors to secure reproductive success. The effects of impulsive sound on fish eggs and larvae have also been studied in the context of offshore pile driving. Common sole (*Solea solea*) larvae exposed to impulsive stimuli up to a Sound Exposure Level (SEL) of 206 dB re 1 $\mu Pa^2 \cdot s$ (corresponding to 100 strikes at a distance of 100 m [328 ft]) had no statistically significant differences in mortality (Bolle et al. 2012). Published exposure guidelines for fish eggs and larvae based on pile driving data proposed a precautionary threshold for mortality of fish eggs and larvae of greater than 207 dB re 1 μPa zero-to-peak (PK) pressure level, which was noted by the publisher to likely be conservative (Popper et al. 2014).

There are no studies available on the potential effects of pile driving sounds on plankton and no established acoustic thresholds for plankton. Although use of air guns is not a proposed action, they provide insight on potential effects from impulsive sound. The results from air gun studies on plankton are mixed, varying from no significant effects on mortality (Parry et al. 2002) to a maximum horizontal effect-range of 1.2 km (0.65 nautical mile [NM]) in which decreases in zooplankton abundance with mortality in adult and larval zooplankton increased two- to three-fold when compared to controls (McCauley et al. 2017). The Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Richardson et al. 2017) simulated the large-scale impact of a seismic survey on zooplankton on the Northwest Shelf of Western Australia using the mortality rate found by McCauley et al. (2017). The major findings of the CSIRO study were that seismic activity had substantial impacts on zooplankton populations on a local scale within or close to the survey area; however, on a regional scale, the impacts were minimal and not discernible over the entire Northwest Shelf Bioregion. The study found that the zooplankton biomass recovered to pre-seismic levels inside the survey area, and within 15 km (8 NM) of the area, within three days following the completion of the survey. This relatively quick recovery was due to the fast growth rates of zooplankton as well as the dispersal and mixing of zooplankton from both inside and outside of the impacted region (Richardson et al. 2017). Another study found that the potential effects of seismic pulses of 221 dB re 1 $\mu Pa^2 \cdot s$ to zooplankton are limited to within approximately 10 m (33 ft) from the seismic source with immediate mortality rates of up to 30% of copepods when compared to controls (Fields et al. 2019).

There has also been a suite of air gun studies examining a variety of invertebrate life stages. New Zealand scallop (*Pecten novaezelandiae*) larvae exposed to extended periods of air gun signals during their ontogeny had increases in abnormality and mortality rates (Aguilar de Soto et al. 2013). Blue mussel clearance (i.e., filtration rate) increased with pile driving noise, likely in response to increased metabolic demands triggered by stress (Spiga et al. 2016). High-intensity, low-frequency sound exposure to crustaceans and mollusks do not appear to result in immediate mass mortality events (Edmonds et al. 2016; Day et al. 2016; Carroll et al. 2017) but may have longer-term effects (Day et al. 2016). Specifically, tail tonicity (i.e., extension) and righting behavior, reflexes used in lobster fishery industries in grading animals for their likelihood of survival, were assessed in southern rock lobster (*Jasus edwardsii*) and significant responses to righting responses were observed after exposure to air gun sounds. André et al. (2011) and Solé et al. (2013) provide evidence of acoustic trauma in four cephalopod species [common cuttlefish (*Sepia officinalis*), common octopus (*Octopus vulgaris*), European squid (*Loligo vulgaris*), and southern shortfin squid (*Illex condietii*)], which they exposed (underwater) for two hours to low-frequency sweeps between 50–400 hertz (Hz) (1 second duration) generated by an in-air speaker. The measured level at the animals' position was 157 dB re 1 μPa with peak levels (unspecified) up to 175 dB re 1 μPa. Both studies reported permanent and substantial morphological and structural alterations of the sensory hair cells of the statocysts following noise exposure, with no indication of recovery. In a more recent experiment, Solé et al. (2017) exposed common cuttlefish to tonal sweeps between 100–400 Hz in a controlled exposure experiment in open water. Their results showed a clear statistical relationship between the cellular damage detected in the sensory cells of the individuals exposed to the sound sweeps and their distance from the sound source. The maximal particle motion level was 0.7 ms^{-2} (2.3 ft^{-2}) observed at 1 m (3.3 ft) depth, the pressure reached levels of 139–142 dB re 1 μPa^2. The reported sound pressure levels were only slightly higher than the hearing threshold determined for longfin squid measured by Mooney et al. (2010). The maximum particle motion (reported in terms of particle acceleration) reported by Solé et al. (2017) is in the same order of magnitude as the behavioral thresholds measured at 100 Hz by Packard et al. (1990) using a standing wave acoustic tube.

In general, the impacts from pile driving will depend on an individual's proximity to the source, intensity of noise, and sensitivity to sound. However, Vineyard Mid-Atlantic plans to implement mitigation measures including a soft-start procedure to the pile driving process, which delivers initial pile drives at a lower intensity, allowing mobile species to move out of the activity area before the full-power pile driving begins. In addition, the Proponent expects to implement noise abatement system(s) to reduce sound levels by a target of approximately 10 dB, which will also reduce any potential impacts to Atlantic sturgeon and giant manta ray. Further, the Proponent will adhere to an anticipated time of year restriction on pile driving between January 1 and April 30 to protect North Atlantic right whales (see Section 4.7), which will likely also confer protection to fish that occur within the Offshore Development Area during that timeframe. Additionally, Atlantic sturgeon are known to inhabit the estuaries of the Hudson and Delaware Rivers and the salt marsh areas of southern Long Island to spawn (NROC 2009), and then move offshore into water depths of 20-50 m (66–164 ft) during the winter and early spring (December to March); therefore, the anticipated time of year restriction may also benefit Atlantic sturgeon in the unlikely event that any are present within the Lease Area during the winter and early spring months (Stein et al. 2004; Dunton et al. 2010). If they are in the Lease Area, Atlantic sturgeon are expected to avoid exposure to noise above the cumulative injury threshold, thus avoiding injury (Krebs et al. 2016; BOEM 2023a, 2024a). Similarly, it is expected that any giant manta ray exposed to pile driving noise will be able to avoid exposure to noise above the levels that could result in exposure to the cumulative injury threshold. Therefore, it is extremely unlikely that that any Atlantic sturgeon or giant manta ray will be exposed to piling driving noise that will result in injury (BOEM 2024b).

Vibratory Pile Setting

A vibratory hammer could be used to install the foundation through surficial sediments in a controlled fashion to avoid the potential for a "pile run," where the pile could drop quickly through the looser surficial sediments and destabilize the installation vessel, risking the integrity of the vessel and safety of the crew. Once the pile has penetrated the surficial sediments with the vibratory hammer, an impact hammer would be used for the remainder of the installation. During vibratory pile driving, piles are driven into the substrate due to longitudinal vibration motion at the hammer's operational frequency and corresponding amplitude. This causes the soil to liquefy, allowing the pile to penetrate into the seabed. Sounds generated by vibratory pile setting are non-impulsive, which are known to be less damaging than impulsive sounds to marine fauna (Tsouvalas et al. 2016; Zykov et al. 2016; Molnar et al. 2020).

There are few data on the effects of vibratory pile driving on fish. Further, generalizations can be difficult because sound affects species differently, particularly with regards to the presence or absence of a swim bladder and its proximity to the ear. Nedwell et al. (2003) detected no changes in activity level or startle response in brown trout, a species without specialized hearing structures, when exposed to vibratory piling at close ranges (<50 m [164 ft]). There are no direct data available on the behavioral response to continuous noise in fish species with more specialized hearing. The masking of communicative signals, as well as signals produced by predators and prey, may be the most likely behavioral impact to fish (Popper and Hawkins 2019). However, the effect is expected to be short term (Popper et al. 2014). Additionally, high risks of any behavioral impacts from continuous sound sources (e.g., vibratory pile driving) are likely to only occur at close range to the source (Popper et al. 2014).

There are no data linking continuous noise to mortality or permanent injury in fish (Popper et al. 2014). Continuous noise has been linked to temporary threshold shift (TTS) in some fish species; however, exposure times to these sounds were at least 12 hours (Amoser and Ladich 2003; Smith et al. 2006).

There is a lack of data involving the effects of vibratory pile installations on invertebrates. Among marine invertebrates, some can detect particle motion and are sensitive to noise (André et al. 2016; Popper et al. 2014; Jézéquel et al. 2023). Invertebrates generally do not possess air-filled spaces like lungs, middle ears, or swim bladders; thus, they have been considered less susceptible than fish to noise and vibration. Invertebrates display measurable behavioral responses to noise, such as interruptions to feeding and resource gathering, startle responses, and escape behaviors (Mooney et al. 2010; Roberts et al. 2015).

The potential impacts from vibratory pile setting are also applicable to Atlantic sturgeon and giant manta ray (BOEM 2024a).

Drilling

During the construction phase of Vineyard Mid-Atlantic, there may be instances when large sub-surface boulders or hard sediment layers are encountered during pile driving, requiring drilling operations to pass through these barriers.

During drilling activities, a drill head produces vibrations that propagate as sound through the sediment and water column (Hall and Francine 1991; Nguyen 1996; Willis et al. 2010). Most measurements of offshore drilling sounds have been made for oil exploration and production drilling. The sound levels associated with those drilling operations have been documented to be within the hearing range of fish injury and behavioral thresholds (Popper et al. 2014). To assess the impacts of underwater sound produced by drilling activities, modeled distances to potential fish injury and behavior thresholds were calculated. The results are provided in Supplement I of Appendix II-E.

It is unclear whether the sound emitted by marine drilling activities is likely to impact the behavior of fish. McCauley (1998) determined that any effects to fish from sounds produced by marine drilling activity would likely be temporary behavioral changes within a few hundred meters of the source. For instance, measured source levels during drilling operations reached 120 dB at 3–5 km, which may have caused fish avoidance (McCauley 1998). The available literature suggests that continuous sound produced by drilling operations may mask acoustic signals of fish that convey important environmental information (McCauley 1994; Popper et al. 2014). Recordings of planktivorous fish choruses showed that the fish were still active during drilling operations off the coast of the Timor Sea; however, it is likely that partial masking of their calls would have occurred (McCauley 1998).

There are no data to support a clear link between anthropogenic sound and permanent injury or mortality in fish, particularly with non-impulsive sound sources (Popper and Hawkins 2019). Continuous sound has been linked to TTS in some species of fish; however, exposure times to these sounds were at least 12 hours (Amoser and Ladich 2003; Smith et al. 2006). The sounds emitted by marine drilling operations for wind farm construction are expected to be short-term and intermittent. Acoustic masking to fish from drilling could occur during the short-term drilling events.

There are very few data on the effect of sound from drilling on marine invertebrates. Solé et al. (2022) reported a decreased survival rate in cephalopod (cuttlefish) larvae exposed to drilling sound levels (167 dB re 1 μPa^2). Importantly, levels below 163 dB re 1 μPa^2 did not elicit severe damage. Evidence from research on the levels of particle motion associated with behavioral responses in blue mussels indicates that the threshold of sensitivity in this species falls within vibration levels measured near blasting, pile driving, and impact drilling (Roberts et al. 2015). Studies have indicated reception of vibration in bivalves and an associated behavioral response, which included closing syphons and, in more active mollusks, moving away from the substrate (Mosher 1972; Ellers 1995; Kastelein 2008). As described above, invertebrates are considered less susceptible than fish to noise and vibration. The potential impacts associated with drilling noise are also applicable to Atlantic sturgeon and giant manta ray (BOEM 2024a). Injury is not anticipated as Atlantic sturgeon or giant manta ray will be able to avoid exposure to noise above the levels that could result in exposure to the cumulative injury threshold (BOEM 2024b), but temporary behavioral responses may occur.

Cofferdam Installation

At the horizontal directional drilling (HDD) offshore exit pit, a temporary cofferdam (or similar method) may be used depending on subsurface conditions and the depth of burial. If used, the cofferdams will be constructed of sheet piles likely using a vessel-mounted crane and vibratory hammer. Up to six cofferdams could be installed in total, with up to four cofferdams at a single landfall site. The cofferdams would also be removed likely using a vessel-mounted crane and vibratory hammer. The vibratory hammer would produce continuous (non-impulsive) sound.

As with vibratory pile driving during foundation installation (described above), non-impulsive sound from vibratory piling during cofferdam installation/removal may result in hearing damage or behavioral responses in fish. To assess the impacts of underwater sound produced by vibratory hammering during cofferdam installation/removal, modeled distances to potential fish injury and behavioral thresholds were calculated. The results are provided in Supplement K of Appendix II-E. As described above, invertebrates are considered less susceptible than fish to noise and vibration.

Unexploded Ordnances

As described in Section 3.10.2 of COP Volume I, if potential UXO and/or DMM are discovered in the Lease Area or OECC, the Proponent will prioritize avoidance of UXO/DMM wherever possible by micro-siting structures and cables around the object. Where avoidance is not possible (e.g., due to layout restrictions, presence of archaeological resources, etc.), UXO/DMM will be relocated or otherwise disposed of (e.g., via deflagration [burning without detonating], detonation, or dismantling the UXO/DMM to extract explosive components). The exact number and type of UXO/DMM that may be present, and which subset of those UXO/DMM cannot be avoided by micro-siting, are unknown at this time (further evaluation is ongoing).

Underwater explosive detonations generate impulsive sound waves with high pressure levels that could cause disturbance and/or injury to marine fauna. An explosion produces hot gases that create a large oscillating sphere and a shock wave (Chapman 1985). The extreme increase in pressure followed by a decrease to below ambient pressure caused by an explosive shock wave can cause injury to soft tissues, membranes, and cavities filled with air (Keevin and Hempen 1997). However, these sound-producing events produce a short signal duration, and the extent of impact will depend on the proximity of the receiver to the detonation.

Injury to fish from exposures to explosion are called barotrauma injuries. Rapid changes in gas volume and rapid changes in the solubility of gas in the blood and tissues cause barotrauma injuries. When pressure increases, solubility increases and vice versa. Injury mechanisms include bubble formation in fluids/tissues (i.e., decompression sickness), and rapidly expanding gas-filled bodies (i.e., swim bladder) that push against surrounding tissues, thereby damaging surrounding tissues (Carlson 2012; Halvorsen 2012).

The potential acoustic impacts of UXO/DMM detonation on fish are further assessed in Supplement J of Appendix II-E. The effects of detonation pressure exposures to fish are assessed according to the peak sound pressure level (L_{pk}) limits for onset of mortality or injury leading to mortality due to explosives, as recommended by Popper et al. (2014), as well as thresholds to fish injury for L_{pk} and sound exposure level ($L_{E,24h}$) defined by NMFS (FHWG 2008).

Currently, there is no available information describing the effect of sound on invertebrates related to UXO detonation. Particle motion changes may cause behavioral response, injury, mortality, sensory damage, and physiological changes (Fitzgibbon et al. 2017; McCauley et al. 2017). Vibration caused by anthropogenic sound, such as UXO detonation, can propagate to the seabed (Roberts and Elliott 2017). Researchers have reported substrate-borne vibrations from anthropogenic sound can alter invertebrate behavior (Roberts et al. 2015, 2016).

The potential impacts associated with noise generated by detonations of UXO/DMM are also applicable to Atlantic sturgeon (BOEM 2024a). Impacts from these detonations are less likely to affect giant manta ray, as a pelagic species. Although potential lethal or injurious exposures are possible, an Atlantic sturgeon would need to be in close proximity to the detonation for injury or mortality to occur. Behavioral responses may occur; however, given that UXO/DMM detonations are short (approximately one second) in duration, such responses are only expected to include brief startle responses (NMFS 2024). Considering that Atlantic sturgeon are widely dispersed and transient in nature, combined with the anticipated infrequent occurrence of detonations and the utilization of noise attenuation systems (i.e. bubble curtains), any potential impacts to Atlantic sturgeon are anticipated to be limited and unlikely to cause population-level effects.

Vessel Noise

Vessel traffic associated with construction, operation, and decommissioning would result in temporary, transient, and continuous non-impulsive noise primarily originating from the vessel's propulsion system. Sound emission from vessels, especially from vessels using dynamic positioning, depends on vessel operational state and is strongly weather-dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 dB re 1 μPa for numerous vessels with varying propulsion power using dynamic positioning. Vessel noise can present a chronic impact for fish species (Popper 2003), whose communication is mainly based on low-frequency sound signals (Ladich and Myrberg 2006; Myrberg and Lugli 2006). Continuous noise greater than or equal to 158 dB root-mean-square (rms) for 12 hours can lead to behavioral disturbance, while noise above 170 dB rms for 48 hours can lead to injury (Popper et al. 2014; Hawkins and Popper 2017). Vessel noise can also cause avoidance behavior that interferes with feeding and breeding, alter schooling behaviors and migration patterns, and mask important environmental auditory cues (CBD 2012; Barber 2017). Recent studies have shown that vessel noise can induce endocrine stress response (Wysocki et al. 2006); diminish hearing ability; and mask intra-specific relevant signals in exposed fish species (Scholik and Yan 2002; Amoser et al. 2004; Vasconcelos et al. 2007; Codarin et al. 2009). Masking communication is of concern because although fishes are generally not loud (120 dB re 1 μPa [at 1 m (3.3 ft)], with the loudest on the order of 160 dB re 1 μPa), species make unique noises that allow for individual identification (Normandeau Associates 2012). In addition, vessel noise has the capacity to provoke short-term changes in the spatial position and group structure of pelagic fish in the water column (Buerkle 1973; Olsen et al. 1983; Schwarz and Greer 1984; Soria et al. 1996; Vabø et al. 2002; Handegard et al. 2003; Mitson and Knudsen 2003; Ona et al. 2007; Sarà et al. 2007). Fish can respond to approaching vessels by diving towards the seafloor or by moving horizontally out of a vessel's path (Ona et al. 2007; Berthe and Lecchini 2016). Nedelec et al. (2014) investigated the response of reef-associated fish by exposing them in their natural environment to playback of motorboat sounds. They found that juvenile fish increased hiding and ventilation rate after a short-term boat sound playback, but responses diminished after long-term playback, indicating habituation to sound exposure over longer durations. These results were corroborated by Holmes et al. (2017) who also observed short-term behavioral changes in juvenile reef fish after exposure to boat noise as well as desensitization over longer exposure periods. Therefore, areas of high vessel traffic may result in habituation by localized fishes. As stated in the BOEM Environmental Assessment and the Alternative Energy Programmatic Environmental Impact Statement that were prepared for the assessment and designation of wind energy areas by BOEM, regular vessel traffic occurs throughout this area thus implying that biological resources in the area are presumably habituated to this noise (BOEM 2007; BOEM 2014).

The potential impacts associated with vessel noise are also applicable to Atlantic sturgeon and giant manta ray (BOEM 2024a). Similar to other fish, Atlantic sturgeon and giant manta ray can detect the low-frequency sounds associated with vessel activity. Although vessel noise may elicit an auditory masking response that could inhibit other sounds on which Atlantic sturgeon and giant manta ray rely, noise associated with Vineyard Mid-Atlantic vessels will be localized and temporary, and Atlantic sturgeon and giant manta ray may be habituated to vessel noise given regular vessel traffic in this area.

High Resolution Geophysical (HRG) Surveys

High Resolution Geophysical (HRG) surveys may be conducted to support pre-construction site clearance activities as well as post-construction facilities surveys. Some aspects of HRG surveys emit sounds at frequencies that are within the hearing range of most fishes and invertebrates (Crocker and Fratantonio 2016; Ruppel et al. 2022), with source levels close to the threshold for injury for fishes sensitive to pressure. Given that fish are unlikely to be within a few meters of the mobile and intermittent HRG source sound (where injury may occur), injury to fishes is very unlikely, especially those with highly dispersed distributions (such as the Atlantic sturgeon) (Popper et al. 2014; Crocker and Fratantonio 2016; NMFS 2024). Finfish and invertebrates are expected to react to noise by moving away from the sound source and avoiding further exposure; however, typical behaviors are expected to quickly resume once the survey vessel leaves the area. Baker and Howson (2021) found that fish species, including ESA-listed fish species, such as Atlantic sturgeon and giant manta ray, are unlikely to be adversely affected by HRG survey equipment.

Pre-Installation and Cable Installation Activities

Prior to offshore cable installation, pre-installation activities may include debris and boulder clearance and minimal to no sand bedform leveling. Boulder clearance (if required) is expected to be accompanied by a grab tool suspended from a vessel's crane, which lifts individual boulders clear of the alignment and relocates them elsewhere within the OECC. Alternatively, a route clearance plow may be towed by a vessel along the cable alignment to push boulders aside. Sand bedform leveling (if required) may be accomplished by one or a combination of the following techniques: controlled flow excavation, offshore excavator, or a route clearance plow. Following boulder clearance and sand bedform leveling (if necessary), pre-lay surveys and pre-lay grapnel runs will be performed to verify seafloor conditions and confirm that the cable alignments are suitable for installation (free of obstructions). The pre-lay surveys are expected to be performed using multibeam echosounders and potentially magnetometers. The offshore cable will then be buried beneath the stable seafloor, likely using jetting techniques or a mechanical plow. Further detail pertaining to the pre-installation activities is included in Section 3.5.3 of COP Volume I.

Sounds from pre-installation activities and cable installation activities are considered non-impulsive and are not expected to produce sounds above those of routine vessel activities. Specific to sand bedform leveling, the sounds produced during excavation vary depending on the sediment type—the denser and more consolidated the sediment is, the more force the equipment needs to impart, and the higher sound levels that are produced (Robinson et al. 2011). Sounds from mechanical dredges (such as an excavator) occur in intervals as the excavator lowers a bucket, digs, and raises the bucket.

Table 4.6-11 provides available sounds of various activities that are similar to some of the pre-installation and cable installation activities proposed for Vineyard Mid-Atlantic. Table 4.6-11 includes representative sounds from different types of dredging activities; however, minimal to no sand bedform leveling is anticipated and therefore this activity (if required) will be of a short duration.

Table 4.6-11 Examples of Broadband Sound Pressure Levels (SPL) of Some Anthropogenic Sounds

Activity	SPL (dB re 1μPa), 1 m from the source	Frequency range (kHz)	Reference
Plough trenching in sandy gravel	178.0	0.7-50	Taormina et al. (2018)
Trenching and cable installation	188.5	NA	
Dredging	168–186	0.03–20	Thomsen et al. (2009)
Drilling	145–190	0.01–10	
Hydraulic cutterhead dredge	168–178	0.02–1000	Reine et al. (2014)
Trailer Suction Hopper dredge during active dredging (1 kts speed)	172.6–179.9	NA	
Backhoe dredge, bottom grabs during removal of gravel and rock	179.4	NA	

Notes:

1. SPL is representative of a distance of 1 m (3.2 ft) from the source.
2. Not available (NA) in the cited references.

Table 4.6-11 shows that sounds from cable installation, drilling, and sand bedform leveling are broadly similar. Further, these sounds are quieter than sound from impact pile driving (as shown in Appendix II-E). Sounds from pre-installation and cable installation activities are also quieter than sound measured from transiting vessels (supertankers and frigates), based on measurements taken in Stellwagen Bank (Haver et al. 2019), which is a region with a similar acoustic soundscape as the Lease Area (both sites are in the shallow water portion of the continental shelf and both sites are in areas that have ports with high density traffic). All noise sources for pre-installation and cable installation activities predominantly emit noise at frequencies less than approximately 1 kHz and there is no substantial overlap with the frequency range for fish chorusing.

Sound levels decrease as a receptor moves away from the source and would be reduced by about 40 dB at a distance of around 500 m (1,640 ft) (based on a common acoustic decay rate of $15\log_{10}(R)$), which is similar to ambient noise. Accordingly, underwater sounds from pre-installation and cable installation activities are spatially localized and temporary and would only have limited effects, if any, to fish and invertebrates, including Atlantic sturgeon and giant manta ray.

Operational Sounds

Operation of WTGs would result in variable, mostly continuous (i.e., during power generation) non-impulsive noise. Underwater noise level is related to WTG power and wind speed, with increased wind speeds creating increased underwater sound (Wahlberg and Westerberg 2005). Operational noise from WTGs is low frequency (60–300 Hz) and at relatively low sound pressure levels near the foundation (100–151 dB re 1 μPa) and decreases to ambient within 1 km (0.6 mi) (Tougaard et al. 2009; Lindeboom et al. 2011; Dow Piniak et al. 2012; HDR 2019).

At high wind speeds, Wahlberg and Westerberg (2005) estimated permanent avoidance by fish would only occur within a range of 4 m (13 ft) of a WTG. In a study on fish near the Svante wind farm in Sweden, Atlantic cod and roach (*Rutilus rutilus*) catch rates were significantly higher near WTGs when rotors were stopped, which could indicate fish attraction to WTG structures and avoidance to generated noise (Westerberg 2000 as cited in Thomsen et al. 2006). Alternatively, no avoidance behavior was detected, and fish densities increased around WTG foundations of the Lillgrund offshore wind farm in Sweden (Bergström et al. 2013). In addition, ambient noise can influence how fish detect other sounds and a change in background noise could alter how fish perceive and react to biological noise stimuli (Popper and Fay 1993). Baseline data on ambient noise within the New York Bight will be measured by the "Blue York" buoy deployed as a joint venture between Wood Hole Oceanographic Institution and Wildlife Conservation Society, located near the southwestern boundary of the Vineyard Mid-Atlantic Lease Area (WHOI 2018). Vineyard Mid-Atlantic will further assess this data as it pertains to operational sounds once it becomes publicly available.

Underwater sound radiated from operating WTGs is low-frequency and low level (Nedwell and Edwards 2004). At distances of 14 to 20 m (46 to 66 ft) from operational WTGs in Europe, underwater sound pressure levels ranged from 109 dB to 127 dB re 1μPa (Tougaard et al. 2009). Pangerc et al. (2016) recorded sound levels at ~50 m (~164 ft) from two individual 3.6 megawatt (MW) WTGs monopile foundations over a 21-day operating period. Miller and Potty (2017) measured a SPL of 100 dB re 1 μPa within 50 m (164 ft) of five General Electric Haliade 150–6 MW wind turbines with a peak signal frequency of 72 Hz. At the Block Island Wind Farm off Rhode Island, sound levels were found to be 112–120 dB re 1 μPa near the WTG when wind speeds were 2–12 m/s (4-23 kts) and the WTG sound levels declined to ambient within 1 km (0.5 NM) from the WTG (Elliott et al. 2019). Tougaard et al. (2009) found that sound level from three different WTG types in European waters was only measurable above ambient sound levels at frequencies below 500 Hz, and Thomsen et al. (2016) suggest that at approximately 500 m (1,640 ft) from operating WTGs, sound levels are expected to approach ambient levels.

Two recent meta-papers (Tougaard et al. 2020; Stöber and Thomsen 2021) assessed WTG operational sounds by extracting sound levels measured at various distances from operating WTGs from currently available reports. Both studies found sounds to generally be higher for higher powered WTGs; thus, distances to a given sound threshold are likely to be greater for higher powered WTGs. However, as Stöber and Thomsen (2021) point out, direct drive technology could reduce these distances substantially. Importantly, no measurements exist for these larger turbine sizes and few measurements have been made for direct drive turbines so the uncertainty in these estimates is large.

Overall, current literature indicates noise generated from the operation of offshore wind projects is minor and does not cause injury or lead to permanent avoidance by fish, including Atlantic sturgeon and giant manta ray, at distances greater than 1 km (0.6 mi) (Wahlberg and Westerberg 2005; Stenberg et al. 2015), with potential to have minimal effects at much closer distances up to within a few meters of the WTG (Bergström et al. 2013) such as masking auditory sensitivity and communication of fishes within a few tens of meters of WTGs (Zhang et al. 2021).

Subsea Cables

Previous impact assessment studies for various cable projects have concluded that sound related to subsea cable installation or cable operation is not a significant issue (Nedwell et al. 2003; Austin et al. 2005). This was based on the prediction that anticipated sound levels would not exceed existing ambient sound levels in the area, although background sound level measurements were often not presented (Meißner et al. 2006). Subsea cables are expected to produce low-frequency tonal vibration sound in the water, since Coulomb forces between the conductors cause the HVAC lines to vibrate at twice the frequency of the current (direct current cables do not produce a similar tonal sound because the current is not alternating). Anticipated SPLs arising from the vibration of AC cables during operation are significantly lower than SPLs that may occur during cable installation (Meißner et al. 2006) and may be undetectable in the ambient soundscape of the Offshore Development Area, especially after consideration of the target cable burial depth beneath stable seabed of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters. The lack of potential impacts associated with the noise from subsea cable installation or cable operation is also applicable to Atlantic sturgeon and giant manta ray (BOEM 2024a).

4.6.2.7 Artificial Light

Artificial lighting will be required during the construction, O&M, and decommissioning of the Offshore Development Area and may cause temporary effects to finfish (including Atlantic sturgeon) and invertebrates. During construction and decommissioning, there will be a temporary increase in lighting from construction equipment and vessels with navigational, deck, and interior lights. During O&M, WTGs and ESP(s) will require lighting that complies with applicable Federal Aviation Administration (FAA), US Coast Guard (USCG), BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) guidelines. Vessel use and associated lighting will also occur, though at a lower frequency than during construction and decommissioning. Other temporary lighting (e.g., helicopter hoist status lights on WTGs, helipad lights on the ESP[s], temporary outdoor lighting on the ESP[s] if any maintenance occurs at night or during low-light conditions) may be used for safety when necessary. These potential effects are independent of the foundation type selected for the ESP(s).

As required for navigational safety, artificial lights will be installed on the WTGs and ESP(s). The approximate maximum height of the marine navigation lights above water is 35 m (115 ft), which is equal to the maximum height of the foundation (including the transition piece) above water (see Section 3.3 of COP Volume I). These navigation safety lights are designed to penetrate only the top few centimeters of the water column; thus, the majority of the water column will not be illuminated (TetraTech 2022). Similarly, marine vessels have small amounts of downward-focused lighting with only a small fraction of emitted light entering the water (BOEM 2024b). Light impacts from vessels and offshore foundations can be mitigated through the application of BOEM's Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development (BOEM 2021b). Light could deter, attract, or initiate other behavioral responses for some finfish and invertebrates; however, effects would likely be short-term for vessel activity, limited to highly localized attraction for vessel activity and operation of offshore foundations, and may include some potential disruptions of biological cycles dependent on daylight (e.g., spawning) (BOEM 2024b). However, the amount of artificial light that penetrates the sea surface from vessels and offshore structures is expected to be minimal and localized; thus, artificial light is unlikely to cause adverse impacts to finfish and invertebrates.

Lighting at the top of WTG structures for aviation safety will likely be too high above sea level to penetrate the water surface, meaning it is unlikely to cause adverse impacts to finfish and invertebrates. The general impacts described above are also applicable to Atlantic sturgeon (BOEM 2024a). Further, Vineyard Mid-Atlantic will minimize lighting by using an Aircraft Detection Lighting System (ADLS) or similar system that automatically activates all aviation obstruction lights when aircraft approach the structures. The use of an ADLS will substantially reduce the amount of time that the aviation obstruction lights are illuminated.

4.6.2.8 Fisheries Survey Gear Utilization

A draft preliminary fisheries monitoring plan for pre-, during, and post-construction fisheries surveys has been developed for Vineyard Mid-Atlantic and is included as Appendix II-U. A preliminary list of potential surveys includes:

- Seasonal trawl survey following the NEAMAP survey protocol;
- Baited remote underwater video;
- Highly migratory species acoustic telemetry;

- Drop camera survey;
- Hydraulic surfclam dredge survey; and/or
- Ecosystem monitoring plankton survey.

The number of surveys to be conducted is expected to be a subset of those listed above and in Appendix II-U. Further refinement will be based on future research and agency and stakeholder feedback. Fisheries monitoring surveys are anticipated to be carried out by qualified scientists.

Several of these potential monitoring survey types include remote or minimally disruptive techniques that are unlikely to meaningfully affect finfish and invertebrates; therefore, the rest of this discussion is focused on those surveys that will harvest finfish and macroinvertebrates via trawl surveys (impacting finfish and squid) and clam dredge surveys (ocean quahog and surfclam). Trawl surveys will likely result in direct impacts to fish, invertebrates, and EFH and have the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations for some species (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). However, trawl surveys conducted as part of fisheries monitoring would be limited to small sampling nets, short tow times, and slow tow speeds, which would reduce the risk of capture of non-target species. Specific to Atlantic sturgeon, use of gear such as trawl nets is considered a reliably safe method to capture sturgeon if tow and handling time are minimized (Beardsall et al. 2013). The same is expected to be the case for manta ray, therefore any captured Atlantic sturgeon or manta ray are expected to be released alive and without significant injury.

Several of these potential monitoring survey types include remote or minimally disruptive techniques that are unlikely to meaningfully affect finfish and invertebrates. The planned trawl and surf clam dredge surveys could cause habitat disturbance due to direct interaction between the survey equipment and the seafloor. During trawl surveys, a net is towed behind a vessel along the seafloor and expanded horizontally by a pair of otter boards or trawl doors. During hydraulic surf clam surveys, high-pressure jets direct water into the seafloor to push sediments aside and allow a metal blade to pass through the upper portion of the seafloor and scoop up clams into a metal cage. The use of bottom trawl and surf clam dredge surveys may also result in limited resuspension of sediments (including any pollutants, although they are not expected to be present given the predominantly sandy surficial sediments in the Lease Area).

Dredging and trawling are methods used to land clams, scallops, and other benthic species, and these dredge and trawl surveys would be expected to have similar effects as existing commercial fishing activities. In particular, commercial dredge gear is used regularly in the Lease Area. Disturbance of benthic invertebrate communities and associated EFH by commercial fishing activities can adversely affect community structure and diversity and limit recovery from offshore wind farms (Avanti Corporation and Industrial Economics 2019), although this impact is less prevalent in sandy areas that are strongly influenced by tidal currents and waves, such as the Lease Area (Nilsson and Rosenberg 2003; Sciberras et al. 2016; BOEM 2024b). Any potential impacts to finfish and invertebrates, including Atlantic sturgeon, from biological monitoring surveys would be similar to disturbance from existing activities and will be minimized by short tow times for trawl surveys. These intermittent impacts would be temporary and localized, and these areas would be expected to undergo relatively fast recovery (Dernie et al. 2003; Brooks et al. 2006), with no population-level effects expected.

4.6.2.9 Port Utilization

The Proponent has identified several ports in the US or Canada (for potential construction ports only) that may be used during construction or operations. See Sections 3.10.1 and 4.4.1 of COP Volume I for more information about potential construction or operations ports. Only a subset of the ports described in Sections 3.10.1 and 4.4.1 of COP Volume I would ultimately be used. Each port under consideration for Vineyard Mid-Atlantic is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction proceeds. The Proponent does not expect to implement any port improvements. Although port utilization and vessel activity would increase at the potential ports utilized by Vineyard Mid-Atlantic (with the greatest activity occurring during construction), such increases in port utilization would be consistent with the intended use of each port. As described further under the various IPF sections above, vessel activity will generally have minimal impacts on finfish and invertebrates.

Vessel traffic associated with Vineyard Mid-Atlantic, including vessels transiting between ports and offshore, would only slightly increase the risk of vessel strike to large pelagic fish species, such as Atlantic sturgeon and giant manta ray, compared to existing vessel traffic (BOEM 2023a). During construction, vessel trips to four potential ports (Port of Albany-Rensselaer, NYS Offshore Wind Port, Port of Coeymans Marine Terminal, and Port of Tompkins Cove) to be used for construction would transverse migratory, spawning, and early life stage habitat for Atlantic sturgeon. Adult Atlantic sturgeon have been documented in the Pinopolis Dam tailrace of the Cooper River, South Carolina, though substantial evidence of Atlantic sturgeon spawning has not been observed (Ruddle 2018). However, this potential spawning location is quite a distance from the three potential South Carolina ports that may be used in construction (Union Pier Terminal, Columbus Street Terminal, and Hugh K. Leatherman Terminal), thus further reducing potential impacts to Atlantic sturgeon. While there is some overlap between these potential ports to be used only for construction and Atlantic sturgeon critical habitat, impacts from vessel activity to the critical habitat across life stages are not expected, given that vessels are not expected to have an effect on required substrates (hard or soft bottom), physical parameters (such as temperature, salinity, dissolved oxygen, water depth or flow), or physical passage (NMFS 2024).

Manta rays have been documented to be susceptible to vessel strikes (McGregor et al. 2019; Pate and Marshall 2020); however, vessel strikes of elasmobranch species, such as the giant manta ray, are extremely rare (BOEM 2024b).

Given the reasons detailed above, impacts from port utilization on finfish and invertebrates are expected to be minimal.

4.6.2.10 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to finfish and invertebrates, including Atlantic sturgeon, during Vineyard Mid-Atlantic are summarized below:

- Offshore export cable installation will avoid sensitive habitats[50] where feasible.
- The Proponent will require the cable installation contractor to prioritize the least environmentally impactful cable installation alternative(s) that are practicable for each segment of cable.
- For vessels other than anchored cable laying vessels (which must maintain tension on anchor lines), the use of mid-line anchor buoys will be considered (where feasible and considered safe) as a potential measure to reduce impacts to sensitive seafloor habitat from anchor line sweep. There is no anchor line sweep from anchored cable laying vessels because the anchor lines are under tension.
- Near the potential landfall sites, HDD may be used to minimize disturbance to coastal habitats by drilling underneath them.
- The target cable burial depth beneath stable seabed of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters, which will reduce effects of EMFs and cable heat. In areas where seafloor type or cable crossings potentially prohibit cable burial, cable protection would serve as a barrier to exposure.
- The Proponent's goal is to minimize the use of cable protection to the greatest extent possible through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route.
- The Proponent will apply a soft-start procedure to the pile driving process, which delivers initial pile drives at a lower intensity, allowing mobile species to move out of the activity area before the full-power pile driving begins.
- Noise abatement system(s) will be used to reduce sound levels by a target of approximately 10 dB during pile driving.

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50 Eelgrass, Complex habitat, and Large Grained Complex habitat are absent from the Lease Area and OECC.

- The Proponent does not intend to conduct pile driving between January 1 and April 30 when higher numbers of North Atlantic right whales (NARW) are expected to be present in the Offshore Development Area. This will reduce the potential impacts to NARW and other species with similar seasonal presence in the region, including Atlantic sturgeon and other soniferous species during their potential spawning seasons.

- A benthic habitat monitoring plan framework has been developed (see Appendix II-R) to monitor recovery after construction in areas with sensitive habitats.

- A fisheries monitoring plan has been developed to monitor key indicators before and after construction (see Appendix II-U); such monitoring may be part of regional monitoring efforts. Trawl surveys conducted as part of fisheries monitoring would be limited to small sampling nets, short tow times, and slow tow speeds, which would reduce the risk of capture of non-target species.

- Trawl surveys conducted as part of fisheries monitoring would be limited to short tow times, and slow tow speeds, which would reduce potential impacts to finfish and invertebrates, including Atlantic sturgeon. Any captured Atlantic sturgeon are expected to be released alive and without significant injury.

- WTGs and ESP(s) will be widely spaced, leaving a large portion of the Lease Area not disturbed by WTG and ESP installation.

4.7 Marine Mammals

This section addresses the potential impacts of Vineyard Mid-Atlantic on marine mammals in the Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of Impact Producing Factors (IPFs) and the proposed measures to avoid, minimize, and mitigate potential effects to marine mammals during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Appendix II-E provides detailed results of the acoustic and exposure modeling conducted for Vineyard Mid-Atlantic.

4.7.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the “Lease Area”), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

Given the regional nature of marine mammal distribution, species that are present within the New York Bight are considered likely to be present within the Offshore Development Area including the entirety of Lease Area OCS-A 0544 as well as the OECC. Marine mammal species that occur within the United States (US) Atlantic Exclusive Economic Zone (EEZ) are discussed generally with an evaluation of their likely occurrence in and near the New York Bight, while species more likely to be present in the vicinity of Vineyard Mid-Atlantic activities are described in detail.

Descriptions of marine mammals, their distribution and abundance, and endangered species density maps are based on information provided by a number of different sources. Examples of primary data sources referenced throughout this section include:

- **Marine Mammal Stock Assessment Reports (SARs):** National Marine Fisheries Service (NMFS) Marine Mammal Stock Assessment Reports for marine mammals that occur within the US Atlantic EEZ as required under the 1994 amendments to the Marine Mammal Protection Act (MMPA) (Hayes et al. 2017, 2018, 2019, 2020, 2021, 2022, 2023; NMFS 2024).

- **Atlantic Marine Assessment Program for Protected Species (AMAPPS):** NMFS Northeast Fisheries Science Center's (NEFSC's) AMAPPS shipboard and aerial observations, biological and oceanographic sampling, satellite-telemetry, and passive acoustic monitoring (PAM) conducted in all four seasons. AMAPPS surveys took place from 2010–2014 and 2014–2019 (Phase 2) (NEFSC and Southeast Fisheries Science Center [SEFSC] 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018; Palka et al. 2017, 2021).

- **NEFSC Aerial Line-transect and Vessel-based Surveys:** NEFSC shipboard and aerial surveys conducted in fall 2019/2020 covering Atlantic waters from Nova Scotia to New Jersey (NEFSC and SEFSC 2020; 2021). Systematic aerial surveys conducted in summer 2021, from the coast out to the 200 meter (m) (656 foot [ft]) isobath (NEFSC and SEFSC 2022). And systematic vessel-based surveys conducted in summer 2021 in waters offshore of the 100 m (328 ft) depth contour (NEFSC and SEFSC 2022).

- **Duke University Habitat-based Cetacean Density Models for the US Atlantic:** The original Duke University Habitat-based Cetacean Density Models were published in 2016 for 26 cetacean species and three cetacean species guilds for US waters of the North Atlantic and northern Gulf of Mexico (Roberts et al. 2016). The models have been updated for the Atlantic (East Coast [EC] models) using the same methods but incorporating additional data. Habitat-based density modeling (Roberts et al. 2016) using the latest 2022 models (Roberts 2022) have been released; however, the full publication has not yet been released.

- **Marine Mammals and Sea Turtles of Narragansett Bay, Block Island Sound, Rhode Island Sound, and nearby waters:** An analysis of existing data for the Rhode Island Ocean Special Area Management Plan (Kenney and Vigness-Raposa 2010).

- **Wildlife Conservation Society (WCS)/ Woods Hole Oceanographic Institution (WHOI) New York Bight Acoustic Buoys:** Digital acoustic monitoring (DMON) "Blue York" buoy deployed to the east of the Offshore Development Area for monitoring of baleen whales through detected vocalization data (WHOI 2018). Deployment of two additional real-time whale detection and monitoring buoys through WCS and WHOI (WCS Ocean Giants 2020).

- **WCS/ WHOI New York Bight and New Jersey Acoustic Buoys and Seaglider (Robots4Whales):** DMON moored buoys and Slocum G3 glider deployed in the New York Bight and 32 kilometers (km) (20 miles [mi]) southeast of Atlantic City for monitoring of baleen whales through detected vocalization data (WHOI 2023).

- **New York State Research and Development Authority's (NYSERDA's) Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy and Remote Marine and Onshore Technology (ReMOTe):** Site-specific high-resolution digital aerial surveys focused on the New York Offshore Planning Area (OPA) were conducted by APEM Ltd. and Normandeau Associates between summer 2016 and spring 2019 to collect spatial and temporal distribution and abundance data on wildlife (Normandeau and APEM Ltd. 2021).

- **Protected Species Observer (PSO) Sighting Data:** Opportunistic PSO sightings data from geophysical and geotechnical surveys (G&G surveys) undertaken across the Lease Area and OECC between August 2022 – December 2022 and April 2023 – September 2023 (see Appendix II-B).

- **New Jersey Department of Environmental Protection (NJDEP) Baseline Studies:** Shipboard surveys, aerial surveys, and PAM data were collected to assess the distribution, abundance, and presence of marine mammals and sea turtles within the Study Area (NJDEP 2010).

- **New York Bight Surveys:** Monthly aerial and acoustic surveys from 2017–2020 in the New York Bight (Tetra Tech and LGL 2020; Estabrook et al. 2021; Zoidis et al. 2021).

- **Draft NYSERDA Master Plan 2.0: Deep Water:** Synthesized scientific information regarding marine mammal and sea turtle distributions and oceanographic conditions within the New York Bight lease areas. Relevant studies were reviewed and are referenced throughout the species description sections below (NEFSC and SEFSC 2020, 2021, 2022; Murray et al. 2021; Palka et al. 2021; Braun et al. 2022; Ampela et al. 2023; WHOI 2023).

- Published scientific literature relating to relevant marine mammals.

4.7.1.1 *Marine Mammals that May Occur in the Offshore Development Area*

There are 39 marine mammal species in the Western North Atlantic Outer Continental Shelf (OCS) Region that are protected under the MMPA and whose ranges include the Northeastern US region where the Offshore Development Area will be located (BOEM 2013a, 2014). This includes two different stocks of the common bottlenose dolphin (offshore and migratory coastal) as well as four different species of beaked whale. The marine mammal assemblage comprises cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals). There are 35 cetacean species, including 29 members of the suborder Odontoceti (toothed whales, dolphins, and porpoises) and six of the suborder Mysticeti (baleen whales) within the region. There are four phocid species (true seals) that are known to occur in the region, including harbor seals (*Phoca vitulina*), gray seals (*Halichoerus grypus*), harp seals (*Pagophilus groenlandica*), and hooded seals (*Cystophora cristata*) (Hayes et al. 2020).

Five of the species known to occur in the Western North Atlantic are listed under the Endangered Species Act (ESA); these include the fin whale (*Balaenoptera physalus*) (endangered), sei whale (*Balaenoptera borealis*) (endangered), blue whale (*Balaenoptera musculus)* (endangered), North Atlantic right whale (*Eubalaena glacialis*) (endangered) and sperm whale (*Physeter macrocephalus*) (endangered). These five species are expected to occur in the Offshore Development Area and are considered affected species. The blue whale is uncommon in the Offshore Development Area; however, blue whale vocalizations and sighting data in the region demonstrate the possibility for the species to be present in the Offshore Development Area. The following sections provide further information regarding species behavior and expected occurrence in the Offshore Development Area.

The protection status, habitat, seasonality in the Offshore Development Area, stock identification, and abundance estimates of each marine mammal species with geographic ranges that include the Northeastern US region are provided in Table 4.7-1. Table 4.7-1 evaluates the potential occurrence of marine mammals in the Offshore Development Area based on the following categories:

- Common—Occurring consistently in moderate to large numbers;
- Uncommon—Occurring in low numbers or on an irregular basis;
- Rare—Range includes the Offshore Development Area, but due to habitat preferences and distribution information, species are not expected to occur in the Offshore Development Area although records may exist for adjacent waters.

Of the 39 marine mammal species with geographic ranges that include the western North Atlantic OCS, 22 species are considered to be "rare" in the Offshore Development Area based on sighting and distribution data (see Table 4.7-1). These are the dwarf and pygmy sperm whales (*Kogia sima and K. breviceps*), northern bottlenose whale (*Hyperoodon ampullatus*), goose-beaked whale (*Ziphius cavirostris*), four species of Mesoplodont beaked whales

(*Mesoplodon densitostris, M. europaeus, M. mirus, and M. bidens*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuate*), melon-headed whale (*Peponocephala electra*), Fraser's dolphin (*Lagenodelphis hosei*), white-beaked dolphin (*Lagenorhynchus albirotris*), pantropical spotted dolphin (*Stenella attenuate*), Clymene dolphin (*Stenella clymene*), striped dolphin (*Stenella coeruleoalba*), spinner dolphin (*Stenella longirostris*), rough-toothed dolphin (*Steno bredanensis*), Tamanend's bottlenose dolphin (*Tursiops erebenndus*) northern migratory coastal stock, and the hooded seal (*Cystophora cristata*) (Kenney and Vigness-Raposa 2010; Kraus et al. 2016; Roberts et al. 2016; Hayes et al. 2019, 2020; Roberts 2022). Of these species considered to be "rare," nine are not expected to occur within the Offshore Development Area including Clymene dolphin, Fraser's dolphin, rough-toothed dolphin, spinner dolphin, northern bottlenose whale, false killer whale, melon-headed whale, pygmy killer whale, and Tamanend's bottlenose dolphin northern migratory coastal stock. Due to these species' unexpected occurrence within the Offshore Development Area, they are not considered in Table 4.7-1. Further descriptions of the species listed in Table 4.7-1 are provided in Sections 4.7.1.2 through 4.7.1.4.

In addition to the information provided in Table 4.7-1, findings from the data sources listed in Section 4.7.1 also indicate marine mammals may occur year-round and/or seasonally within the Offshore Development Area. The mean monthly density estimates for marine mammal species with a "common" or "uncommon" occurrence in the New York Bight in an 10 km (5.4 nautical mile [NM]) perimeter around the Lease Area are provided in Appendix II-E. The mean monthly density estimates for marine mammal species with a "common" or "uncommon" occurrence in the New York Bight within a 5 km (2.7 NM) perimeter around the OECC are provided in Table 4.7-2. The Duke University density models provide densities for pilot whales and seals as a guild, rather than as individual species. The best available data were used to split these guild densities into species. For pilot whales, the *Mystic Aquarium's marine mammal and sea turtle stranding data 1976-2011* (Smith 2014), as downloaded from the Ocean Biodiversity Information System (OBIS) data repository,[51] were used resulting in proportions of 0.93 for long-finned and 0.07 for short-finned pilot whales. For seals, PSO data from 2022-2023 site characterization surveys of the Offshore Development Area were used, resulting in proportions of 0.34 for gray seals and 0.66 for harbor seals (DoC and NOAA 2024).

[51] OBIS data repository is available at https://obis.org/.

Table 4.7-1 Marine Mammals that Could be Present in the Offshore Development Area

Common Name (Species Name) and Stock	ESA/MMPA Status[1]	Habitat[2]	Occurrence in the New York Bight[3]	Seasonality in the New York Bight[4]	Abundance (NMFS best available)[5]
Mysticetes					
Blue whale* *(Balaenoptera musculus)* Western North Atlantic Stock	Endangered/Strategic	Slope, pelagic	Rare	Winter and Fall	402
Fin whale *(Balaenoptera physalus)* Western North Atlantic Stock	Endangered/ Strategic	Coastal, shelf	Common	Year-round, but mainly summer	6,802
Humpback whale (*Megaptera novaeangliae*) Gulf of Maine Stock	Not Listed/Depleted	Coastal, shelf	Common	Year-round, but mainly summer and fall	1,396
Common minke whale (*Balaenoptera acutorostrata*) Canadian East Coast Stock	Not Listed/Not Strategic	Coastal, shelf	Common	Year-round, but mainly summer	21,968
North Atlantic right whale (*Eubalaena glacialis*) Western North Atlantic Stock	Endangered/ Strategic	Coastal, shelf, offshore	Common	Year-round, but mainly winter	340
Sei whale *(Balaenoptera borealis)* Nova Scotia Stock	Endangered/ Strategic	Pelagic, shelf	Common	Spring and summer (March to June)	6,292

Table 4.7-1 Marine Mammals that Could be Present in the Offshore Development Area (Continued)

Common Name (Species Name) and Stock	ESA/MMPA Status[1]	Habitat[2]	Occurrence in the New York Bight[3]	Seasonality in the New York Bight[4]	Abundance (NMFS best available)[5]
Odontocetes					
Dwarf sperm whale *(Kogia sima)* Western North Atlantic Stock	Not Listed/Not Strategic	Deep, slope	Rare	Not Applicable (N/A)	9,474[6]
Pygmy sperm whale *(Kogia breviceps)* Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic, slope	Rare	N/A	9,474[6]
Sperm whale (Physeter *macrocephalus)* North Atlantic Stock	Endangered/ Strategic	Pelagic, steep topography, slope	Uncommon	Mainly summer	5,895
Atlantic spotted dolphin *(Stenella frontalis)* Western North Atlantic Stock	Not Listed/Not Strategic	Continental shelf, slope	Uncommon	Fall and spring	31,506
Atlantic white-sided dolphin *(Lagenorhynchus acutus)* Western North Atlantic Stock	Not Listed/Not Strategic	Coastal, shelf, slope	Common	Winter and fall	93,233
Common bottlenose dolphin *(Tursiops truncatus)* Western North Atlantic Offshore Stock	Not Listed/Not Strategic	Outer continental shelf, deep, slope	Common	Year-round, but mainly spring and summer	64,587

Table 4.7-1 Marine Mammals that Could be Present in the Offshore Development Area (Continued)

Common Name (Species Name) and Stock	ESA/MMPA Status[1]	Habitat[2]	Occurrence in the New York Bight[3]	Seasonality in the New York Bight[4]	Abundance (NMFS best available)[5]
Odontocetes (Continued)					
Killer whale *(Orcinus orca)* Western North Atlantic Stock	Not Listed/Not Strategic	Offshore and mid-ocean	Rare	N/A	Unknown
Pantropical spotted dolphin *(Stenella attenuata)* Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic, continental slope	Rare	N/A	2,757
Pilot whale, long-finned (*Globicephalus melas*) Western North Atlantic Stock	Not Listed/Not Strategic	Continental shelf edge, high relief	Uncommon	Summer and fall	39,215
Pilot whale, short-finned (*Globicephalus macrorhynchus*) Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic, high relief	Uncommon	Summer and fall	18,726
Risso's dolphin *(Grampus griseus)* Western North Atlantic Stock	Not Listed/Not Strategic	Continental slope, pelagic	Uncommon	Year-round, but mainly summer	44,067
Striped dolphin *(Stenella coeruleoalba)* Western North Atlantic Stock	Not Listed/Not Strategic	Continental slope, pelagic	Rare	N/A	48,274

Table 4.7-1 Marine Mammals that Could be Present in the Offshore Development Area (Continued)

Common Name (Species Name) and Stock	ESA/MMPA Status[1]	Habitat[2]	Occurrence in the New York Bight[3]	Seasonality in the New York Bight[4]	Abundance (NMFS best available)[5]
Odontocetes (Continued)					
Short-beaked common dolphin *(Delphinus delphis delphis)* Western North Atlantic Stock	Not Listed/Not Strategic	Continental shelf, slope	Common	Year-round, but mainly in summer	93,100
White-beaked dolphin *(Lagenorhynchus albirostris)* Western North Atlantic Stock	Not Listed/Not Strategic	Continental shelf	Rare	N/A	536,016
Goose-beaked whale[7] *(Ziphius cavirostris)* Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic, slope	Rare	N/A	2,936
Blainville's beaked whale[8] *(Mesoplodon densitostris)* Western North Atlantic Stock	Not Listed/Not Strategic	Slope, pelagic	Rare	N/A	2,936
Gervais' beaked whale[8] *(Mesoplodon europaeus)* Western North Atlantic Stock	Not Listed/Not Strategic	Slope, pelagic	Rare	N/A	8,595

Table 4.7-1 Marine Mammals that Could be Present in the Offshore Development Area (Continued)

Common Name (Species Name) and Stock	ESA/MMPA Status[1]	Habitat[2]	Occurrence in the New York Bight[3]	Seasonality in the New York Bight[4]	Abundance (NMFS best available)[5]
Odontocetes (Continued)					
Sowerby's beaked whale[8] *(Mesoplodon bidens)* Western North Atlantic Stock	Not Listed/Not Strategic	Slope, pelagic	Rare	N/A	492
True's beaked whale[8] *(Mesoplodon mirus)* Western North Atlantic Stock	Not Listed/Not Strategic	Slope, pelagic	Rare	N/A	4,480
Harbor porpoise (*Phocoena phocoena*) Gulf of Maine/Bay of Fundy Stock	Not Listed/Not Strategic	Coastal, continental shelf	Common	Year-round, but less abundant in summer	85,765
Pinnipeds					
Gray seal *(Halichoerus grypus)* Western North Atlantic Stock	Not Listed/Not Strategic	Nearshore, shelf	Common	Year-round, but mainly spring and winter	27,911
Harbor seal *(Phoca vitulina)* Western North Atlantic Stock	Not Listed/Not Strategic	Coastal	Common	Year-round, but rare in summer	61,336

Table 4.7-1 Marine Mammals that Could be Present in the Offshore Development Area (Continued)

Common Name (Species Name) and Stock	ESA/MMPA Status[1]	Habitat[2]	Occurrence in the New York Bight[3]	Seasonality in the New York Bight[4]	Abundance (NMFS best available)[5]
Pinnipeds (Continued)					
Harp seal *(Pagophilus groenlandicus)* Western North Atlantic Stock	Not Listed/Not Strategic	Nearshore, coastal	Uncommon	Winter and spring	7.6 M[9]
Hooded seal *(Crysophora cristata)* Western North Atlantic Stock	Not Listed/Not Strategic	Off continental shelf, coastal	Rare	N/A	Unknown

Notes:

N/A= Not applicable and/or insufficient data available to determine seasonal occurrence in the Offshore Development Area.

* No occurrence of this species within the Offshore Development Area (DoN 2007; NJDEP 2010).

1. Listing status under the US ESA, NMFS (NMFS 2024), and MMPA.
2. Habitat descriptions from the 2019 Marine Mammal SARs and scientific paper by Braun et al. 2022 (Hayes et al. 2019; Braun et al. 2022).
3. Occurrence in the New York Bight is mainly derived from Hayes et al. (Hayes et al. 2022), Kenney and Vigness-Raposa (Kenney and Vigness-Raposa 2010), Kraus et al. (Kraus et al. 2016), and Roberts et al. (Roberts et al. 2016; Roberts 2022).
4. Seasonality in the New York Bight was mainly derived from Kraus et al. (2016) and Kenney and Vigness-Raposa (Kenney and Vigness-Raposa 2010).
5. Best Available" abundance estimate is from the 2019 Marine Mammal SARs, published by NMFS on the Federal Register on 27 November 2019 (84 FR 65353); the 2020 Marine Mammal SARs (Hayes et al. 2020); the 2021 Marine Mammal SARs (Hayes et al. 2022); the 2022 Marine Mammal SARs (Hayes et al. 2023); and the Draft 2023 Marine Mammal SARs (NMFS 2024).
6. This estimate includes both dwarf and pygmy whales. Source: NMFS (2024)
7. Goose-beaked whale is another common name for this species, which has widely been called Cuvier's beaked whale. A recent letter to the Society for Marine Mammalogy requests discarding the name Cuvier's beaked whale and adopting goose-beaked whale instead (Rogers et al. 2024).
8. Mesoplodont beaked whale abundance estimates are derived from shipboard surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Garrison and Dias 2023; Palka 2023). Field protocols were improved in the 2021 survey for both visual observers and passive acoustic monitoring of *Mesoplodon* species facilitating differentiation of species during encounters. This enabled abundance estimates to be calculated for each species individually rather than grouping them together at the genus level (NMFS 2024).
9. Hayes et al. (2021) report insufficient data to estimate the population size of harp seals in US waters; however, the best estimate for the whole population is 7.6 million and this appears to be stable.

Table 4.7-2 Mean Monthly Marine Mammal Density Estimates (Animals per Hundred Square Kilometers [100 km²]) for Species Considered "Common" or "Uncommon" in a 5 km (2.7 NM) Buffer around the OECC

Species	January	February	March	April	May	June	July	August	September	October	November	December
Mysticetes												
Fin whale	0.1445	0.1028	0.0854	0.1110	0.1224	0.1231	0.1027	0.0740	0.0413	0.0313	0.0328	0.1121
Humpback whale	0.0963	0.0632	0.0795	0.0811	0.0882	0.0722	0.0215	0.0175	0.0384	0.0702	0.0966	0.1435
Minke whale	0.0557	0.0469	0.0559	0.6975	1.0741	0.5646	0.1366	0.0671	0.0400	0.0813	0.0198	0.0456
North Atlantic right whale	0.0913	0.1026	0.0908	0.0723	0.0191	0.0044	0.0026	0.0022	0.0031	0.0060	0.0154	0.0468
Sei whale	0.0246	0.0134	0.0238	0.0483	0.0357	0.0075	0.0019	0.0014	0.0041	0.0095	0.0277	0.0425
Odontocetes												
Sperm whale	0.0046	0.0016	0.0015	0.0037	0.0043	0.0087	0.0082	0.0105	0.0008	0.0000	0.0077	0.0052
Atlantic spotted dolphin	0.0005	0.0001	0.0002	0.0007	0.0023	0.0052	0.0102	0.0237	0.0685	0.0967	0.0448	0.0038
Atlantic white-sided dolphin	0.4385	0.2687	0.2441	0.5847	0.9067	0.7811	0.0883	0.0360	0.1845	0.5858	0.6277	0.7103
Bottlenose dolphin	0.8880	0.2705	0.2766	1.1277	3.3412	5.3233	6.0547	5.3363	4.9111	5.3381	4.1695	3.1271
Long-finned pilot whale	0.0235	0.0235	0.0235	0.0235	0.0235	0.0235	0.0235	0.0235	0.0235	0.0235	0.0235	0.0235
Short-finned pilot whale	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018
Risso's dolphin	0.0195	0.0024	0.0014	0.0096	0.0154	0.0066	0.0071	0.0038	0.0040	0.0055	0.0295	0.1062

Table 4.7-2 Mean Monthly Marine Mammal Density Estimates (Animals per Hundred Square Kilometers [100 km^2]) for Species Considered "Common" or "Uncommon" in a 5 km (2.7 NM) Buffer around the OECC (Continued)

Species	January	February	March	April	May	June	July	August	September	October	November	December
Odontocetes (Continued)												
Common dolphin	3.0920	0.9492	0.7370	1.5168	1.9570	1.4205	0.8445	0.9942	0.8157	2.0210	4.6970	5.5366
Harbor porpoise	4.0934	4.2387	4.1661	4.7215	1.6599	0.2739	0.3160	0.1525	0.0858	0.1008	0.2557	3.0386
Pinnipeds												
Gray seal	4.9486	4.4696	3.7312	4.7898	5.8931	5.1871	0.3835	0.2203	0.4442	3.0419	2.5843	4.5152
Harbor seal	9.6061	8.6764	7.2429	9.2978	11.4395	10.0690	0.7445	0.4277	0.8622	5.9048	5.0165	8.7648

4.7.1.2 Mysticetes

4.7.1.2.1 Blue Whale (Balaenoptera musculus)

The blue whale is the largest cetacean, although its size range overlaps with that of fin and sei whales. Most adults are 23 to 27 m (75 to 90 ft in length; Jefferson et al. 2008). Blue whales feed almost exclusively on krill (Kenney and Vigness-Raposa 2010).

Blue whales are considered low-frequency cetaceans in terms of their classification in the acoustic categories assigned by NMFS for the purposes of assessment of the potential for harassment or injury arising from exposure to anthropogenic noise sources, a group whose hearing is estimated to range from 7 hertz (Hz) to 35 kilohertz (kHz) (NMFS 2018b). Peak frequencies of blue whale vocalizations range from roughly 10 to 120 Hz; an analysis of calls recorded since the 1960s indicates that the tonal frequency of blue whale calls has decreased over the past several decades (McDonald et al. 2009).

Status

The blue whale is listed as endangered under the ESA (Hayes et al. 2020). Blue whales are also listed as endangered under New York and New Jersey state law. The Western North Atlantic stock of blue whales is considered strategic and depleted under the MMPA. Potential Biological Removal (PBR) for the Western North Atlantic blue whale is 0.8 (Hayes et al. 2020). PBR is defined as the product of minimum population size, one-half the maximum net productivity rate and recovery factor for endangered, depleted, threatened, or stocks of unknown status relative to the optimal sustainable population (OSP) (Hayes et al. 2020). The total level of human-caused mortality and serious injury is unknown but is believed to be insignificant and approaching a zero mortality and serious injury rate (Hayes et al. 2020). Human-induced threats to blue whales include entanglement in fishing gear, ship-strikes, pollution, and disruptions of pelagic food webs in response to changes in ocean temperatures and circulation processes (Hayes et al. 2020). There is no designated critical habitat for this species within the Offshore Development Area (Hayes et al. 2020).

Distribution

Blue whales are found in all oceans, including at least two distinct populations inhabiting the eastern and western North Atlantic Ocean (Sears et al. 2005). Although blue whales spend most of their time in deep open ocean waters, there are summertime feeding aggregations of Western North Atlantic blue whales in the Gulf of St. Lawrence, where animals target krill swarms in accessible shallow waters (McQuinn et al. 2016). Data from animals tagged in the St. Lawrence estuary indicate that blue whales use other summer feeding grounds off Nova Scotia and Newfoundland, and they also feed sporadically during the winter in the New York Bight, occasionally venturing to waters along or shoreward of the continental shelf break (Lesage et al. 2017, 2018). The New York Bight is often recognized as the southernmost extent of the species' feeding range within the region (CETAP 1982; Wenzel et al. 1988). Tagging studies show blue whale movements from the Gulf of St. Lawrence to North Carolina, including both on- and off-shelf waters, extending into deeper waters around the New England seamounts (Lesage et al. 2017; Davis et al. 2020). Acoustic detections of blue whales have occurred in deep waters north of the West Indies and east of the US EEZ, indicating that their southern range limit is not clear cut (Clark 1995; Nieukirk et al. 2004; Davis et al. 2020).

Although considered rare in the New York Bight, the blue whale has been regularly observed in low numbers within the area. Recent deployment of passive acoustic devices in the New York Bight yielded detections of blue whales about 37 km (20 NM) southeast of the entrance to New York Harbor during the months of January, February, and March (Muirhead et al. 2018). Three sightings of three individual blue whales were observed near the Offshore Development Area in the summer, during three years of AMAPPS aerial and shipboard surveys from 2010–2013 (Palka et al. 2017). Similarly, 18 sightings of 19 individuals were observed near the Offshore Development Area across seven years of AMAPPS shipboard surveys (summer and fall effort) from 2010–2017 (Palka et al. 2021). Over three years of New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020) in waters offshore New York, three sightings of five individual blue whales were observed during fall and winter months (Tetra Tech and LGL 2020; Zoidis et al. 2021).

Abundance

The current minimum estimate of the Western North Atlantic population, based on photo-identification efforts in the St. Lawrence Estuary and the Northwestern Gulf of St. Lawrence, is 402 animals (Sears and Calambokidis 2002; Ramp and Sears 2013; Hayes et al. 2020). This work led to a suggestion that between 400–600 individuals may be found in the Western North Atlantic (Hayes et al. 2020). There are insufficient data to determine population trends for this species (Hayes et al. 2020).

4.7.1.2.2 Fin Whale (Balaenoptera physalus)

Fin whales are the second largest species of baleen whale in the Northern Hemisphere (NMFS 2021b), with a maximum length of about 22.8 m (75 ft). These whales have a sleek, streamlined body with a V-shaped head that makes them fast swimmers. This species has a distinctive coloration pattern: the dorsal and lateral sides of the body are black or dark brownish-gray, and the ventral surface is white. The lower jaw is dark on the left side and white on the right side. Fin whales feed on krill (Euphausiacea), small schooling fish (e.g., Atlantic herring [*Clupea harengus*], capelin [*Mallotus villosus*], sand lance [Ammodytidae species (spp.)], and squid [*Teuthida* spp.]) by lunging into schools of prey with their mouths open (Kenney and Vigness-Raposa 2010).

Fin whales produce characteristic vocalizations that can be distinguished during PAM surveys (BOEM 2013b; Erbe et al. 2017). The most commonly observed calls are the "20-Hz signals," a short down sweep falling from 30 to 15 Hz over a one-second period. Fin whales can also produce higher frequency sounds up to 310 Hz, and sound levels (SLs) as high as 195 decibels (dB) relative to one microPascal (re 1 µPa) @ 1 m (3.28 ft) root mean square sound pressure level (SPL_{rms}) have been reported, making it one of the most powerful biological sounds in the ocean (Erbe et al. 2017). Anatomical modeling based on fin whale ear morphology suggests their greatest hearing sensitivity is between 20 Hz and 20 kHz (Cranford and Krysl 2015; Southall et al. 2019).

Status

Fin whales are listed as endangered under the ESA and are listed as Vulnerable by the International Union for Conservation of Nature (IUCN) Red List (Hayes et al. 2020; IUCN 2020). Fin whales are also listed as endangered under New York and New Jersey state law. This stock is listed as strategic and depleted under the MMPA due to its endangered status (Hayes et al. 2020). PBR for the Western North Atlantic fin whale is 11 (Hayes et al. 2020). Annual human-caused mortality and serious injury for the period between 2015 and 2019 was estimated to be 1.8 animals per year (Hayes et al. 2021). This estimate includes incidental fishery interactions (i.e., bycatch/entanglement) and vessel collisions, but does not include other threats to fin whales such as contaminants found within their habitat and potential climate-related shifts in distribution of prey species (Hayes et al. 2020). There is no dedicated critical habitat for this species within the Offshore Development Area.

Distribution

Fin whales have a wide distribution and can be found in the Atlantic and Pacific Oceans in both the Northern and Southern Hemisphere (Hayes et al. 2020). The population is divided by ocean basins; however, these boundaries are arbitrary as they are based on historical whaling patterns rather than biological evidence (Hayes et al. 2020). Fin whales off the eastern US, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission (IWC) management scheme (Donovan 1991). This stock has been named the Western North Atlantic stock.

Fin whales transit between summer feeding grounds in the high latitudes and the wintering, calving, or mating habitats in low latitudes or offshore. However, acoustic records indicate that fin whale populations may be less migratory than other mysticetes whose populations make distinct annual migrations (Watkins et al. 2000). Fin whales typically feed in New England waters on fishes (e.g., sand lance, capelin, herring), krill, copepods, and squid in deeper waters near the edge of the continental shelf (90 to 180 m [295 to 591 ft]) but will migrate towards coastal areas following prey distribution. Fin whales' habitat use has shifted in the southern Gulf of Maine, most likely due to changes in the abundance of sand lance and herring, both of which are prey for the fin whale (Kenney and Vigness-Raposa 2010). Fin whales have been observed in high densities utilizing the New York Bight waters for feeding during the summer months (LeBrecque et al. 2015; Lomac-MacNair et al. 2021; Zoidis et al. 2021). The winter distribution of fin whales summering in New England remains largely unknown; however, Zoidis et al. (2021), observed fin whales in all distribution zones during winter months with a concentrated presence in nearshore and slope waters. While fin whales typically feed in the

Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas remain largely unknown (Hayes et al. 2020). Hain et al. (1992) suggest that calving takes place during October to January in latitudes of the Mid-Atlantic region. Between August – December 2022 and April – September 2023, there were 14 visual sightings of fin whales recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

Fin whales have been visually and acoustically detected within the New York Bight year-round with the highest sighting rates recorded during summer months (CeTAP 1982; Whitt et al. 2015; Davis et al. 2020; Normandeau and APEM Ltd. 2021; Zoidis et al. 2021). Over three years of New York Bight Whale Monitoring Aerial Surveys (March 2017-February 2020) in waters offshore New York, fin whales were observed each year and during all 12 survey months (Tetra Tech and LGL 2020). In the surrounding waters off New York, 124 sightings of 207 individual fin whales were recorded, with sighting rates approximately three times higher during summer months (Tetra Tech and LGL 2020). During summer months (June–September), 13 sightings of 17 individuals were observed near the Offshore Development Area during AMAPPs aerial surveys conducted in 2021 and 346 sightings of 534 individuals were observed during shipboard surveys (summer and fall effort) conducted from 2010–2017 (Palka 2021; NEFSC and SEFSC 2022). Over three years of PAM monitoring, fin whales were detected year-round within the New York Bight; however, detections decreased from April–June (Estabrook et al. 2021). Fin whales were the most frequently sighted large whale species during the NJDEP Ecological Baseline Studies (EBS) with a total of 37 whales observed predominantly during the winter and summer months (NJDEP 2010). Detections were made in water depths ranging from 12–29 m (39–95 ft) (NJDEP 2010). Conversely, during AMAPPS surveys, fin whales were found in low densities off New Jersey during most months of the year, with the peak densities in cooler months (Palka et al. 2017). The first New York Bight DMON buoy deployed in 2018 recorded the highest fin whale presence from July–January, with a drop off between March–June (WHOI 2018). The southeast WCS/WHOI buoy recorded the greatest fin whale presence in fall followed by winter, spring, and summer respectively with 185 detections and 24 possible detections recorded between June 2022 and August 2023 (WCS Ocean Giants 2020; WHOI 2023). The northwest New York Bight Buoy recorded 98 detections and 25 possible detections of fin whales between June 2022–August 2023 while the New York Bight glider off the coast of Long Island recorded nine detections and one possible detection of fin whale during the month of August (WHOI 2023). Based on both visual and acoustic data collection in the New York Bight, there is a lack of certainty as to how fin whales are using their habitat for feeding, mating, or whether it is being used as a migratory corridor (Estabrook et al. 2021; Normandeau and APEM Ltd. 2021; Zoidis et al. 2021). A map of fin whale average seasonal density (as number of animals per 100 km^2) from Roberts et al. (2016; 2022) is presented in Figure 4.7-1.

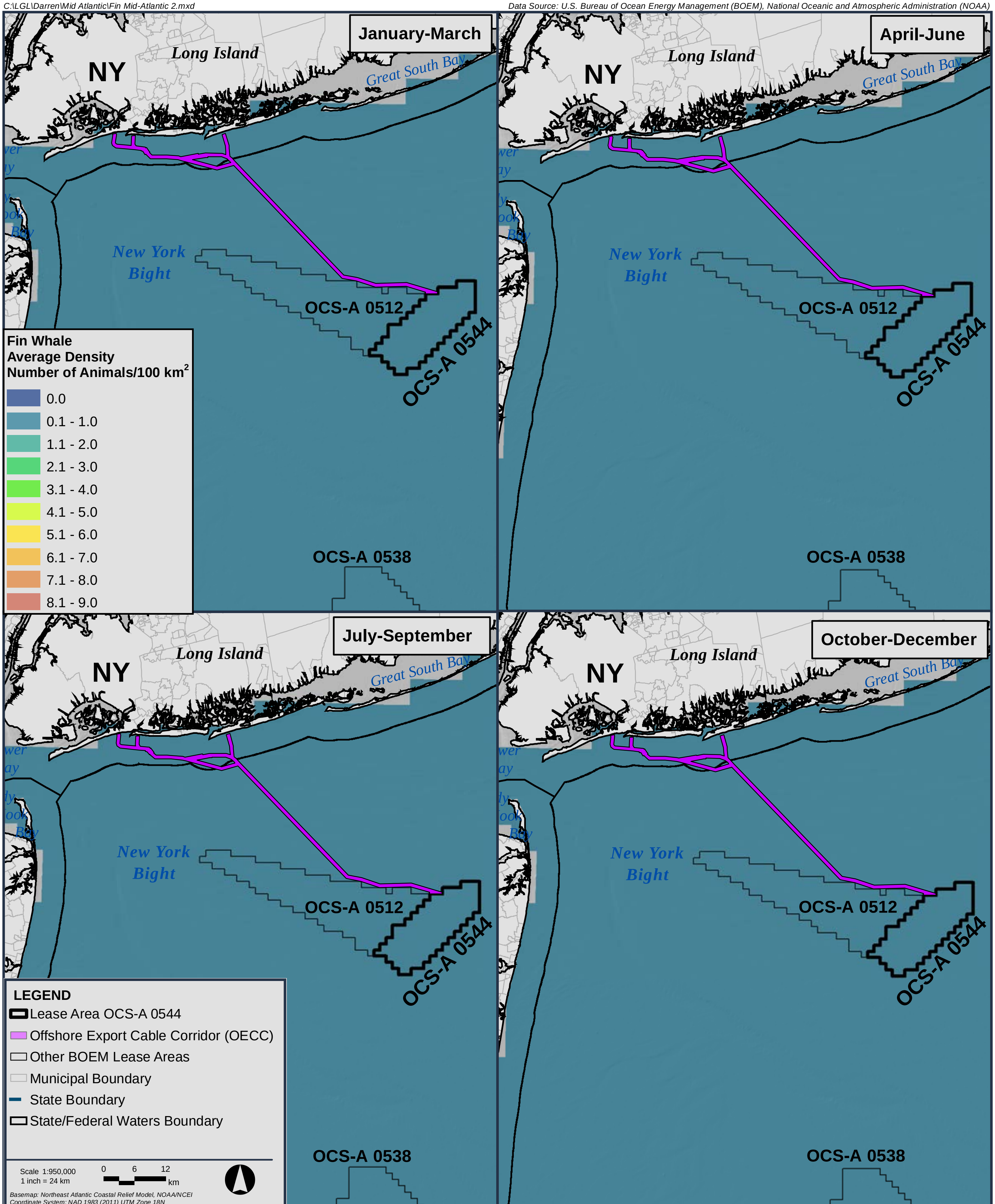

Figure 4.7-1
Map of Fin Whale Average Seasonal Density from Roberts et al. (2016; 2022)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Abundance

The best abundance estimate available for the Western North Atlantic stock is 6,802 individuals based on data from NMFS shipboard and aerial surveys and the 2016 NEFSC and Department of Fisheries and Oceans Canada (DFO) surveys (Hayes et al. 2020). A population trend analysis does not currently exist for this species because of insufficient data; however, based on photographic identification, the gross annual reproduction rate is 8% with a mean calving interval of 2.7 years (Agler et al. 1993; Hayes et al. 2020).

4.7.1.2.3 Humpback Whale (Megaptera novaeangilae)

Female humpback whales are larger than males and can reach lengths of up to 18 m (60 ft) (NMFS 2021e). Humpback whale body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins, belly, and flukes. These distinct coloration patterns are used by scientists to identify individuals. These baleen whales feed on small prey often found in large concentrations, including krill and fish such as herring and sand lance (Kenney and Vigness-Raposa 2010). Humpback whales exhibit unique behaviors, including bubble nets, bubble clouds, and flicking of their flukes and fins to herd and capture prey (NMFS 1991).

During migration and breeding seasons, male humpback whales are often recorded producing vocalizations arranged into repetitive sequences termed "songs" that can last for hours or even days. These songs have been well studied in the literature to document spatio-temporal changes. Generally, the frequencies produced during these songs range from 20 Hz to over 24 kHz. Most of the energy is focused between 50 and 1,000 Hz and reported SLs range from 151 to 189 dB re 1 μPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). Other calls produced by humpbacks, both male and female, include pulses, moans, and grunts used for foraging and communication. These calls are lower frequency (under 2 kHz) with SLs ranging from 162 to 190 dB re 1 μPa @ 1 m (3.28 ft) SPL_{rms} (Thompson et al. 1986; Erbe et al. 2017). Anatomical modeling based on humpback whale ear morphology indicates that their best hearing sensitivity is between 18 Hz and 15 kHz (Ketten et al. 2014; Southall et al. 2019).

Status

NMFS revised the listing status for humpback whales under the ESA in 2016 (81 FR 62260 2016). Globally, there are 14 distinct population segments (DPSs) recognized for humpback whales, four of which are listed as endangered. The Gulf of Maine stock (formerly known as the Western North Atlantic stock) which occurs in the Offshore Development Area is considered non-strategic under the MMPA and does not coincide with any ESA-listed DPS (Hayes et al. 2020). This stock is considered non-strategic because the detected level of US fishery-caused mortality and serious injury derived from the available records do not exceed the calculated PBR of 22, with a set recovery factor at 0.5 (Hayes et al. 2020). Because the observed mortality is estimated to be only 20% of all mortality, total annual mortality may be 60-70 animals in this stock (Hayes et al. 2020). If anthropogenic causes are responsible for as little as 31% of potential total mortality, this stock could be over PBR. While detected mortalities yield an estimated minimum fraction anthropogenic mortality at 0.85, additional research is being done before apportioning mortality to anthropogenic versus natural causes for undetected mortalities and making a potential change to the MMPA status of this stock. Annual human-caused mortality and serious injury for the period between 2013 and 2017 was estimated to be 12.15 animals per year (Hayes et al. 2020). This estimate includes incidental fishery interaction records, 7.75 animals; and vessel collisions, 4.4 animals (Hayes et al. 2020). There is no designated critical habitat for this species within the Offshore Development Area (Hayes et al. 2020).

An Unusual Mortality Event (UME) was declared for this species in January 2016, which as of August 2023 has caused 204 stranded humpback whales with 40 of those strandings occurring in New York and 28 strandings in New Jersey (Hayes et al. 2020; NMFS 2023a). Stranding investigations have concluded that 40% of the stranded humpback whales show signs of interaction with vessels or entanglement in commercial fishing gear (NMFS 2023a). A Biologically Important Area (BIA) for humpback whales for feeding has been designated northeast of the Offshore Development Area in the Gulf of Maine, Stellwagen Bank, and the Great South Channel from March through December (LaBrecque et al. 2015). Major threats to humpback whales include vessel strikes, entanglement, and climate-related shifts in prey distribution (Hayes et al. 2020).

Distribution

The humpback whale can be found worldwide in all major oceans from the equator to sub-polar latitudes. In the summer, humpbacks are found in higher latitudes feeding in the Gulf of Maine and Gulf of Alaska. During the winter months, humpbacks migrate to calving grounds in subtropical or tropical waters, such as the Dominican Republic in the Atlantic and Hawaiian Islands in the Pacific (Hayes et al. 2020). Humpback whales from the North Atlantic feed, mate, and calve in the West Indies (Hayes et al. 2020). In the summer, humpback whales in the Western North Atlantic are typically observed in the Gulf of Maine and along the Scotian Shelf; there have also been numerous winter sightings in the southeastern US (Hayes et al. 2020). Feeding behavior has also been observed in New England off Long Island, New York, and NMFS survey data suggests a potential increase in humpback whale abundance off New York and New Jersey (Hayes et al. 2020). There were 46 sightings of humpback whales in the New York-New Jersey Harbor Estuary documented between 2011 and 2016 (Brown et al. 2017). Between August – December 2022 and April – September 2023, there were 66 visual sightings of humpback whales recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

Humpback whales in the Gulf of Maine stock typically feed in the waters between the Gulf of Maine and Newfoundland during spring, summer, and fall, but have been observed feeding in other areas, such as the New York Bight (Sieswerda et al. 2015; King et al. 2021; Lomac-MacNair et al. 2021; Stepanuk et al. 2021). Feeding groups greater than 50 animals were observed in the New York Bight during summer and fall (Lomac-MacNair et al. 2021). When migrating, humpback whales utilize the New York Bight as a migratory pathway between calving/mating grounds to the south and feeding grounds in the north (Hayes et al. 2022). Humpback whales have recently been observed as the most common species of large whale within the New York Bight, overtaking fin whales (Zoidis et al. 2021). However, sighting rates varied across the three years of New York Bight surveys, suggesting potentially high levels of interannual variability (Zoidis et al. 2021). Over three years of New York Bight Whale Monitoring Aerial Surveys (March 2017-February 2020) in waters offshore New York, humpback whales were observed during all three years and all 12 survey months (Tetra Tech and LGL 2020). In the surrounding waters off New York, 111 sightings of 279 individual humpback whales were recorded, with sighting rates four times higher during summer (Tetra Tech and LGL 2020). Similarly, over three years of PAM in the New York Bight, humpback whales were recorded during all three years in all 12 months; humpback whales were most frequently detected from June through December (Estabrook et al. 2021). During summer months (June–September), 14 sightings of 17 individuals were observed near the Offshore Development Area during AMAPPs aerial surveys conducted in 2021 and 157 sightings of 370 individuals were observed during shipboard surveys (summer and fall effort) conducted from 2010–2017 (Palka et al. 2021; NEFSC and SEFSC 2022). Conversely, humpback whales were acoustically detected by WHOI during the winter and spring season from January–June (WHOI 2018). The northwest New York Bight Buoy recorded 94 detections and 43 possible detections of humpback whales while the southeast New York Bight buoy recorded 87 detections and 43 possible detections between June 2022–August 2023 (WHOI 2023). Humpback whales were also observed during spring and fall aerial AMAPPS surveys off New Jersey (NEFSC and SEFSC 2016, 2018). Although sightings off New York were highest in the summer, sightings of humpback whales off New Jersey peaked in cooler months (fall to winter) (NJDEP 2010; Palka et al. 2017). There were 17 sightings of humpback whales recorded during the EBS study period in water depths ranging from 12–29 m (39.4–95.1 ft) (NJDEP 2010). The year-round presence of humpback whales in the New York Bight may suggest that not all humpback whales within the Western North Atlantic population are migrating (Estabrook et al. 2021). A map of humpback whale average seasonal density (as number of animals per 100 km^2) from Roberts et al. (2016; 2022) is presented in Figure 4.7-2.

Abundance

The best available abundance estimate of the Gulf of Maine stock is 1,396 individuals, derived from modeled sighting histories constructed using photo-identification data collected through October 2016 (Hayes et al. 2020). Available data indicate that this stock is characterized by a positive population trend, with an estimated increase in abundance of 2.8% per year (Hayes et al. 2020).

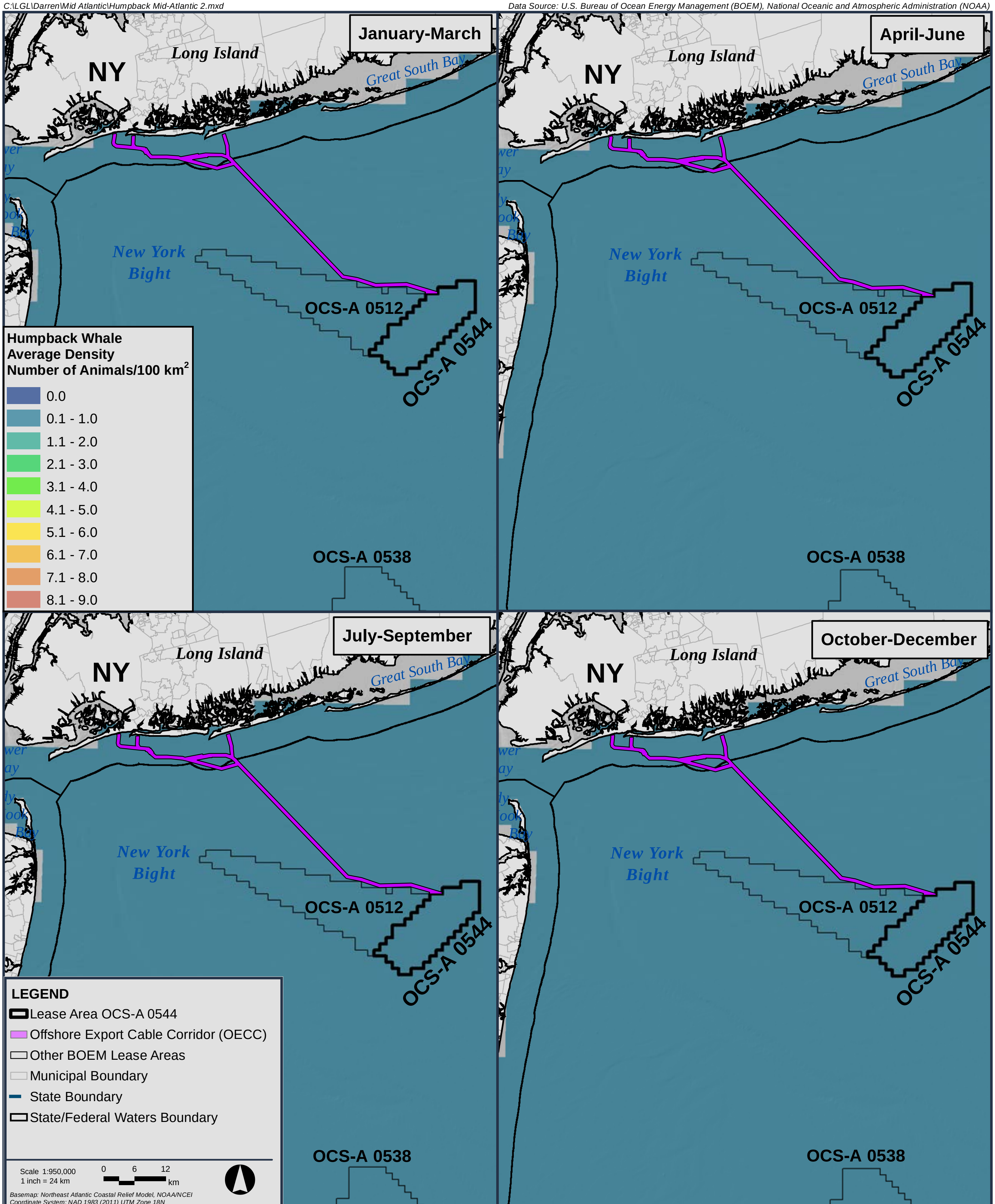

Figure 4.7-2

Map of Humpback Whale Average Seasonal Density from Roberts et al. (2016; 2022)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

4.7.1.2.4 *Minke Whale (Balaenoptera acutorostrata)*

Minke whales are a baleen whale species reaching 10 m (35 ft) in length. The minke whale is common and widely distributed within the US Atlantic EEZ and is the third most abundant great whale (any of the larger marine mammals of the order Cetacea) in the EEZ (CeTAP 1982). A prominent morphological feature of the minke whale is the large, pointed median ridge on top of the rostrum. The body is dark gray to black with a pale belly, and frequently shows pale areas on the sides that may extend up onto the back. The flippers are smooth and taper to a point, and the middle third of each flipper has a conspicuous bright white band that can be distinguished during visual surveys (Kenney and Vigness-Raposa 2010). Its diet is comprised primarily of crustaceans, schooling fish, and copepods. Minke whales generally travel in small groups (one to three individuals), but larger groups have been observed on feeding grounds (NMFS 2021g). Minke populations are often separated by age, reproductive condition, and sex. For example, calves are generally not seen within an adult feeding area (Reeves et al. 2002).

In the North Atlantic, minke whales commonly produce pulse trains lasting 10–70 seconds with a frequency range between 10 and 800 Hz. SLs for this call type have been reported between 159 and 176 dB re 1 µPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). Some minke whales also produce a unique "boing" sound which is a train of rapid pulses often described as an initial pulse followed by an undulating tonal (Rankin and Barlow 2005; Erbe et al. 2017). The "boing" ranges from one to five kHz with an SLs of approximately 150 dB re 1 µPa @ 1 m (3.28 ft) SPL_{rms} (Rankin and Barlow 2005; Erbe et al. 2017). Auditory sensitivity for this species based on anatomical modeling of minke whale ear morphology is best between 10 Hz and 34 kHz (Ketten et al. 2014; Southall et al. 2019).

Status

Minke whales are not listed under the ESA or classified as strategic under the MMPA. They are listed as Least Concern on the IUCN Red List (Hayes et al. 2020; IUCN 2020). The estimated annual human-caused mortality and serious injury from 2014 to 2018 was 10.55 animals per year attributed to fishery interactions, vessel strikes, and non-fishery entanglement in both the US and Canada (Hayes et al. 2020), and a UME was declared for this species in January 2017, which is ongoing (NMFS 2023b). As of August 2023, a total of 156 strandings have been reported, with 24 of those strandings occurring offshore New York and 11 strandings offshore New Jersey (NMFS 2023b). The PBR for this stock is estimated to be 170 (Hayes et al. 2020). A BIA for minke whales for feeding has been designated east of the Offshore Development Area from March through November (LaBrecque et al. 2015). Minke whales may also be vulnerable to climate-related changes in prey distribution, although the extent of this effect on minke whales remains uncertain (Hayes et al. 2020).

Distribution

Minke whales prefer the colder waters in northern and southern latitudes, but they can be found in every ocean in the world. Available data suggest that minke whales are distributed in shallower waters along the continental shelf between the spring and fall and are located in deeper oceanic waters between the winter and spring (Hayes et al. 2020). They are most abundant in New England waters in the spring, summer, and early fall (Hayes et al. 2020). Acoustic detections show that minke whales migrate south in mid-October to early November and return from wintering grounds starting in March through early April (Risch et al. 2014). Between August – December 2022 and April – September 2023, there were six visual sightings of minke whales recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

During the New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), 39 sightings of 45 individuals were recorded across all four seasons, with a peak in the summer (Tetra Tech and LGL 2020; Zoidis et al. 2021). Similarly, during summer months (June–September), 50 sightings of 50 individuals were observed near the Offshore Development Area during AMAPPs aerial surveys conducted in 2021 (NEFSC and SEFSC 2022). There have been four sightings of minke whales recorded during the NJDEP EBS surveys which were consistent with their known migration movements (NJDEP 2010). All sightings were of single individuals in water depths ranging from 11–24 m (36–79 ft) (NJDEP 2010). Minke whales were observed in AMAPPS surveys within the Mid-Atlantic during the spring 2013 aerial survey and winter/spring 2015 aerial surveys (NEFSC and SEFSC 2013, 2015). During AMAPPs shipboard surveys, 32 sightings of 32 individual minke whales were observed near the Offshore Development Area during shipboard surveys (summer and fall effort) conducted from 2010–2017 (Palka et al. 2021). A map of minke whale average seasonal density (as number of animals per 100 km^2) from Roberts et al. (2016; 2022) is presented in Figure 4.7-3.

Abundance

The best available current global abundance estimates for the common minke whale, compiled by the IUCN Red List, is around 200,000 individuals (Graham and Cooke 2008). The most recent population estimate for the Canadian East Coast stock which occurs in the Offshore Development Area is 21,968 minke whales, derived from surveys conducted by NMFS and the DFO Canada between Labrador and central Virginia (Hayes et al. 2020). There are no current population trends or net productivity rates for this species due to insufficient data.

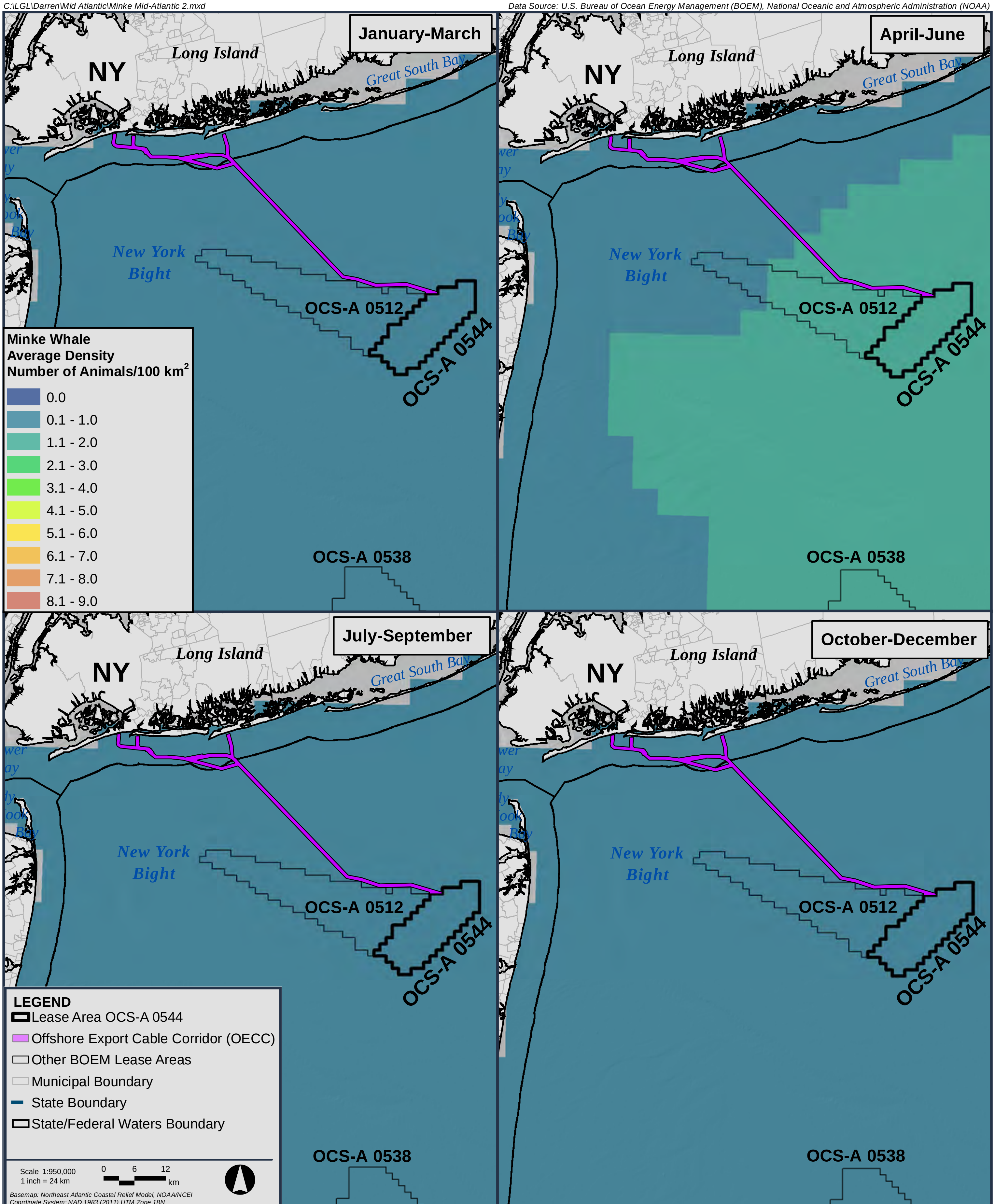

Figure 4.7-3

Map of Minke Whale Average Seasonal Density from Roberts et al. (2016; 2022)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

4.7.1.2.5 North Atlantic Right Whale (*Eubalaena glacialis*)

North Atlantic right whales (NARWs) are among the rarest of all marine mammal species in the Atlantic Ocean. They average approximately 15 m (50 ft) in length (NMFS 2021h). They have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities. NARWs feed mostly on zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera (Hayes et al. 2020). NARWs are slow-moving grazers that feed on dense concentrations of prey at or below the water's surface, as well as at depth (NMFS 2021h). When feeding, they can dive to 300 m (1,000 ft) and typically stay submerged for 10–15 minutes (Jefferson et al. 2015). Research suggests that NARWs must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are a primary characteristic of the spring, summer, and fall NARW habitats (Kenney et al. 1995). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in the feeding or breeding areas (Jefferson et al. 2008).

NARW vocalizations most frequently observed during PAM studies include upsweeps rising from 30 to 450 Hz, often referred to as "upcalls," and broadband (30 to 8,400 Hz) pulses, or "gunshots," with SLs between 172 and 187 dB re 1 µPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). However, recent studies have shown that mother-calf pairs reduce the amplitude of their calls in the calving grounds, possibly to avoid detection by predators (Parks et al. 2019). Modeling conducted using right whale ear morphology suggests that the best hearing sensitivity for this species is between 16 Hz and 25 kHz (Ketten et al. 2014; Southall et al. 2019).

<u>Status</u>

The NARW is listed as an endangered species under both federal and New York and New Jersey state law and is listed as critically endangered by the IUCN Red List (Hayes et al. 2020; IUCN 2020). NARWs are considered to be the most critically endangered large whales in the world (Hayes et al. 2019). The average annual human-related mortality/injury rate exceeds that of the calculated PBR of 0.7, classifying this population as strategic and depleted under the MMPA (Hayes et al. 2021). Estimated human-caused mortality and serious injury between 2017 and 2021 was 7.1 individual whales per year (NMFS 2024). Pettis et al. (2017) used a hierarchical Bayesian, state-space model to estimate NARW abundance, which can also be used to estimate total mortality (NMFS 2024). The estimated rate of total mortality using this modeling approach is 27.2 animals per year, or 136 animals total, for the period of 2016–2020 (Pettis et al. 2021). The annual rate of total mortality is 3.5 times higher than the 8.1 detected mortality and serious injury value reported for the same period in the previous stock assessment report (NMFS 2024). To apportion the estimated total NARW mortality by cause, the proportion of observed mortalities and serious injuries from entanglement compared to those from vessel collision for the period of 2017–2021 were used (NMFS et al. 2024). During this period, 65% of the observed mortalities and serious injuries were the result of entanglement and 35% were from vessel collisions (NMFS 2024). Applying these proportions to the estimated total mortality (136) provides an estimate of 88 total entanglement deaths and 48 total vessel collision deaths during 2017-2021 (NMFS 2024).

There have been an elevated number of mortalities reported since 2017 and continuing through 2024 totaling 41 dead NARWs which prompted NMFS to designate an UME for NARWs (NMFS 2023c). This includes 22 stranded whales in Canada and 19 in the US. The leading category for the cause of death for this UME is "human interaction" specifically from vessel strikes (15) followed by entanglements (9) (NMFS 2024). In addition to the documented mortalities, since 2017, 36 individuals have been documented with serious injury resulting from entanglement and two have been reported with serious injury resulting from a vessel strike (NMFS 2023c).

To protect this species from ship strikes, NMFS designated Seasonal Management Areas (SMAs) in US waters in 2008 (NMFS 2008). All vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 18.5 kilometers per hour (km/hr) (10 knots [kts]) or less within these areas during designated time periods. The Block Island Sound SMA is active between November 1 and April 30 each year. The Great South Channel is active April 1 to July 31. In addition, the rule provides for the establishment of Dynamic Management Areas (DMAs) when and where NARWs are sighted outside SMAs. DMAs are generally in effect for two weeks and the 18.5 km/hr (10 kts) or less speed restriction is voluntary.

NMFS has designated two critical habitat areas for the NARW under the ESA: the Gulf of Maine/Georges Bank region and the southeast calving grounds from North Carolina to Florida (NMFS 2016). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009).

The Offshore Development Area is encompassed by a NARW BIA for migration from March to April and from November to December (LaBrecque et al. 2015). The NARW BIA for migration includes the New York Bight and beyond to the continental slope, extending northward to offshore Provincetown, Massachusetts and southward to halfway down the Florida coast (LaBrecque et al. 2015).

Distribution

The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds, though this species has been observed feeding in winter in the New York Bight region and has been recorded off the coast of New Jersey in all months of the year (Whitt et al. 2013). The Western North Atlantic stock of NARWs ranges primarily from calving grounds in coastal waters of the southeastern US to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Hayes et al.

2020). These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the US east coast to their calving grounds in the waters of the southeastern US (Kenney and Vigness-Raposa 2010).

NARWs are considered to be comprised of two separate stocks: Eastern and Western North Atlantic stocks. The Eastern North Atlantic stock was largely extirpated by historical whaling (Aguilar 1986). NARWs in US waters belong to the Western North Atlantic stock. Since 2010, NARWs have been declining in and around once key habitats in the Gulf of Maine and the Bay of Fundy (Davies et al. 2015; Davis et al. 2017), while sightings have increased in other areas including Cape Cod Bay, Massachusetts Bay, the Mid-Atlantic Bight, and the Gulf of St. Lawrence (Whitt et al. 2013; Davis et al. 2017; Mayo et al. 2018; Davies and Brillant 2019; Ganley et al. 2019; Charif et al. 2020). An eight-year analysis of NARW sightings within southern New England (SNE) shows that the NARW distribution has been shifting (Quintana-Rizzo et al. 2021). The SNE study area (shores of Martha's Vineyard and Nantucket to and covering all the offshore wind lease sites of Massachusetts and Rhode Island) recorded sightings of NARWs in almost all months of the year, with the highest sighting rates between December and May, when close to a quarter of the population may be present at any given time (Quintana-Rizzo et al. 2021).

Some evidence provided through acoustic monitoring suggests that not all individuals of the population participate in annual migrations, with a continuous presence of NARWs occupying their entire habitat rage throughout the year, particularly north of Cape Hatteras (Davis et al. 2017). These data also recognize changes in population distribution throughout the NARW habitat range that could be due to environmental or anthropogenic effects, a response to short-term changes in the environment, or a longer-term shift in the NARW distribution cycle (Davis et al. 2017). A climate-driven shift in the Gulf of Maine/western Scotian Shelf region occurred in 2010 and impacted the foraging environment, habitat use, and demography of the NARW population (Meyer-Gutbrod et al. 2021). In 2010, the number of NARWs returning to the traditional summertime foraging grounds in the eastern Gulf of Maine/Bay of Fundy region began to decline rapidly (Davies et al. 2019; Davies and Brillant 2019; Record et al. 2019). Despite considerable survey effort, the location of most of the population during the 2010-2014 foraging seasons are largely unknown; however, sporadic sightings and acoustic detections in Canadian waters suggest a dispersed distribution (Davies et al. 2019) and a significant increase in the presence of whales in the southern Gulf of St. Lawrence beginning in 2015 (Simard et al. 2019).

Surveys demonstrate the existence of seven areas where NARWs congregate seasonally: the coastal waters of the southeastern US, the Great South Channel, Jordan Basin, Georges Basin along the northeastern edge of Georges Bank, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf (Hayes et al. 2018). NMFS has designated two critical habitat areas for the NARW under the ESA: the Gulf of Maine/Georges Bank region, and the southeast calving grounds from North Carolina to Florida (DoC 2016). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009).

Feeding behavior was recorded, as was the presence of a cow−calf pair, suggesting that nearshore waters off New Jersey serve as feeding and nursery habitat. Initial sightings of females, and subsequent confirmations of these same individuals in calving grounds, illustrate that these waters are part of the species' migratory corridor (Whitt et al. 2013). The "Blue York" buoy deployed by WHOI detected NARWs roughly 35.4 km (22 mi) south of Fire Island, New York with peak abundance during the month of December (WHOI 2018). Additionally, the Southeast WCS/WHOI buoy located 29 km (15.7 NM) beyond the NARW SMA border, detected right whales during winter months predominantly from November–April for a total of eight detections and six possible detections between June 2022–August 2023 (WCS Ocean Giants 2020; WHOI 2023). Since July 2020, WHOI has deployed DMON moored buoys 32.2 km (20 mi) southeast of Atlantic City to monitor the presence of baleen whales in near real-time by automatically detecting and identifying their calls (WHOI 2023). Rutgers University has deployed autonomous underwater gliders in the surrounding waters off New Jersey (Rutgers University 2021). The northwest New York Bight buoy has recorded 94 detections and 43 possible detections of NARW between June 2022–August 2023 (WHOI 2023).

NARWs are expected to migrate through New York Bight waters primarily during spring and fall, while traveling between feeding and breeding/calving regions (Hayes et al. 2022). However, the extended presence of NARWs observed in the New York Bight outside of the migratory period suggests NARWs may not exclusively be migrating through this region (Estabrook et al. 2021). Recent studies, as described above, have shown a shift in spatial distribution of NARW to more northern locations during summer months suggesting the population is shifting its range farther north due to change in prey availability (Davies et al. 2019; Simard et al. 2019; Hayes et al. 2022). In over three years of New York Bight Whale Monitoring Aerial Surveys (March 2017-February 2020), 15 sightings (24 individuals) of NARW were documented (Tetra Tech and LGL 2020). NARW were observed in seven of 12 months, primarily from November to May, with a continuous lack of sightings from June through October. Only a single individual was recorded during year one (2017) in the fall (Zoidis et al. 2021). Similarly, over three years of New York Bight whale PAM, NARW were most frequently detected (greater than five days per week) from fall through spring (Estabrook et al. 2021). The NYSERDA OPA aerial surveys detected NARW only during winter (n = 6) and spring (n = 3 months (Normandeau and APEM Ltd. 2021). The NJDEP EBS surveys recorded three sightings in November, December, and January with no sightings during the summer months (NJDEP 2010). These sightings occurred in water depths ranging from 17 to 26 m (56 to 85 ft) with the whales exhibiting feeding behavior (i.e., surface skimming with mouths open) (NJDEP 2010). Visual sightings and acoustic detections of NARW were most commonly recorded in the shelf zone and nearshore habitats with the highest nearshore presence during the fall and winter (Muirhead et al. 2018; Zoidis et al. 2021). NARWs were observed in the spring 2014 aerial and the winter/spring 2015 aerial AMAPPS surveys (NEFSC and SEFSC 2014, 2015). Finally, during summer months (June–September), two sightings of two individual NARW were observed near the Offshore Development Area during AMAPPs aerial surveys conducted in 2021 (NEFSC and SEFSC 2022). Between August – December 2022 and April – September 2023, there were three visual sightings of North Atlantic right whales recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

Sightings of this species in the Offshore Development Area are possible at any time of year. A map of NARW average seasonal density (as number of animals per 100 km^2) from Roberts et al. (2016; 2022) is presented in Figure 4.7-4.

Abundance

The Western North Atlantic population size was estimated to be 340 individuals in the most recent draft 2023 SAR, which used data from the photo-identification database maintained by the New England Aquarium (NEAq) as it existed on 30 August 2022, and included photographic information from all dedicated survey teams in the U.S. and Canada up through 31 December 2021 (NMFS 2024). However, the Right Whale Consortium 2020 Report Card estimates the NARW population to be 336 individuals (Pettis et al. 2021). A population trend analysis conducted on the abundance estimates from 1990 to 2011 suggest an increase at about 2.8% per year from an initial abundance estimate of 270 individuals in 1998 to 481 in 2011, but there was a 100% chance the abundance declined from 2011 to 2021 when the final estimate was 340 individuals (NMFS 2024). Based on the abundance estimates between 2011 and 2021, there was an overall abundance decline of 29.3% (derived from 2011 and 2021 median point estimates) (NMFS 2024). Modeling conducted by Pace et al. (2021) showed a decline in annual abundance after 2011; however, an increase in the abundance estimate was shown from 338 in 2023 to 340 in 2024 (NMFS 2024).

Highly variable data exists regarding the productivity of this stock. Over time, there have been periodic swings of per capita birth rates (Hayes et al. 2023). Between 1990–2020, at least 491 calves were born into the NARW population; however, the number of calves born annually ranged from 0 to 39 individuals, with an average of 15.3 individuals (NMFS 2024). No calves were born in the winter of 2017–2018 while seven and 10 calves were identified in 2019 and 2020, respectively (Pettis et al. 2021). Based on the most recent population estimate, there are approximately 68 females known to have calved that are likely (>50% probability) still alive (Hayes et al. 2023). The observed variability in the calving rates of NARW has been attributed to a number of factors such as the variability in nutrition, documented regime shifts in primary feeding habitat (Meyer-Gutbrod and Greene 2017; Meyer-Gutbrod et al. 2021; Record et al. 2019), and increased expenditures related to non-lethal entanglements (Fortune et al. 2013; Rolland et al. 2016; Pettis et al. 2017; van der Hoop 2017). Net productivity rates are unknown for the Western North Atlantic stock; therefore, the net productivity rate was assumed to be the default value of 0.04 based on theoretical modeling showing that cetacean populations may not grow at rates greater than 4% as a result of the constraints of their reproductive life

C:\LGL\Darren\Mid Atlantic\NARW Mid-Atlantic 2.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

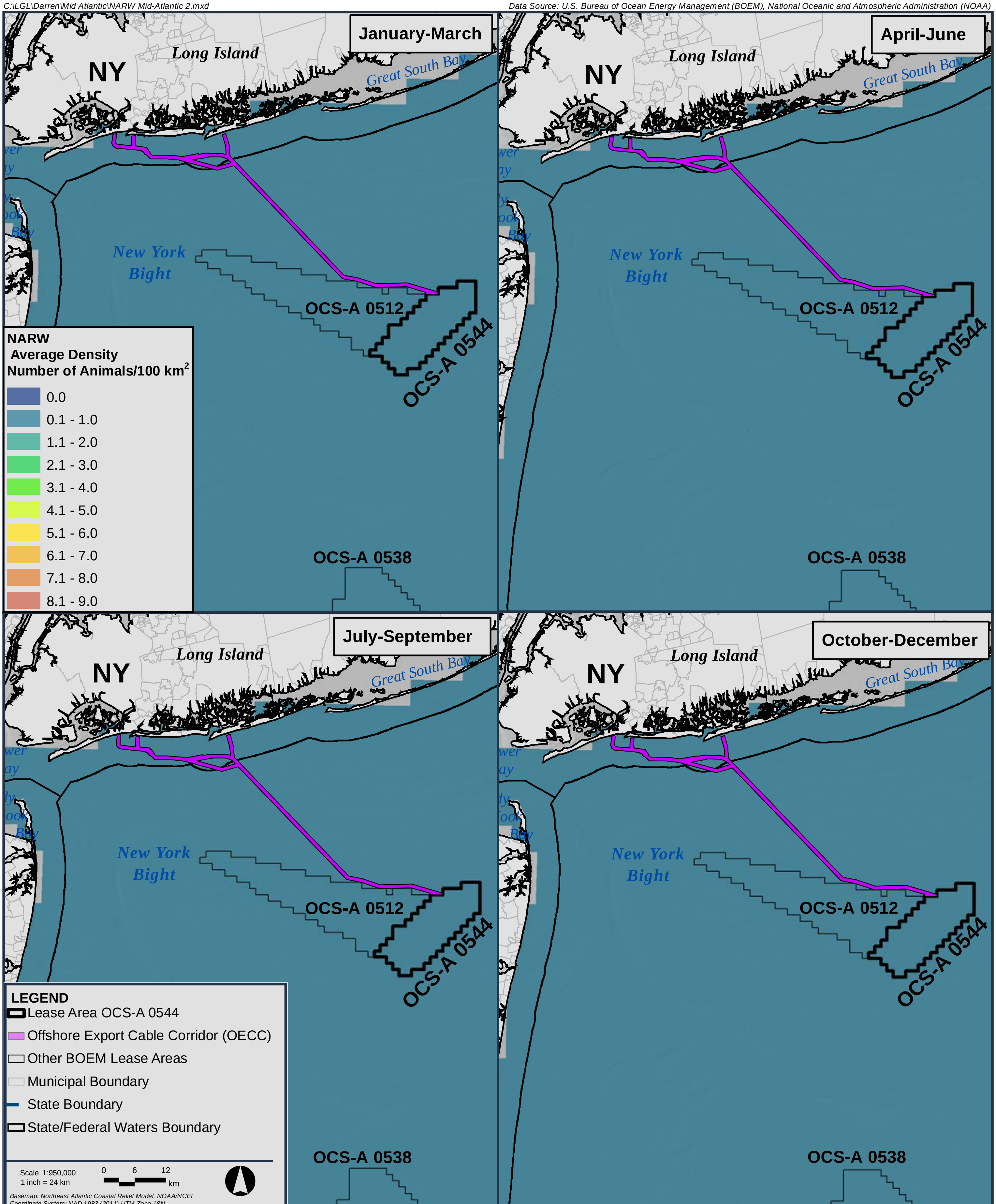

Figure 4.7-4

Map of NARW Average Seasonal Density from Roberts et al. (2016; 2022)

VINEYARD MID-ATLANTIC

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(Barlow et al. 1995; Hayes et al. 2023). The available literature shows that NARW single year-production has both exceeded and been below the default net productivity rate and is therefore to be much higher than the default (Kenney 2018; Corkeron et al. 2018).

4.7.1.2.6 Sei Whale (Balaenoptera borealis)

Sei whales are baleen whales that can reach lengths of about 12–18 m (40–60 ft) (NMFS 2021j). This species has a long, sleek body that is dark bluish gray to black in color and pale underneath (NMFS 2021j). Their diet is comprised primarily of plankton, schooling fish, and cephalopods. Sei whales generally travel in small groups (two to five individuals), but larger groups are observed on feeding grounds (NMFS 2021j).

Although uncertainties still exist with distinguishing sei whale vocalizations during PAM surveys, they are known to produce short duration (0.7 to 2.2 seconds) upsweeps and downsweeps between 20 and 600 Hz. SLs for these calls can range from 147 to 183 dB re 1 μPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). No auditory sensitivity data are available for this species (Southall et al. 2019).

Status

Sei whales are listed as endangered under the ESA and New York State ESA and by the IUCN Red List (Hayes et al. 2020; IUCN 2020). This stock is listed as strategic and depleted under the MMPA due to its endangered status (Hayes et al. 2020). Annual human-caused mortality and serious injury from 2015 to 2019 was estimated to be 0.8 animals per year (Hayes et al. 2021). The PBR for this stock is 6.2 (Hayes et al. 2020). Like fin whales, major threats to sei whales include fishery interactions, vessel collisions, contaminants, and climate-related shifts in prey species (Hayes et al. 2020). There are no critical habitat areas designated for the sei whale under the ESA. A BIA for feeding for sei whales occurs east of the Offshore Development Area from May through November (LaBrecque et al. 2015).

Distribution

Sei whales occur in all the world's oceans and migrate between feeding grounds in temperate and sub-polar regions to wintering grounds in lower latitudes (Kenney and Vigness-Raposa 2010; Hayes et al. 2020). In the Western North Atlantic, most of the population is concentrated in northerly waters along the Scotian Shelf. Sei whales are observed in the spring and summer, utilizing the northern portions of the US Atlantic EEZ as feeding grounds, including the Gulf of Maine and Georges Bank. The highest concentration is observed during the spring along the eastern margin of Georges Bank and in the Northeast Channel area along the southwestern edge of Georges Bank. PAM conducted along the Atlantic Continental Shelf and Slope in 2004-2014 detected sei whales calls from south of Cape Hatteras to the Davis Strait with evidence of distinct seasonal and geographic patterns. It is believed that mating takes place in December and January with most calves born between November and December in the North Atlantic (Lockyer and Martin 1983). Davis et al. (2020) detected peak call occurrence in northern latitudes during summer indicating feeding grounds ranging from SNE through the Scotian Shelf. Sei whales were recorded in the southeast on Blake's Plateau in the winter months, but only on the offshore recorders indicating a more pelagic distribution in this region. In general, sei whales are observed offshore with periodic incursions into more shallow waters for foraging (Hayes et al. 2020). Persistent year-round detections in the New York Bight highlight this as an important region for the species (Hayes et al. 2021).

Typically, sei whales inhabit deep water along continental slopes and shelf breaks, including the Scotian Shelf edge during the spring feeding season (Horwood 1987; Hayes et al. 2017; Davis et al. 2020). The New York Bight may serve as an important migration corridor for sei whales, but no known resident seasonal population is known to occur there. Sei whales were detected acoustically from April–May within the New York Bight (WHOI 2018). During New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), two sightings (seven individuals) of sei whales were recorded, which occurred only in the spring (Tetra Tech and LGL 2020; Zoidis et al. 2021). Similarly, during the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 within the New York OPA, sei whales were recorded across all four seasons (in low numbers) with the majority occurring in the spring (Normandeau and APEM Ltd. 2021)). The highest number of sei whales was documented in spring 2018 (6 individuals) (Normandeau and APEM Ltd. 2021). Over three years of PAM in the New York Bight, sei whales were recorded during all three years with the highest detection rate from March to mid-June (Estabrook et al. 2021). The northwest New York Bight buoy recorded a single detection and three possible detections of sei whales while the southeast New York Bight buoy recorded a single detection and two possible detections between June 2022–August 2023 (WHOI 2023). During the NJDEP EBS surveys conducted from January 2008–December 2009 by the NJDEP, no sei whales were recorded; however, during the summer 2016 AMAPPS survey, a fin/sei whale was documented in the waters off New Jersey (NJDEP 2010; NEFSC and SEFSC 2016). The sei whale is expected to have an uncommon presence within the Offshore Development Area and surrounding waters with the New York Bight, representing the southern extent of the sei whales' distribution range, during spring and summer months (Hayes et al. 2020).

Abundance

Prior to 1999, sei whales in the Western North Atlantic were considered a single stock. Following the suggestion of the Scientific Committee of the IWC, two separate stocks were identified for this species: a Nova Scotia stock and a Labrador Sea stock. Only the Nova Scotia stock can be found in US waters, and the current abundance estimate for this stock is 6,292 individuals derived from recent surveys conducted between Halifax, Nova Scotia and Florida (Hayes et al. 2020). Population trends are not available for this stock because of insufficient data (Hayes et al. 2020).

4.7.1.3 Odontocetes

4.7.1.3.1 Atlantic Spotted Dolphin (Stenella frontalis)

There are two species of spotted dolphins in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*Stenella attenuata*) (Perrin 1987). In addition, two forms of the Atlantic spotted dolphin exist: one that is large and heavily spotted and usually inhabits the continental shelf, and the other is smaller in size with less spots and occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling and Fertl 2003; Mullin and Fulling 2003; Viricel and Rosel 2014). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate (Hayes et al. 2021). Atlantic spotted dolphins in the Western Atlantic belong to the Western North Atlantic stock (Hayes et al. 2021). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). They form groups of varying sizes, usually less than 50 individuals, but can be seen travelling in groups of more than 200 individuals. In shallower waters, group size is typically five to 15 individuals.

Atlantic spotted dolphins are in the mid-frequency functional hearing group (Southall et al. 2007). They have an auditory bandwidth of 150 Hz to 160 kHz with vocalizations typically ranging from 100 Hz to 130 kHz (DoN 2008). Because calls produced by many delphinid species are highly variable and overlap in frequency characteristics, they are challenging to identify to individual species during acoustic studies (Oswald et al. 2007).

<u>Status</u>

The Atlantic spotted dolphin is not listed under the ESA and is not considered strategic under the MMPA. There have been no recent UMEs declared for the Atlantic spotted dolphin. No fishing-related mortality of spotted dolphin was reported for 1998 through 2003 (Yeung 1999, 2001; Garrison 2003; Garrison and Richards 2004). From 2007 through 2011, the estimated mean annual fishery-related mortality and serious injury for this species was 42 Atlantic spotted dolphins (Hayes et al. 2017). More recent observer data are not available. The commercial fisheries that interact or potentially interact with the Atlantic spotted dolphin are the pelagic longline fishery and the shrimp trawl fishery (Hayes et al. 2017). From 2017 – 2021, 21 Atlantic spotted dolphins were reported stranded along the US East Coast (NMFS 2024). Evidence of human interaction was detected for four of the strandings (all animals pushed out to sea by members of the public). No evidence of human interaction was detected for seven strandings, and for the remaining ten strandings, it could not be determined if there was evidence of human interaction. It should be noted that evidence of human interaction does not necessarily mean the interaction caused the animal’s stranding or death. There is no designated critical habitat for the Atlantic spotted dolphin within the Offshore Development Area.

Distribution

The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf 10 to 200 m (33 to 650 ft) deep to slope waters greater than 500 m (1,640 ft) deep. It has been suggested that the species may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966; Fritts et al. 1983). They occur in the US Atlantic waters year-round, ranging from the Mid-Atlantic south through the Caribbean and the Gulf of Mexico (Hayes et al. 2021). This species inhabits inshore waters and along the continental shelf edge and slope, with sightings concentrated north of Cape Hatteras. Between August – December 2022 and April – September 2023, there was one visual sighting of an Atlantic spotted dolphin recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

During the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 within the New York OPA, Atlantic spotted dolphins were recorded in low numbers during the fall and spring (Normandeau and APEM Ltd. 2021). The highest number of Atlantic spotted dolphins was documented in fall 2016 (54 individuals) (Normandeau and APEM Ltd. 2021). During AMAPPs shipboard surveys (summer and fall effort) conducted between 2010–2017, 63 sightings of 1,835 individuals were observed near the Offshore Development Area (Palka et al. 2021). No sightings of Atlantic spotted dolphins were reported during aerial and shipboard surveys conducted within 37 km (23 mi) off the coast of New Jersey during 2008 and 2009 (Whitt et al. 2015). Similarly, no sightings were reported during AMAPPs aerial surveys conducted from June–September 2021 (NEFSC and SEFSC 2022). Due to the rare nature of this species, as well as low density estimates, it is unlikely that Atlantic spotted dolphins will be encountered within the Offshore Development Area.

Abundance

The best available abundance estimate for Atlantic spotted dolphins is 31,506 individuals from 2021 surveys covering waters from Florida to the lower Bay of Fundy (NMFS 2024). Distinction between the two Atlantic spotted dolphin ecotypes has not regularly been made during surveys (Hayes et al. 2020).

4.7.1.3.2 Atlantic White-Sided Dolphin (Lagenorhynchus acutus)

The Atlantic white-sided dolphin is robust and attains a body length of approximately 2.8 m (9 ft) (Jefferson et al. 2008). It is characterized by a strongly "keeled" tail stock and distinctive, white-sided color pattern (BOEM 2014a). They feed mostly on small schooling fishes, shrimps, and squids, and are often observed feeding in mixed-species groups with pilot whales and other dolphin species (Jefferson et al. 2008; Cipriano 2018). Behaviorally, this species is highly social, but not as demonstrative as some other common dolphins. They typically form pods of around 30 to 150 individuals but have also been seen in very large pods of 500 to 2,000 individuals (Hayes et al. 2020). It is common to find these pods associated with the presence of other white-beaked dolphins, pilot whales, fin whales, and humpback whales.

Like most dolphin species, Atlantic white-sided dolphins produce clicks, buzzes, calls, and whistles. Their clicks are broadband sounds ranging from 30 to 40 kHz that can contain frequencies over 100 kHz and are often produced during foraging and for orientation within the water column. Buzzes and calls are not as well studied, and they may be used for socialization as well as foraging. Whistles are primarily for social communication and group cohesion and are characterized by a down sweep followed by an upsweep with an approximate starting frequency of 20 kHz and ending frequency of 17 kHz (Hamran 2014). No hearing sensitivity data are currently available for this species (Southall et al. 2019).

Status

Atlantic white-sided dolphins are not listed under the ESA or considered a strategic stock under the MMPA. They are classified as Least Concern on the IUCN Red List (Hayes et al. 2020; IUCN 2020). The PBR for this stock is 544 and the annual rate of human-caused mortality and serious injury from 2015 to 2019 was estimated to be 27 dolphins (Hayes et al. 2021). This estimate is based on observed fishery interactions, but Atlantic white-sided dolphins are also threatened by contaminants in their habitat, and climate-related shifts in prey distribution (Hayes et al. 2021). There is no designated critical habitat for this stock in the Offshore Development Area.

Distribution

Atlantic white-sided dolphins migrate between the temperate and polar waters of the north Atlantic Ocean, but usually maintain migration routes over outer shelf or slope waters. This is the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence; they are rarely seen off the coast of Nova Scotia (Kenney and Vigness-Raposa 2010). The species occurs year-round between central West Greenland to North Carolina primarily in continental shelf waters to the 100 m (328 ft) depth contour (Hayes et al. 2020). There are seasonal shifts in the distribution of the Atlantic white-sided dolphins off the northeastern US coast, with low abundance in winter between Georges Basin and Jeffrey's Ledge and very high abundance in the Gulf of Maine during spring. During summer, Atlantic white-sided dolphins are most abundant between Cape Cod and the lower Bay of Fundy. During fall, the distribution of the species is similar to that in summer, with less overall abundance (DoN 2005).

This species can be found off the coast of SNE during all seasons but is usually most numerous in areas farther offshore at depth range of 100 m (330 ft) (Reeves et al. 2002; Kenney and Vigness-Raposa 2010). During the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 within the New York OPA, Atlantic white-sided dolphins were recorded in low numbers during the fall and winter (Normandeau and APEM Ltd. 2021). The highest number of Atlantic white-sided dolphins was documented in fall 2016 (16 individuals) (Normandeau and APEM Ltd. 2021). More recently, during summer months (June–September), 17 sightings of 209 individuals were observed near the Offshore Development Area during AMAPPs aerial surveys conducted in 2021 (NEFSC and SEFSC 2022). Atlantic white-sided dolphins could potentially be seen within the Offshore Development Area.

Abundance

The best abundance estimate currently available for the Western North Atlantic stock is 93,233 individuals based on surveys conducted between Labrador to Florida (Hayes et al. 2020). A trend analysis is not currently available for this stock due to insufficient data (Hayes et al. 2020).

4.7.1.3.3 Common Bottlenose Dolphin (Tursiops truncatus)

Common bottlenose dolphins are one of the most well-known and widely distributed species of marine mammals. These dolphins reach 2–4 m (6–12.5 ft) in length (NMFS 2021a). The snout is stocky and set off from the head by a crease. They are typically light to dark grey in color with a white underside (Jefferson et al. 1993). Bottlenose dolphins are commonly found in groups of two to 15 individuals, though aggregations in the hundreds are occasionally observed (NMFS 2021a). They are considered generalist feeders and consume a wide variety of organisms, including fish, squid, shrimp, and other crustaceans (Jefferson et al. 2008).

Whistles produced by bottlenose dolphins can vary over geographic regions, and newborns are thought to develop "signature whistles" within the first few months of their lives that are used for intraspecific communication. Whistles generally range in frequency from 300 Hz to 39 kHz with SLs between 114 and 163 dB re 1 μPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). Bottlenose dolphins also make burst-pulse sounds and echolocation clicks, which can range from a few kHz to over 150 kHz. As these sounds are used for locating and capturing prey, they are directional calls; the recorded frequency and sound level can vary depending on whether the sound was received head-on or at an angle relative to the vocalizing dolphin. SLs for burst-pulses and clicks range between 193 and 228 dB re 1 μPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). There are sufficient available data for bottlenose dolphin hearing sensitivity using both behavioral and auditory evoked potential (AEP) methods as well as anatomical modeling studies, which show hearing for the species is most sensitive between approximately 400 Hz and 169 kHz (Southall et al. 2019).

Status

Common bottlenose dolphins of the Western North Atlantic are not listed under the ESA and are classified as Least Concern on the IUCN Red List (Hayes et al. 2020; IUCN 2020). The offshore common bottlenose stock is considered a species of interest under the New Jersey state law. The Western North Atlantic Offshore Stock is not considered strategic under the MMPA (Hayes et al. 2021); however, the Western North Atlantic Migratory Coastal Stock is considered strategic by NMFS because it is listed as depleted under the MMPA (Hayes et al. 2018). The PBR for the offshore stock is 507, and the average annual human-caused mortality and serious injury from 2017 – 2021 was estimated to be 28 animals, attributed to fishery interactions (NMFS 2024). The PBR for the Northern Migratory Coastal Stock is 48, and the average annual human-caused mortality and serious injury from 2013–2017 was estimated to be 12.2–21.5 animals (Hayes et al. 2021). The largest threat to the population is bycatch, as the dolphins are frequently caught in fishing gear, gillnets, purse seins, and shrimp trawls (Waring et al. 2016). In addition to fisheries, threats to common bottlenose dolphins include non-fishery related human interaction; anthropogenic noise; offshore development; contaminants in their habitat; and climate-related changes in prey distribution (Hayes et al. 2020). There is no designated critical habitat for either stock in the Offshore Development Area.

Distribution

The common bottlenose dolphin is a cosmopolitan species that occurs in temperate and tropical waters worldwide. Two distinct morphotypes of bottlenose dolphin, coastal and offshore, occur along the eastern coast of the US (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997; Rosel et al. 2009). The genetic and morphological differences recently led to the coastal form being described as a new species, *Tursiops erebennus* (Costa et al. 2022). The offshore morphotype inhabits outer continental slope and shelf edge regions from Georges Bank to the Florida Keys, and the coastal morphotype is continuously distributed along the Atlantic Coast from south of New York to the Florida Peninsula (Hayes et al. 2017). Offshore common bottlenose dolphin sightings occur from Cape Hatteras to the eastern end of Georges Bank (Kenney 1990). There are 17 coastal, offshore, bay, and estuarine stocks of common bottlenose dolphins in the US Atlantic EEZ. Bottlenose dolphins encountered in the Offshore Development Area would likely belong to the Western North Atlantic Offshore Stock and the Western North Atlantic Northern Migratory Coastal Stock (Hayes et al. 2021). However, bottlenose dolphins residing in the New York Bight are thought to belong to the Northern Migratory Coastal Stock, which occupies a small range between Long Island, New York, and southern North Carolina, and high abundances coincide with the known movement into the northern portion of their range (NJDEP 2010). These animals often move into or reside in bays, estuaries, the lower reaches of rivers, and coastal waters within the approximate 25 m (82 ft) depth isobath north of Cape Hatteras (Reeves et al. 2002; Hayes et al. 2017).

The Northern Migratory Coastal stock ranges from North Carolina to New York and is likely to occur in the Offshore Development Area (Hayes et al. 2021). There is separation North of Cape Hatteras of the offshore and coastal morphotypes across bathymetric contours during summer months. Aerial surveys flown from 1979 through 1981 indicated a concentration of bottlenose dolphins in waters <25 m (82 ft) deep that corresponded with the coastal morphotype, and an area of high abundance along the shelf break that corresponded with the offshore stock (Hayes et al. 2021). Torres et al. (2003) found a statistically significant break in the distribution of the morphotypes; almost all dolphins found in waters >34 m (111 ft) depth and >34 km (21 mi) from shore were of the offshore morphotype. The coastal stock is best defined by its summer distribution, when it occupies coastal waters from the shoreline to the 20 m (65 ft) isobath between Virginia and New York (Hayes et al. 2021). This stock migrates south during late summer and fall, and during colder months it occupies waters off Virginia and North Carolina (Hayes et al. 2021). Therefore, during the summer, dolphins found inside the 20 m (65 ft) isobath are likely to belong to the coastal stock, while those found in deeper waters or observed during cooler months belong to the offshore stock.

According to the NJDEP (NJDEP 2010), the bottlenose dolphin is present off the New Jersey coast year-round and would likely be ubiquitous throughout the Offshore Development Area. Bottlenose dolphins were the most frequently sighted marine mammals during NJDEP EBS surveys with sightings most frequently occurring in spring and summer (NJDEP 2010). Fewer bottlenose dolphins were observed during the fall in comparison with other seasons, since fall is potentially a transitional period when bottlenose dolphins move south of the Offshore Development Area (NJDEP 2010). During AMAPPS surveys, bottlenose dolphin peak abundance was in the summer within shallow nearshore waters (Palka et al. 2017). Between August – December 2022 and April – September 2023, there were 53 visual sightings of common bottlenose dolphins recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

During the New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), 39 sightings of 385 individuals were recorded across all four seasons with a peak in the summer (Tetra Tech and LGL 2020; Zoidis et al. 2021). During the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 within the New York OPA, common bottlenose dolphins were recorded across all four seasons (Normandeau and APEM Ltd. 2021). The highest number of common bottlenose dolphins was documented in summer 2017 (175 individuals) (Normandeau and APEM Ltd. 2021). EBS results also indicate that nearshore waters are important to bottlenose dolphins, but distribution is not thought to be limited to a particular depth or distance from shore (Palka et al. 2017). More recently, during AMAPPs aerial surveys conducted from June–September 2021, 58 sightings of 510 individual common bottlenose dolphins were observed near the Offshore Development Area (NEFSC and SEFSC 2022). Bottlenose dolphins were sighted within 0.3 km (0.2 mi) of shore, with peak densities from the shore to 5.5 km (3.4 mi) off Atlantic City and Little Egg Inlet in spring, but farther offshore of Barnegat Light and Barnegat Bay in the summer. However, several bottlenose dolphin sightings were also recorded in deeper waters (34 m [112 ft]) and farther offshore (maximum 38 km [24 mi] from shore).

Abundance

The best abundance estimate for the Western North Atlantic offshore stock is 64,587 individuals based on 2021 surveys between the lower Bay of Fundy and Florida (NMFS 2024). The best abundance estimate for the Western North Atlantic Migratory Coastal stock is estimated at approximately 6,639 individuals, derived from aerial surveys conducted during the summer of 2016 covering coastal and shelf waters from Assateague, Virginia to Sandy Hook, New Jersey (Hayes et al. 2021). A population trend analysis for the Western North Atlantic offshore stock was conducted using abundance estimates from 2004, 2011, and 2016, and showed no statistically significant trend (Hayes et al. 2020). A population trend analysis for the Western North Atlantic Migratory Coastal stock was conducted to evaluate trends in coast-wide population size based on aerial surveys conducted between 2002 and 2016. There was no significant trend in population size between 2002 and 2011; however, there was a statistically significant change in slope between 2011 and 2016, indicating a decline in population size (Hayes et al. 2021).

4.7.1.3.4 Common Dolphin (Delphinus delphis)

Two common dolphin species were previously recognized: the long-beaked common dolphin (*Delphinus capensis*) and the short-beaked common dolphin (*Delphinus delphis*). However, Cunha et al. (2015) summarized the relevant data and analyses along with additional molecular data and analysis and recommended that the long-beaked common dolphin not be further recognized in the Atlantic Ocean. Short-beaked common dolphins can reach 2.7 m (9 ft) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape" (NMFS 2021k). This species feeds on schooling fish and squid found near the surface at night (NMFS 2021k). They have been known to feed on fish escaping from fishermen's nets or fish that are discarded from boats (NMFS 1993). This highly social and energetic species usually travels in large pods consisting of 50 to >1,000 individuals (Cañadas and Hammond 2008). The common dolphin can frequently be seen performing acrobatics and interacting with large vessels and other marine mammals.

Common dolphin clicks are broadband sounds between 17 and 45 kHz with peak energy between 23 and 67 kHz. Burst-pulse sounds are typically between 2 and 14 kHz while the key frequencies of common dolphin whistles are between 3 and 24 kHz (Erbe et al. 2017). No hearing sensitivity data are available for this species (Southall et al. 2019).

Status

The common dolphin is not listed under the ESA and is classified as Least Concern by the IUCN Red List (Hayes et al. 2020; IUCN 2020). Historically, this species was hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from vessel collisions and Eastern North American fishing activities within the Atlantic, most prominently yellowfin tuna (*Thunnus albacares*) nets, driftnets, and bottom-set gillnets (Kraus et al. 2016; Hayes et al. 2020). The common dolphin faces anthropogenic threats because of its utilization of nearshore habitat and highly social nature, but it is not considered a strategic stock under the MMPA because the average annual human-caused mortality and serious injury does not exceed the calculated PBR of 599 individuals for this stock (NMFS 2024). The annual estimated human-caused mortality and serious injury for 2017 to 2021 was 413 animals, which included fishery-interactions and research takes (NMFS 2024). Other threats to this species include contaminants in their habitat and climate-related changes in prey distribution (Hayes et al. 2020). There is no designated critical habitat for this stock in the Offshore Development Area.

Distribution

Common dolphins in the US Atlantic EEZ belong to the Western North Atlantic stock, generally occurring from Cape Hatteras, North Carolina to the Scotian Shelf (Hayes et al. 2018). Common dolphins are a highly seasonal, migratory species. In the US Atlantic EEZ, this species is distributed along the continental shelf between the 200–2,000 m (650–6,561.6 ft) isobaths and is associated with Gulf Stream features (CeTAP 1982; Payne and Selzer 1989; Hamazaki 2002; Hayes et al. 2018). Common dolphins occur from Cape Hatteras northeast to Georges Bank (35° to 42°N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to fall (Payne and Selzer 1989; Hayes et al. 2020). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 11° Celsius (C) (51.8° Fahrenheit [F]) (Sergeant et al. 1970; Gowans and Whitehead 1995). Breeding usually takes place between June and September and females have an estimated calving interval of two to three years (Hayes et al. 2018). Between August – December 2022 and April – September 2023, there were 145 visual sightings of common dolphins recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

During the New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), 51 sightings of 3,867 individuals were recorded across all four seasons with a peak in the summer (Tetra Tech and LGL 2020; Zoidis et al. 2021). Similarly, during the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 within the New York OPA, common dolphins were recorded across all four seasons with the majority occurring in the summer (Normandeau and APEM Ltd. 2021). The highest number of common dolphins was documented in summer 2018 (1,342 individuals) (Normandeau and APEM Ltd. 2021). More recently, during AMAPPs aerial surveys conducted from June–September 2021, 125 sightings of 5,238 individual common dolphins were observed near the Offshore Development Area (NEFSC and SEFSC 2022). The NJDEP EBS results indicate that common dolphins occur much closer to shore and were observed near the Offshore Development Area in water depths of 10 to 31 m (33 to 102 ft) and 3 to 37 km (1.9 to 23 mi) from shore (NJDEP 2010).

Abundance

The best population estimate in the US Atlantic EEZ for the Western North Atlantic common dolphin is 70,184 common dolphins (Hayes et al. 2018) while Roberts et al. (2016) habitat-based density models provide an abundance estimate of 86,098 individuals in the US Atlantic EEZ. The current best abundance estimate for the entire Western North Atlantic stock is 93,100 individuals which is the total of NEFSC and SEFSC surveys conducted in 2021 (NMFS 2024). A trend analysis was not conducted for this stock because of the imprecise abundance estimate and long survey intervals (Hayes et al. 2020).

4.7.1.3.5 Harbor Porpoise (Phocoena phocoena)

This species is among the smallest of the toothed whales and is the only porpoise species found in northeastern US waters. A distinguishing physical characteristic is the dark stripe that extends from the flipper to the eye. The rest of its body has common porpoise features; a dark gray back, light gray sides, and small, rounded flippers (Jefferson et al. 1993). It reaches a maximum length of 1.8 m (6 ft) and feeds on a wide variety of small fish and cephalopods (Reeves and Read 2003; Kenney and Vigness-Raposa 2010). Most harbor porpoises are observed in small groups, usually between five and six individuals, although they aggregate into larger groups for feeding or migration (Jefferson et al. 2008).

Harbor porpoises produce high frequency clicks with a peak frequency between 129 and 145 kHz and an estimated SLs that ranges from 166 to 194 dB re 1 µPa @ 1 m (3.28 ft) SPL_{rms} (Villadsgaard et al. 2007). Available data estimating auditory sensitivity for this species suggest that they are most receptive to noise between 300 Hz and 160 kHz (Southall et al. 2019).

<u>Status</u>

This species is not listed under the ESA and is considered non-strategic under the MMPA (Hayes et al. 2020). However, harbor porpoise is considered a species of interest and a species of concern under New Jersey and New York state law, respectively. Harbor porpoise is listed as Least Concern by the IUCN Red List (IUCN 2020). The PBR for this stock is 649, and the estimated human-caused annual mortality and serious injury from 2017 – 2021 was 145 harbor porpoises per year (NMFS 2024). This species faces major anthropogenic impacts because of its nearshore habitat. Historically, Greenland populations were hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from Western North Atlantic fishing activities such as gillnets and bottom trawls (Hayes et al. 2020). Harbor porpoises also face threats from contaminants in their habitat, vessel traffic, habitat alteration due to offshore development, and climate-related shifts in prey distribution (Hayes et al. 2020). There is no designated critical habitat for this species near the Offshore Development Area.

<u>Distribution</u>

The harbor porpoise is mainly a temperate, inshore species that prefers to inhabit shallow, coastal waters of the North Atlantic, North Pacific, and Black Sea. Harbor porpoises mostly occur in shallow shelf and coastal waters. In the summer, they tend to congregate in the northern Gulf of Maine, southern Bay of Fundy, and around the southern tip of Nova Scotia (Hayes et al. 2020). In the fall and spring, harbor porpoises are widely distributed from New Jersey to Maine (Hayes et al. 2020). In the winter, intermediate densities can be found from New Jersey to North Carolina, with lower densities from New York to New Brunswick, Canada (Kenney and Vigness-Raposa 2010). In cooler months, harbor porpoises have been observed from the coastline to deeper waters (>1,800 m [5,906 ft]), although the majority of sightings are over the continental shelf (Hayes et al. 2020).

The harbor porpoise is likely to occur most frequently in the New York Bight where they are considered abundant from fall through spring, with the highest densities occurring in the spring when they will migrate towards the Gulf of Maine feeding grounds (Kenney and Vigness-Raposa 2010; DoN 2007; NYSDOS 2013). More than 90 percent of the harbor porpoise sightings recorded during the NJDEP EBS surveys occurred during winter (mainly February and March), and few sightings were recorded in April, May, and July (NJDEP 2010). Similarly, during the New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), 2 sightings of 16 individuals were recorded, with the majority during the winter followed by the summer. During the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 within the New York OPA, harbor porpoises were recorded with the highest presence in winter (Normandeau and APEM Ltd. 2021). The highest number of harbor porpoises was documented in winter 2016–2017 (192 individuals) (Normandeau and APEM Ltd. 2021). More recently, during AMAPPs aerial surveys conducted from June–September 2021, 84 sightings of 229 individual harbor porpoises were observed near the Offshore Development Area (NEFSC and SEFSC 2022). No harbor porpoise sightings were recorded during the fall survey; however, they are likely to occur in the Offshore Development Area throughout the fall (NJDEP 2010). Harbor porpoises were observed in the spring 2013 and 2014 aerial AMAPPS surveys (NEFSC and SEFSC 2013, 2014). Seasonal abundance estimates generated for harbor porpoises in the New York Bight showed the highest densities during spring, with very low numbers in the fall and no estimate during summer and winter (Hayes et al. 2021).

Abundance

The best available abundance estimate for the Gulf of Maine/Bay of Fundy stock occurring in the Offshore Development Area is 85,765 individuals based on the 2021 NEFSC and SEFSC surveys that covered US and Canadian waters, from Florida to Nova Scotia, Canada (NMFS 2024). A population trend analysis is not available because data are insufficient for this species (Hayes et al. 2019).

4.7.1.3.6 Pilot Whales (Globicephala spp.)

Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale and the short-finned pilot whale. These species are difficult to differentiate at sea and cannot be reliably distinguished during most surveys (Rone and Pace 2012; Hayes et al. 2017). Both short-finned and long-finned pilot whales are similar in coloration and body shape. Pilot whales have bulbous heads, are dark gray, brown, or black in color, and can reach approximately 7.3 m (25 ft) in length (NMFS 2021f). However, long-finned pilot whales can be distinguished by their long flippers, which are 18 to 27% of the body length with a pointed tip and angled leading edge (Jefferson et al. 1993). These whales form large, relatively stable aggregations that appear to be maternally determined (ACS 2018). Pilot whales feed primarily on squid, although they also eat small to medium-sized fish and octopus when available (NMFS 2021f).

Like dolphin species, pilot whales can produce whistles and burst-pulses used for foraging and communication. Whistles typically range in frequency from one to 11 kHz while burst-pulses cover a broader frequency range from 100 Hz to 22 kHz (Erbe et al. 2017). AEP measurements conducted by Pacini et al. (2010) indicate that the hearing sensitivity for this species ranges from <4 kHz to 89 kHz.

Status

Neither pilot whale species is listed as threatened or endangered under the ESA and neither stock is considered strategic under the MMPA (Hayes et al. 2021). However, the short-finned pilot whale is listed as a species of interest under New Jersey state law. Long-finned pilot whales have a propensity to mass strand in US waters, although the role of human activity in these strandings remains unknown (Hayes et al. 2020). The PBR for the long-finned pilot whale is 306, and the annual human-caused mortality and serious injury was estimated to be nine whales between 2015 and 2019 (Hayes et al. 2021). Threats to this population include entanglement in fishing gear, contaminants, climate-related shifts in prey distribution, and anthropogenic noise (Hayes et al. 2020). The PBR for the short-finned pilot whale is 143, and the annual human-caused mortality and serious injury was estimated to be 218 whales between 2017 and 2021 (NMFS 2024). Strandings involving hundreds of individuals are not unusual and demonstrate that these large schools have a high degree of social cohesion (Reeves et al. 2002). From 2013–2017, 16 long-finned pilot whales were reported as stranded between Maine and Florida (Hayes et al. 2020). There is no designated critical habitat for either of these two species in the Offshore Development Area.

Distribution

In general, short-finned pilot whales tend to have a tropical and subtropical distribution whereas long-finned pilot whales prefer colder temperate waters (Olson 2018). In US Atlantic waters, pilot whales are distributed principally along the continental shelf edge off the northeastern US coast in winter and early spring (CeTAP 1982; Payne and Heinemann 1993; Abend and Smith 1999; Hamazaki 2002). In late spring, pilot whales move onto Georges Bank, into the Gulf of Maine, and into more northern waters, where they remain through late fall (CeTAP 1982; Payne and Heinemann 1993). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993; Hayes et al. 2019). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whale have stranded as far north as Massachusetts (Hayes et al. 2019). The latitudinal ranges of the two species therefore remain uncertain. However, south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of approximately 42°N, most pilot whale sightings are expected to be long-finned pilot whales (Hayes et al. 2020). Therefore, it is possible that both species of pilot whale may be found within the Offshore Development Area (Hayes et al. 2021).

Recent surveys undertaken for offshore wind projects in the New York Bight found pilot whales near the continental shelf break (NYSDOS 2013; NYSERDA 2017), but not in nearshore waters (Whitt et al. 2015). During the New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), 20 sightings of 472 individuals were recorded with the majority during the summer and fall (Tetra Tech and LGL 2020; Zoidis et al. 2021). Similarly, during AMAPPs aerial surveys conducted from June–September 2021, 27 sightings of 255 individual pilot whales were observed near the Offshore Development Area (NEFSC and SEFSC 2022). While it is unlikely that pilot whales will be encountered in the Offshore Development Area, they may be present in low numbers.

Abundance

The best available estimate of long-finned pilot whales in the Western North Atlantic is 39,215 individuals which is the sum of the estimates generated from the northeast US summer 2016 survey covering US waters from central Virginia to Maine and the Department of Fisheries and Oceans Canada summer 2016 survey covering Canadian waters from the US to Labrador (Lawson and Gosselin 2018; Garrison 2020; Hayes 2020; Palka 2020). A trend analysis has not been conducted for the long-finned pilot whale due to the relatively imprecise abundance estimates (Hayes et al. 2020). For short-finned pilot whales, the best available estimate is 18,749 individuals from summer 2021 surveys from central Florida to George's Bank because those surveys covered the full range of this species in the US Atlantic waters (Hayes et al. 2019). A population trend analysis for the short-finned pilot whale was conducted using abundance estimates from the summers of 2004, 2011, and 2016, and showed no statistically significant trend.

4.7.1.3.7 Risso's Dolphin (Grampus griseus)

The Risso's dolphin attains a body length of approximately 2.6–4 m (8.5–13 ft) (NMFS 2021i). Unlike most other dolphins, Risso's dolphins have blunt heads without distinct beaks. Coloration for this species ranges from dark to light grey. Adult Risso's dolphins are typically covered in white scratches and spots that can be used to identify the species in field surveys (Jefferson et al. 1993). The Risso's dolphin forms groups ranging from 10 to 30 individuals and primarily feed on squid, but also fish such as anchovies (Engraulidae), krill, and other cephalopods (NMFS 2021i).

Whistles for this species have frequencies ranging from around 4 kHz to over 22 kHz with estimated SLs between 163 and 210 dB re 1 µPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). Studies using both behavioral and AEP methods have been conducted for this species, which show greatest auditory sensitivity between <4 kHz to >100 kHz (Nachtigall et al. 1995; Nachtigall et al. 2005).

Status

Risso's dolphins are not listed as threatened or endangered under the ESA and are classified as a species of Least Concern on the IUCN Red List (Hayes et al. 2020; IUCN 2020). The PBR for this stock is 307, and the annual human-caused mortality and injury for 2017 to 2021 was estimated to be 18 animals (NMFS 2024). This stock is not classified as strategic under the MMPA because mortality does not exceed the calculated PBR. Threats to this stock include fishery interactions, non-fishery related human interaction, contaminants in their habitat, and climate-related shifts in prey distribution (Hayes et al. 2020). There is no designated critical habitat for this stock in the Offshore Development Area.

Distribution

Risso's dolphins in the US Atlantic EEZ are part of the Western North Atlantic Stock. The Western North Atlantic stock of Risso's dolphins inhabits waters from Florida to eastern Newfoundland (Leatherwood et al. 1976; Baird and Stacey 1991). Off the northeastern US coast, Risso's dolphins are primarily concentrated along the continental shelf edge, but they can also be found swimming in shallower waters to the mid-shelf (Hayes et al. 2020). During spring, summer, and fall, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank (CeTAP 1982; Payne et al. 1984). During the winter, the distribution extends outward into oceanic waters (Payne et al. 1984). The stock may contain multiple demographically independent populations that should themselves be stocks because the current stock spans multiple eco-regions (Longhurst 1998; Spalding et al. 2007).

During the New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), 232 sightings of 2,462 individuals were recorded across all four seasons with the majority of sighting occurring in the summer (Tetra Tech and LGL 2020; Zoidis et al. 2021). Similarly, during the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 within the New York OPA, Risso's dolphins were recorded across all four seasons with the majority occurring in the summer (Normandeau and APEM Ltd. 2021). The highest number (229 individuals) of Risso's dolphins was documented in summer 2018 within the New York OPA (Normandeau and APEM Ltd. 2021). More recently, during summer months (June–September), 46 sightings of 384 individual Risso's dolphins were observed near the Offshore Development Area during AMAPPs aerial surveys conducted in 2021 (NEFSC and SEFSC 2022). During the NJDEP surveys, no Risso's dolphins were observed, and density models predicted them at very low densities in offshore edges of several wind energy development areas close to the shelf break and extending into deeper waters (Palka et al. 2017). While it is unlikely that Risso's dolphins will be encountered in the Offshore Development Area, they may occur in low numbers.

Abundance

The best abundance estimate in the Western North Atlantic is 44,067 individuals based on the 2021 NEFSC and SEFSC surveys (NMFS 2024). A trend analysis was not conducted on this species, because there is insufficient data to generate this information.

4.7.1.3.8 Sperm Whale (Physeter macrocephalus)

The sperm whale is the largest of all toothed whales; males can reach 16 m (52 ft) in length and weigh over 40,823 kilograms (kg) [45 US tons]), and females can attain lengths of up to 11 m (36 ft) and weigh over 13,607 kg (15 tons) (Whitehead 2009). Sperm whales have extremely large heads, which account for 25–35% of the total length of the animal. This species tends to be uniformly dark gray in color, though lighter spots may be present on the ventral surface. Sperm whales frequently dive to depths of 400 m (1,300 ft) in search of their prey, which includes large squid, fishes, octopus, sharks, and skates (Whitehead 2009). This species can remain submerged for over an hour and reach depths as great as 1,000 m (3,280 ft). Sperm whales form stable social groups and exhibit a geographic social structure; females and juveniles form mixed groups and primarily reside in tropical and subtropical waters, whereas males are more solitary and wide-ranging and occur at higher latitudes (Whitehead 2002; Whitehead 2003). Sperm whale births typically occur during the months between July and November, following a 14.5–16.5 month gestation period (Hayes et al. 2020).

Unlike mysticete whales that produce various types of calls used solely for communication, sperm whales produce clicks that are used for echolocation and foraging as well as communication (Erbe et al. 2017). Sperm whale clicks have been grouped into five classes based on the click rate, or number of clicks per second; these include "squeals," "creaks," "usual clicks," "slow clicks," and "codas." In general, these clicks are broadband sounds ranging from 100 Hz to 30 kHz with peak energy centered around 15 kHz. Depending on the class, SLs for sperm whale calls range between approximately 166 and 236 dB re 1 µPa @ 1 m (3.28 ft) SPL_{rms} (Erbe et al. 2017). Hearing sensitivity data for this species are currently unavailable (Southall et al. 2019).

Status

The Western North Atlantic stock is considered strategic under the MMPA due to its listing as endangered under the ESA, and the global population is listed as Vulnerable on the IUCN Red List (Hayes et al. 2020; IUCN 2020). The sperm whale is also listed as endangered under the New York and New Jersey state law. Between 2017–2021, 10 sperm whale strandings were documented along the US Atlantic coast; two of these strandings were classified as human interactions, both due to plastic ingestion (NMFS 2024). A moratorium on sperm whale hunting was adopted in 1986 and currently no hunting is allowed for any purposes in the North Atlantic. Occasionally, sperm whales will become entangled in fishing gear or be struck by ships off the east coast of the US. However, this rate of mortality is not believed to have biologically significant impacts. The current PBR for this stock is 9.28, and because the total estimated human-caused mortality and serious injury is <10% of this calculated PBR, it is considered insignificant (NMFS 2024). Other threats to sperm whales include contaminants, climate-related changes in prey distribution, and anthropogenic noise, although the severity of these threats on sperm whales is currently unknown (Hayes et al. 2020). There is no designated critical habitat for this population in the Offshore Development Area.

Distribution

This species is widely distributed, occurring from the edge of the polar pack ice to the equator in both hemispheres (Whitehead 2018). In general, they are distributed over large temperate and tropical areas that have high secondary productivity and steep underwater topography, such as volcanic islands (Jacquet and Whitehead 1996). Their distribution and relative abundance can vary in response to prey availability, most notably squid (Jaquet and Gendron 2002). A single stock of sperm whales is recognized for the North Atlantic, and Reeves and Whitehead (1997) and Dufault et al. (1999) suggest that sperm whale populations lack clear geographic structure. Though sperm whales mainly reside in deep-water habitats along the shelf edge and in mid-ocean regions, this species has been observed in relatively high numbers in the shallow continental shelf areas of southern New England (Scott and Sadove 1997). In the US Atlantic EEZ waters, sperm whales appear to exhibit seasonal movement patterns (CeTAP 1982; Scott and Sadove 1997). During the winter, they are concentrated to the east and north of Cape Hatteras. This distribution shifts northward in spring, when sperm whales are most abundant in the central portion of the Mid-Atlantic Bight to the southern region of Georges Bank. In summer, this distribution continues to move northward, including the area east and north of Georges Bank and the continental shelf to the south of New England. In fall months, sperm whales are most abundant on the continental shelf to the south of New England and remain abundant along the continental shelf edge in the Mid-Atlantic Bight.

Sperm whales have a documented presence within the New York OPA, per the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 (Normandeau and APEM Ltd. 2021). Sperm whales were sighted within the New York OPA most commonly in the summer and fall, with the highest number documented in summer 2018 (5 individuals). During the New York Bight Whale Monitoring Aerial Surveys (March 2017–February 2020), 32 sightings of 72 individuals were recorded across all four seasons (Tetra Tech and LGL 2020; Zoidis et al. 2021). Whales were observed offshore New York during all months except May and November (Tetra Tech and LGL 2020; Zoidis et al. 2021). All sightings were made in deep offshore waters, where sperm whales are more likely to occur (Zoidis et al. 2021; Roberts 2022). Additional sightings of sperm whales were recorded during the AMAPPS surveys in 2016 (summer to fall) along the continental slope and deeper waters along the New York Bight (Palka et al. 2017). During summer months (June–September), two sightings of two individual sperm whale were observed near the Offshore Development Area during AMAPPs aerial surveys conducted in 2021 (NEFSC and SEFSC 2022). Over three years of PAM in the New York Bight, no clear seasonal signal was detected leading to inconclusive results as to whether or not these animals are resident individuals or passing through the area (Estabrook et al. 2021). A map of sperm whale maximum seasonal density (as number of animals per 100 km^2) from Roberts et al. (2016; 2022) is presented in Figure 4.7-5.

<u>Abundance</u>

The IWC recognizes only one stock of sperm whales for the North Atlantic, and Reeves and Whitehead (1997) and Dufault et al. (1999) suggest that sperm whale populations lack clear geographic structure. The best and most recent abundance estimate based on 2021 surveys conducted between the lower Bay of Fundy and Florida is 5,895 individuals (NMFS 2024). No population trend analysis is available for this stock.

4.7.1.4 Pinnipeds

Two species of pinnipeds occur in the Atlantic Ocean near the Offshore Development Area: the gray seal and harbor seal. Both pinniped species are likely to occur in the region year-round.

The Draft 2021 SAR mentions an increase of sightings and stranding data for harp seals off of the east coast of the US from Maine to New Jersey (Hayes et al. 2021). However, assessment of the Ocean Biodiversity Information System (OBIS 2021) database found only records of stranding for the harp seal within the New York Bight region. Although the presence of stranded animals indicates some level of occurrence in the regions, it does not necessarily reflect the likely encounter of free-ranging animals in the Offshore Development Area.

4.7.1.4.1 Gray Seal (Halichoerus grypus)

Gray seals are the second most common pinniped in the US Atlantic EEZ (Jefferson et al. 2008). This species inhabits temperate and sub-arctic waters and lives on remote, exposed islands, shoals, and unstable sandbars (Jefferson et al. 2008). Gray seals are large, reaching 2–3 m (7.5–10 ft) in length, and have a silver-gray coat with scattered dark spots (NMFS 2021c). These seals are generally gregarious and live in loose colonies while breeding (Jefferson et al. 2008). Though they spend most of their time in coastal waters, gray seals can dive to depths of 300 m (984 ft), and frequently forage on the outer shelf (Hammill et al. 2001; Jefferson et al. 2008). These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (Bonner et al. 1971; Reeves et al. 1992; Jefferson et al. 2008). They often co-occur with harbor seals because their habitat and feeding preferences overlap (NMFS 2021c).

Two types of underwater vocalizations have been recorded for male and female gray seals; clicks and hums. Clicks are produced in a rapid series resulting in a buzzing noise with a frequency range between 500 Hz and 12 kHz. Hums, which are described as being similar to that of a dog crying in its sleep, are lower frequency calls with most of the energy <1 kHz (Schusterman et al. 1970). AEP studies indicate that hearing sensitivity for this species is greatest between 140 Hz and 100 kHz (Southall et al. 2019).

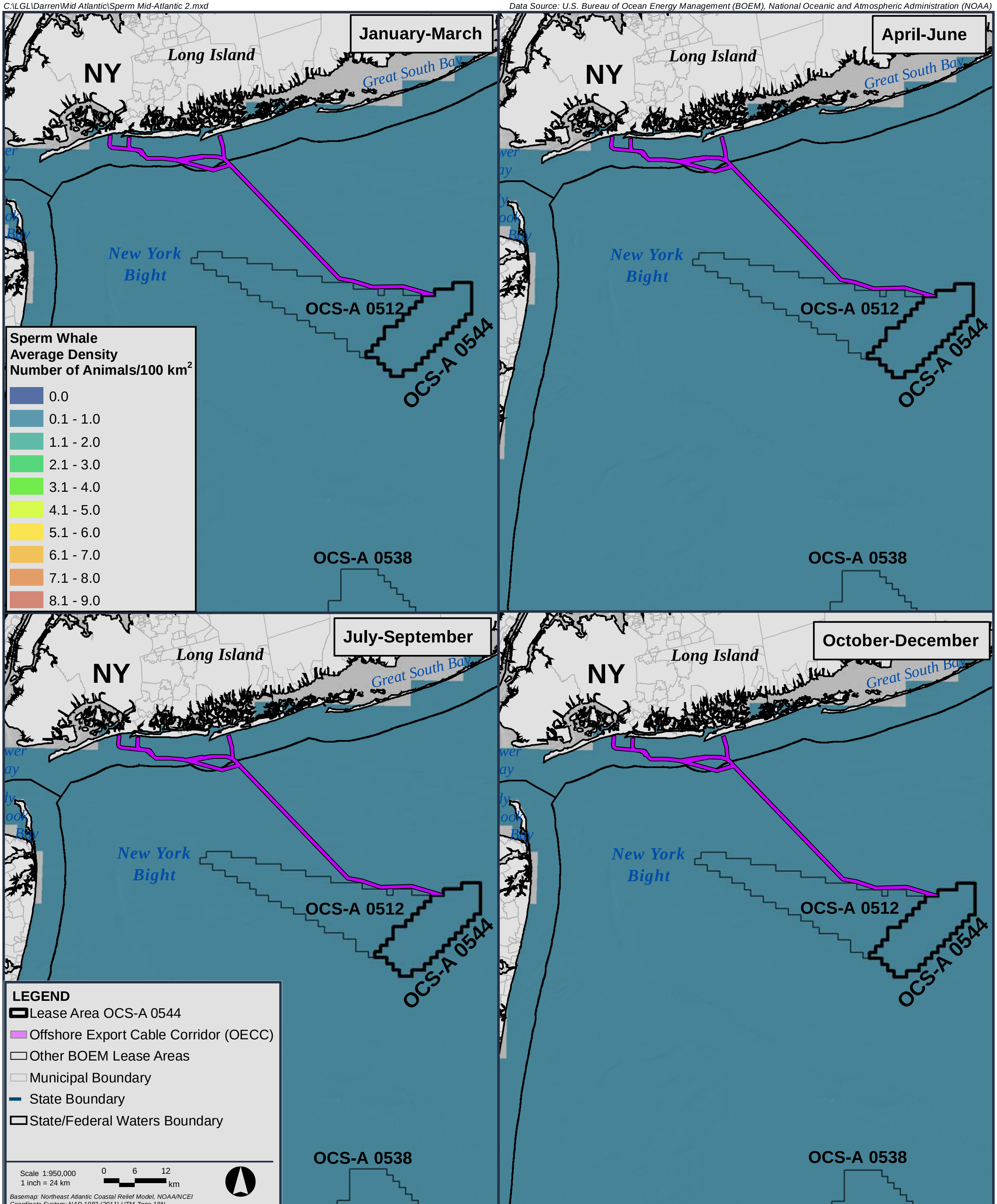

Figure 4.7-5

Map of Sperm Whale Average Seasonal Density from Roberts et al. (2016; 2022)

Status

This species is not listed under the ESA and is considered non-strategic under the MMPA because anthropogenic mortality does not exceed PBR (Hayes et al. 2020). Gray seals are listed as Least Concern by the IUCN Red List (IUCN 2020). The PBR for this population in the US is 1,512, and the annual human-caused mortality and serious injury between 2017 and 2021 was estimated to be 1,388 seals in the US (NMFS 2024). Like harbor seals, the gray seal was commercially and recreationally hunted until 1972. Mortality is currently attributed to fishery interactions, non-fishery related human interactions and hunting, research activities, Canadian commercial harvest, and removals of nuisance animals in Canada (Hayes et al. 2020). Other threats to this population include disease, predation, and natural phenomena like storms (Hayes et al. 2020). There is no designated critical habitat for this species in the Offshore Development Area.

Distribution

This species inhabits temperate and sub-arctic waters and lives on remote, exposed islands, shoals, and unstable sandbars (Jefferson et al. 2008). In the northwestern Atlantic, they occur from Labrador south to Massachusetts (King 1983). The Northwest Atlantic population of gray seals ranges from New Jersey to Labrador (Hayes et al. 2019). There are three breeding concentrations in eastern Canada: Sable Island, the Gulf of St. Lawrence, and along the east coast of Nova Scotia (Lavigueur and Hammill 1993). In US waters, gray seals currently pup at four established colonies from late December to mid-February: Muskeget and Monomoy Islands in Massachusetts, and Green and Seal Islands in Maine (Hayes et al. 2019). Pupping was also observed in the early 1980s on small islands in Nantucket-Vineyard Sound and since 2010 at Nomans Island in Massachusetts (Hayes et al. 2019). The distributions of individuals from different breeding colonies overlap outside the breeding season.

Gray seals have a documented presence most frequently in winter and spring within the New York OPA, per the NYSERDA Digital Aerial Baseline Surveys conducted from summer 2016 through winter 2019 (Normandeau and APEM Ltd. 2021). Gray seals sighted within the New York OPA occurred most often during the spring and winter months but were also documented in the fall, with the highest number documented in winter 2016 to 2017 (33 individuals). From 2019 to 2021, the Atlantic Marine Conservation Society (AMCS) has documented approximately four harbor and/or gray seal haulout sites along the Atlantic coastline of Long Island, with more scattered within Long Island Sound and off the coast of Rhode Island (AMCS 2020). The gray seal has been reported with greater frequency is waters south of Cape Cod in recent years, likely due to a population rebound in southern New England and the mid-Atlantic (Kenney and Vigness-Raposa 2009); however, most gray seals present are juveniles dispersing in the spring.

Young pups have been documented as stranded at Long Island, New York and Rhode Island beaches. The AMAPPS surveys identified 11 individuals during their winter aerial surveys (NMFS 2017; Palka et al. 2017). The overall time spent in US waters remains uncertain (Hayes et al. 2019), but the updated US population estimates make it possible that these seals will be seen around offshore New York waters. Additionally, Murray et al. (2021) tagged 30 gray seal pups in 2019 and 2020 at sites in coastal Maine and Massachusetts. Tagged pups were observed to use the Mid-Atlantic waters most heavily from January–June (Murray et al. 2021).

Historically, gray seals were relatively absent from New York, Rhode Island, Massachusetts, and nearby OCS waters. However, with the recent recovery of the Massachusetts and Canadian populations, their occurrence has increased in the US Mid-Atlantic (Kenney and Vigness-Raposa 2010). Records of gray seal strandings are primarily observed in spring and are distributed broadly along ocean-facing beaches in Long Island, New York and Rhode Island. In New York, gray seals are typically seen alongside harbor seal haulouts. Two frequent sighting locations include Great Gull Island and Fisher's Island, New York as well as Sag Harbor and Gardiners Island (Kenney and Vigness-Raposa 2010). Therefore, the gray seal is expected to have a common presence within the Offshore Development Area.

Abundance

Estimates of the entire Western North Atlantic gray seal population are not available. Some estimates are available for portions of the stock, although recent genetic evidence suggests that all Western North Atlantic gray seals may actually comprise a single stock (Hayes et al. 2020). The best available current abundance estimate for the Canadian gray seal stock is 424,300 individuals and the current US population estimate is 27,911 individuals (NMFS 2024). The population of gray seals is likely increasing in the US Atlantic EEZ; recent data show approximately 28,000 to 40,000 gray seals were observed in southeastern Massachusetts in 2015 (Hayes et al. 2020). The 2021 survey marked the first time in 60 years that the estimate of pup production has decreased on Sable Island, though total pup production in the Gulf and Scotian Shelf was not significantly different than in 2016 (NMFS 2024). Based on the most recent assessment of animals in Canada, the population increased at a rate of 1.5% per year between 2016 and 2021 (NMFS 2024).

4.7.1.4.2 Harbor Seal (Phoca vitulina vitulina)

The harbor seal is one of the smaller pinnipeds, and adults are often light to dark grey or brown with a paler belly and dark spots covering the head and body (Jefferson et al. 1993; Kenney and Vigness-Raposa 2010). This species is approximately 2 m (6 ft) in length (NMFS 2021d). Harbor seals complete both shallow and deep dives during hunting, depending on the availability of prey (Tollit et al. 1997). Harbor seals consume a variety of prey, including fish, shellfish, and crustaceans (Bigg 1981; Reeves et al. 1992; Burns 2002; Jefferson et al. 2008). They commonly occur in coastal waters and on coastal islands, ledges, and sandbars (Jefferson et al. 2008).

Male harbor seals have been documented producing an underwater roar call which is used for competition with other males and attracting mates. These are relatively short calls with a duration of about two seconds and a peak frequency between one and two kHz (Van Parijs et al. 2003). Behavioral audiometric studies for this species estimate peak hearing sensitivity between 100 Hz and 79 kHz (Southall et al. 2019).

Status

Harbor seals are not listed under the ESA or New York State ESA, are listed as Least Concern by the IUCN Red List and are considered non-strategic because anthropogenic mortality does not exceed PBR (Hayes et al. 2020; IUCN 2020). The PBR for this population is 1,729 and the annual human-caused mortality and serious injury from 2015 to 2019 was estimated to be 399 seals per year (Hayes et al. 2021). This mortality and serious injury was attributed to fishery interactions, non-fishery related human interactions, and research activities (Hayes et al. 2020). Until 1972, harbor seals were commercially and recreationally hunted. Currently, only Alaska natives can hunt harbor seals for sustenance and the creation of authentic handicrafts. Other threats to harbor seals include disease and predation (Hayes et al. 2020). There is no designated critical habitat for this species in the Offshore Development Area.

Distribution

The harbor seal is found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30°N and is the most abundant pinniped in the US Atlantic EEZ (Hayes et al. 2018). Harbor seals, also known as common seals, are one of the most widely distributed seal species in the Northern Hemisphere. They can be found inhabiting coastal and inshore waters from temperate to polar latitudes. Harbor seals occur seasonally along the coast during winter months from southern New England to New Jersey, typically from September through late May (Kenney and Vigness-Raposa 2010; Hayes et al. 2020). In recent years, this species has been seen regularly as far south as North Carolina, and regular seasonal haulout sites of up to 40-60 animals have been documented on the eastern shore of Virginia and the Chesapeake Bay (Jones and Rees 2020). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the Bay of Fundy (DoN 2005; Hayes et al. 2020). Genetic variability from different geographic populations has led to five subspecies being recognized. Peak breeding and pupping times range from February to early September, and breeding occurs in open water (Temte 1994).

While harbor seals occur year-round north of Cape Cod, they only occur during winter migration, typically September through May, south of Cape Cod (Southern New England to New Jersey) (Kenney and Vigness-Raposa 2009; Hayes et al. 2020). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the Bay of Fundy (DoN 2005).

Survey data collected from National Oceanic and Atmospheric Administration (NOAA) Fisheries and the Provincetown Center for Coastal Research reported 151 harbor seal sightings, a large concentration of which were observed near the coast from eastern Long Island, New York to Buzzards Bay and Vineyard Sound ((Center for Coastal Studies 2017; CRESLI 2020). There were also occurrences of harbor seal offshore; however, the level of abundance was lower than what was observed near haulout sites (Kenney and Vigness-Raposa 2010). A single sighting of one individual harbor seal was recorded during the NJDEP EBS surveys in shallow waters (18 m [59 ft]) during the month of June (NJDEP 2010). Additional unidentified pinnipeds were observed during the NJDEP EBS surveys; however, no further identification was made (NJDEP 2010).

There are about 30 known Long Island haulout sites, which are scattered around the eastern end of Long Island and along both sides of the Atlantic and Long Island Sound shores (Kenney and Vigness-Raposa 2010; CRESLI 2020). From 2019 to 2021, the AMCS has documented approximately four harbor and/or gray seal haulout sites along the Atlantic coastline of Long Island, with more scattered within Long Island Sound and off the coast of Rhode Island (AMCS 2020).

Seals are generally present on New York beaches from late fall until early spring (CRESLI 2020) and are most likely to be encountered at low tide. Furthermore, seal watching activities on the northeast US coastline is most prevalent from December through mid-April in New York (DiGiovanni and Sabrosky 2010). Within the last three years, seals have been sited along the Fire Island National Seashore, Cupsogue Beach County Park, Montauk Point State Park, and Smith Point County Park (Long-Island-Pulse 2017; Harrington 2020). Additionally, harbor seals instrumented with satellite tags in Virginia (2018–2022) were observed at haul-out sites in New York (Ampela et al. 2023). Based on data analysis, the haul-out sites in New York are thought to be stop-overs during the northern migration of the species (Ampela et al. 2023). Between August – December 2022 and April – September 2023, there was a single sighting of a harbor seal recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

Abundance

The best available abundance estimate for harbor seals in the Western North Atlantic is 61,336 individuals, with global population estimates reaching 610,000 to 640,000 individuals (Bjørge et al. 2010; Hayes et al. 2020; IUCN 2020; Hayes et al. 2021). Estimates of abundance are based on surveys conducted during the pupping season, when most of the population is assumed to be congregated along the Maine coast. Abundance estimates do not reflect the portion of the stock that might pup in Canadian waters (Hayes et al. 2021). Trend in population from 1993 to 2018 was estimated for non-pups and pups using a Bayesian hierarchical model to account for missing data both within and between survey years. The estimated mean change in non-pup harbor seal abundance per year was a positive from 2001 to 2004, but close to zero or negative between 2005 and 2018 (Hayes et al. 2021). After 2005, mean change in pup abundance was steady or declining until 2018 but these changes were not significant (Hayes et al. 2021).

4.7.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect marine mammals during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.7-3. This section provides an assessment of Vineyard Mid-Atlantic's activities that have the potential to behaviorally or physically disturb or harm marine mammal species expected to occur within the Offshore Development Area.

Table 4.7-3 Impact Producing Factors for Marine Mammals

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Noise	•	•	•
Vessel Activity	•	•	•
Habitat Modification	•	•	•
Presence of Structures	•	•	•
Marine Debris and Discharges/Intakes	•	•	•
Entanglement and Entrapment	•	•	•
Fisheries Survey Gear Utilization	•	•	
Electromagnetic Fields		•	
Alteration in Prey Availability	•	•	•
Suspended Sediments and Deposition	•	•	•
Artificial Light	•	•	•

Potential effects to marine mammals were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

4.7.2.1 Noise

The ability to hear and transmit sound is vital for marine mammals to perform basic life functions, such as navigating, communicating, foraging, and avoiding predators. Marine mammals use sound to gather and understand information about their environment, including detection of prey, predators, and conspecifics, and environmental conditions, such as wind, waves, and rain, as well as anthropogenic sounds (Richardson et al. 1995). Increased levels of unwanted or disturbing sounds, defined as noise, may affect marine mammals in one or more of the following ways: masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment ([temporary threshold shift [TTS] or permanent threshold shift [PTS]), or non-auditory physical or physiological effects (Richardson et al. 1995; Nowacek et al. 2007; Southall et al. 2007). The distances to which a sound travels through the water and remains audible depends on existing environmental conditions and propagation characteristics (e.g., sea floor topography, stratification, and ambient noise levels) and characteristics of the sound, such as SLs and frequency (Richardson et al. 1995). The level of impact on marine mammals will vary depending on many factors, including but not limited to:

the species and its sensitivity to the received sounds; life stage; orientation and distance between the marine mammal and the activity; the intensity and duration of the activity; and the environmental conditions affecting sound propagation.

Marine mammals could be impacted from increased levels of underwater sound associated with various construction activities including impact pile driving, vibratory pile driving, drilling, unexploded ordnances (UXO) detonation, high resolution geophysical (HRG) surveys, vessel movements, cable installation (including pre-installation activities), and aircrafts. Activities that produce sounds during O&M will be more limited and primarily related to vessel traffic, infrequent HRG surveys, and in some cases operating wind turbine generators (WTGs). The Proponent will implement several mitigation measures to reduce the level of impact from underwater sounds caused by the planned activities on marine mammals present in the Offshore Development Area.

Acoustic Thresholds Used to Evaluate Potential Effects on Marine Mammals

To assess potential auditory injury or PTS, NMFS has provided technical guidance that establishes dual criteria for five different marine mammal hearing groups, four of which are shown in Table 4.7-4. The criteria are based on measured or assumed values for the onset of TTS in marine mammals, which are also shown for impulsive sounds in Table 4.7-4. The two criteria are based on different acoustic metrics or ways of measuring sound, the peak sound pressure level (SPL_{pk}) and the cumulative sound exposure level (SEL_{cum}). The SPL_{pk} metric captures the potential for auditory injury caused by intense, instantaneous sounds while the SEL_{cum} metric captures the potential for injury caused by fatiguing of the auditory system from sounds received over time (in this case, a maximum 24-hr period). The PTS onset acoustic thresholds for marine mammals exposed to continuous sound sources (NMFS 2018) are shown in Table 4.7-5.

Many studies on marine mammal behavioral responses to sound exposure have been conducted over the past 20 years; however, there is still no consensus in the scientific community regarding the appropriate metric to assess behavioral reactions. NMFS currently uses behavioral response thresholds of 160 dB re 1 Pa for impulsive sounds and 120 dB re 1 μPa for continuous sounds for all marine mammal species (NMFS 2018), based on observations of mysticetes (Malme et al. 1983, 1984; Richardson et al. 1986, 1990).

The marine mammal hearing groups are based on the frequencies of sound and the sensitivities of the species to the frequencies in that group. The frequency-dependent hearing sensitivities of each group are characterized by frequency weighting functions that are applied to the sounds being modeled and effectively filter out sound energy at frequencies of less importance to the species in each group. Frequency weighting is applied when calculating distances to the SEL_{cum} thresholds and some behavioral thresholds, while SPL_{pk} is not frequency weighted, which is also referred to as unweighted or flat-weighted (see Table 4.7-4).

Table 4.7-4 Marine Mammal Functional Hearing Groups and PTS and TTS Thresholds for Impulsive Sounds as Defined by NMFS

Marine Mammal Hearing Group	Generalized Hearing Range	PTS onset (Level A) Thresholds (Impulsive Sounds)	TTS onset Thresholds (Impulsive Sounds)	Behavioral Harassment (Level B) Threshold (Impulsive Sounds)
Low-frequency cetaceans (LF)	7 Hz to 35 kHz	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{pk,flat}$: 213 dB $L_{E,LF,24h}$: 168 dB	$L_{p,flat}$: 160 dB
Mid-frequency cetaceans (MF)	150 Hz to 160 kHz	$L_{pk,flat}$: 230 dB $L_{E,LF,24h}$: 185 dB	$L_{pk,flat}$: 224 dB $L_{E,LF,24h}$: 170 dB	$L_{p,flat}$: 160 dB
High-frequency cetaceans (HF)	275 Hz to 160 kHz	$L_{pk,flat}$: 202 dB $L_{E,LF,24h}$: 155 dB	$L_{pk,flat}$: 196 dB $L_{E,LF,24h}$: 140 dB	$L_{p,flat}$: 160 dB
Phocid pinnipeds (underwater)	50 Hz to 86 kHz	$L_{pk,flat}$: 218 dB $L_{E,LF,24h}$: 185 dB	$L_{pk,flat}$: 212 dB $L_{E,LF,24h}$: 170 dB	$L_{p,flat}$: 160 dB

Notes:

1. $L_{pk,flat}$ = unweighted/flat-weighted peak sound pressure (dB re 1 μPa).
2. $L_{E,LF,24h}$ = Cumulative sound exposure level (dB re 1 $\mu Pa^2 \cdot s$) over a 24-hour period.
3. $L_{p,flat}$ = Unweighted/flat-weighted root mean square sound pressure (dB re 1 μPa).

Table 4.7-5 Summary of PTS Onset Acoustic Thresholds for Marine Mammals Exposed to Continuous Sound Sources (NMFS 2018)

Marine Mammal Hearing Group	Generalized Hearing Range	Frequency-weighted $L_{E,24h}$ (dB re μPa^2 s)
Low-frequency cetaceans (LF)	7 Hz to 35 kHz	199
Mid-frequency cetaceans (MF)	150 Hz to 160 kHz	198
High-frequency cetaceans (HF)	275 Hz to 160 kHz	173
Phocid pinnipeds (underwater)	50 Hz to 86 kHz	201

Scientific recommendations for revisions to these classifications were recently published by Southall et al. (2019). This publication proposes a new nomenclature and classification for the marine mammal hearing groups, but the proposed thresholds and weighting functions do not differ from those in NMFS (2018a). The hearing groups and nomenclature proposed by Southall et al. (2019) have not yet been incorporated into the NMFS guidelines.

The received level at which marine mammals may behaviorally respond to anthropogenic sounds varies by numerous factors including the frequency content, predictability, and duty cycle of the sound as well as the experience, demography, and behavioral state of the animal (Richardson et al. 1995; Southall et al. 2007; Ellison et al. 2012). Despite this variability, there is a practical need for a reasonable and specific threshold. NMFS currently defines the threshold for behavioral harassment, Level B take, as 160 dB re 1 μPa SPL_{rms} (unless otherwise noted, all dB values hereafter are referenced to 1 μPa) for impulsive or intermittent sounds, such as those produced by impact pile driving and some HRG survey equipment. For non-impulsive sounds, such as vibratory pile driving and drilling, NMFS defines the threshold for behavioral harassment at 120 dB SPL_{rms} (see Table 4.7-5).

Foundation Installation

Foundation installation is expected to require impact pile driving and may also require the use of a vibratory hammer and/or drilling. A vibratory hammer could be used to install the foundation through surficial sediments in a controlled fashion to avoid the potential for a "pile run," where the pile could drop quickly through looser surficial sediments and destabilize the installation vessel. During vibratory pile driving, longitudinal vibration motion at the hammer's operational frequency and corresponding amplitude causes the soil to liquify, allowing the pile to penetrate into the seabed. Drilling could also be required if pile driving encounters refusal (e.g., due to hard sediments, a large boulder, or bedrock). If drilling is required, a rotary drilling unit would likely be installed on top of the monopile or pin pile to remove obstructing material from the pile's interior. The modeling for foundation installation (i.e., impact pile driving, vibratory pile setting, and drilling) is described in Appendix II-E.

Studies assessing the behavioral disturbance of harbor porpoise and harbor and gray seals showed some avoidance during periods of construction activity, followed by continued use of the area after construction activities were completed (Tougaard et al. 2009a; Tougaard et al. 2009b, Bailey et al. 2010; Edrén et al. 2010; Brandt et al. 2011; Dähne et al. 2013a; Thompson et al. 2013; Russell et al. 2016; Dähne et al. 2017). Sound produced by impact pile driving noise produces low-frequency sound (generally >1 Khz), which falls on the lower end of mid-frequency cetaceans hearing range (Brandt et al. 2016; NOAA NMFS 2016). Therefore, short-term avoidance in areas where sounds are above disturbance thresholds are expected to have little overall impact on these species. Odontocete and pinniped reactions to strong impulsive sounds are variable and, at least for delphinids seals, and some porpoises, seem to be confined to a smaller radius than has been observed for some mysticetes. Bottlenose dolphins have been observed to detect pile driving noise up to 40–50 km (25-31 mi) away; however, change in behavior cannot be definitively attributed to pile driving sound (David 2006; Bailey et al. 2010).

Graham et al. (2017) reported that bottlenose dolphins spent less time in a construction area when impact or vibratory piling was occurring. The longer duration of non-impulsive sounds produced by vibratory pile driving may result in greater temporal potential for behavioral disturbance; however, responses are expected to be short-term. In a captive study assessing the effects of playbacks of vibratory piling sound on echolocation and vigilance in bottlenose dolphins, five dolphins were required to scan their enclosure and indicate the occurrences of phantom echoes during five different source levels of vibratory pile driver playback sounds: no-playback control, 100, 120, 130, and 140 dB re 1 μPa (Branstetter et al. 2018). The initial cessation of echolocation activity during the first 140 dB re 1 μPa exposure suggested a shift of attention from the task to the noise source and/or a decrease in motivation to perform the task. The continued performance decrement for the post-exposure condition, in which there was no noise exposure, suggests the animals' motivation state was a major, if not the primary, factor influencing target detection performance and vigilant behavior. Rapid acclimation to the noise exposure was demonstrated by all animals within the study.

A study of tagged harbor seals during construction of an offshore wind farm in the United Kingdom (UK) showed a reduced seal abundance up to 25 km (15 mi) away from active impact pile driving (Russell et al. 2016). However, displacement was limited to piling activity, and seals returned to non-piling distribution within two hours of cessation of pile driving (Russel et al. 2016). During pile driving activities (using both vibratory and impact techniques for sheet pile installation around a gravity-based structure) at the Nysted offshore wind farm off the coast of Denmark, a significant decrease in harbor porpoise echolocation activities and presumably abundance was reported within the construction area and in a reference area 10–15 km (6.2–9.3 mi) from the wind farm (Tougaard et al. 2006b; Teilmann et al. 2008). Carstensen et al. (2006) reported a medium-term porpoise response to construction activities in general and a short-term response to ramming/vibration activities. Porpoises appeared to have left the area during piling but returned after several days (Teilmann et al. 2006a). Porpoises at the Nysted offshore wind farm were observed to be more negatively affected by construction than those at Horns Rev off the coast of Denmark (Teilmann et al. 2006a). Two years after construction, echolocation activity and presumably porpoise abundance were still significantly reduced in the wind farm but had returned to baseline levels at the reference sites (Teilmann et al. 2006a, 2008). Teilmann et al. (2006a) speculated as to the cause of the negative effect of construction persisting longer for porpoises at Nysted than at Horns Rev. Porpoises at Horns Rev may have been more tolerant to disturbance, because the area is thought to be important to porpoises as a feeding ground; the Horns Rev area has much higher densities of animals than Nysted (Teilmann et al. 2006a). Another explanation proposed by Teilmann et al. (2006a) took into account that the Nysted wind farm is located in a sheltered area whereas Horns Rev is exposed to wind and waves with higher background noise. Thus, noise from construction may be more audible to porpoises at Nysted than at Horns Rev. Graham et al. (2017) reported that vibratory pile driving had a greater effect on reducing the probability of harbor porpoise occurrence in a construction area than impact pile driving. In general, any displacement would likely only last for the duration that the sound source is active in that location, with animals resuming regular behavior within a relatively short timeframe once the sounds stop. If a marine mammal reacts to an underwater sound by slightly changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population (New et al. 2013). Baleen whales generally tend to avoid strong impulsive sounds, but avoidance radii vary greatly, and available data are primarily from the use of seismic airgun arrays (Richardson et al. 1995; Gordon et al. 2003). Whales are often reported to show no overt reactions to impulsive sounds from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much farther distances. Some cetaceans are known to increase the source levels of their calls, shift their peak frequencies, or otherwise modify their vocal behavior (increase or decrease call rates) in response to pulsed sounds from airguns (Buck and Tyack et al. 2000; Clark and Gagnon 2006; Castellote et al. 2012; Blackwell et al. 2013; Blackwell et al. 2015). When observing migrating bowhead, humpback, and gray whales, the changes in behavior appeared to be of little or no biological consequence to the animals. Whales simply avoided the sound source by displacing their migration route to varying degrees still within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995; Dunlop et al. 2017). There has been increased concern regarding NARW displacement from foraging areas or migratory pathways due to noise (BOEM 2022). In feeding areas, displacement could lead to reduced foraging time, which may further result in a reduced body condition and health (Kraus et al. 2019). Additionally, displacement of NARW from foraging areas or migratory pathways may lead to overlap with vessel traffic and fishing activities, exposing them to increased risk of vessel strikes or entanglement (BOEM 2022). Overall, the effects of impact pile driving sounds on baleen whales are expected to be limited to short-term avoidance of areas with the highest elevated sound levels.

Marine mammals may also be affected by impact and vibratory pile driving through the masking of natural sounds. Masking is the obscuring of sounds of interest by interfering sounds, generally at similar frequencies. Introduced underwater sound will, through masking, reduce the effective listening area and/or communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Erbe et al. 2016; Tennessen and Parks 2016; Guan and Miner 2020). 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, the strength, temporal pattern, and location of the introduced sound also play a role in determining 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). Baleen whales (low-frequency cetaceans) are most vulnerable to masking by low-frequency noise, such as noise produced by vessel traffic (Richardson et al. 1995; Redfern et al. 2017). Humpback and NARW mother-calf pairs communicate quietly, likely as an anti-predator strategy, resulting in an increased vulnerability to masking (Kraus et al. 2019). Odontocetes are also vulnerable to masking. Bottlenose dolphin communication has been masked during impact pile driving activity up to 40 km from the source (Brandt et al. 2011). Harbor porpoise vocalizations were reduced up to 17.8 km (11 mi) from the impact pile driving source (Brandt et al. 2011).

The potential for masking from vibratory pile driving is expected to be less than that for impulsive sounds (e.g., impact pile driving). A recent study (Matthews et al. 2018) compared potential impacts to marine mammals from two different geophysical survey sources—a non-impulsive source, the marine vibrator (MV), and a strong impulsive source, an airgun array. Potential impacts were assessed by comparing signal level, duration, and bandwidth, which are all parameters known to contribute to masking. The MV array was found to ensonify the marine environment for periods 36–67% longer than the airgun array (Matthews et al. 2018).

The longer duration of MV sounds, relative to airgun pulses, increases the potential for MV sound to mask signals of interest to marine mammals. However, despite longer signal durations, MV arrays were found to be less likely than airgun arrays to result in masking for most species because the distances within which MV sounds may be perceived were smaller, and the main frequencies produced by the MV source did not overlap with the hearing ranges of most marine mammals (Matthews et al. 2018). The higher the peak pressure level (SPL_{pk}), cumulative sound exposure level (SEL_{cum}), and sound pressure level (SPL_{rms}) of airgun sounds means that the distances within which masking might occur were two to more than five times greater for the airgun arrays than the MV arrays (Matthews et al. 2018). Thus, the lower amplitude of non-impulsive MV sounds resulted in smaller ranges of potential masking than those predicted for airgun arrays (Matthews et al. 2018).TTS or PTS is possible when marine mammals are exposed to very intense sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds (Southall et al. 2007; Finneran 2015). There are empirical data on the sound exposures that elicit onset of TTS in captive bottlenose dolphins, belugas, porpoise, and three species of pinnipeds (Finneran 2015). Most of these data concern non-impulse sound, but there are some limited published data concerning TTS onset upon exposure to pile driving sounds (Kastelein et al. 2015; Kastelein et al. 2016). Relative to impact pile driving, vibratory pile driving is less likely to elicit PTS; however, continuous sounds may result in marine mammal TTS due to the lower sound (SPL_{rms} 120 dB), which could result in larger ensonified areas above the threshold level. There have not been any field studies that have examined TTS or PTS in free-ranging marine mammals exposed to anthropogenic sounds. However, some studies have shown that bottlenose dolphins can decrease their hearing sensitivity in order to mitigate the impacts of exposure to loud sounds (Nachtigall and Supin 2014; Nachtigall and Supin 2015; Nachtigall et al. 2016; Nachtigall et al. 2018; Finneran 2020; Kastelein et al. 2020). Such responses, as well as likely avoidance reactions of some marine mammals and the planned monitoring and mitigation measures will further reduce the already low probability of exposure of marine mammals to sounds strong enough to induce TTS or PTS.

To evaluate the potential risks to marine mammals from foundation installation noise, the Proponent conducted an underwater acoustic and animal exposure modeling analysis (see Appendix II-E). For WTG and electrical service platform (ESP) foundation installation, sound exposure modeling accounts for the movement and behavior of marine mammals and their exposure to the underwater sound fields produced. Sound exposure modeling involves the use of a three-dimensional computer simulation in which simulated animals (animats) move through the modeled marine environment over time as defined by the known or assumed movement patterns for each species. These movement patterns were derived from visual observation, animal borne tag, or other similar studies. The sound field produced by the activity is then added to the modeling environment at the location and for the duration of time anticipated for one or more pile installations. At each time step in the simulation, each animat records the received sound levels at its location resulting in a sound exposure history for each animat. These exposure histories are then analyzed to determine whether and how many animats were exposed above threshold levels. Finally, the density of animats used in the modeling environment, which is usually much higher than the actual density of marine mammals in the activity area so that the results are more statistically robust, is compared to the actual density of marine mammals anticipated to be in the activity area. The results are then used to scale the animat exposure estimates to the actual density estimates (see Appendix II-E).

The sound fields used in the exposure modeling are generated through acoustic modeling of impact and vibratory pile driving. Piles deform when driven with impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (e.g., marine mammals) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed. Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates, sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness), and the make and energy of the hammer.

Noise abatement systems (NAS), also known as noise attenuation systems, are often used to decrease the sound levels in the water near a source by inserting a local impedance change that acts as a barrier to sound transmission. Attenuation by impedance change can be achieved through a variety of technologies, such as bubble curtains, evacuated sleeve systems (e.g., IHC-Noise Mitigation System [NMS]), encapsulated bubble systems (e.g., HydroSound Dampers [HSD]), or Helmholtz resonators (AdBm NMS). The effectiveness of each system is frequency dependent and may be influenced by local environmental conditions, such as current and depth. For example, the size of the bubbles determines the effective frequency band of an air bubble curtain, with larger bubbles needed for lower frequencies. The Proponent will use AS(s) for all piling events to reduce sound levels by a target of approximately 10 dB during pile driving. As technology continues to evolve, higher levels of attenuation may be achieved. The type and number of NAS to be used during construction have not yet been determined but preference will be given to systems effective at attenuating low frequency sounds. For example, the HSD shows the highest potential for noise reduction at lower frequencies (<200 Hz) and is often seen paired with a double big bubble curtain for monopiles with large diameters (Bellmann et al. 2020).

Cofferdam Installation

At the horizontal directional drilling (HDD) offshore exit pit, a temporary cofferdam (or similar method) may be used depending on subsurface conditions and the depth of burial. If used, the cofferdams will be constructed of sheet piles likely using a vessel-mounted crane and vibratory hammer. Up to six cofferdams could be installed in total, with up to four cofferdams at a single landfall site. The cofferdams would also be removed likely using a vessel-mounted crane and vibratory hammer. The vibratory hammer would produce continuous (non-impulsive) sound.

As with vibratory pile driving during foundation installation (described above), non-impulsive sound from vibratory piling during cofferdam installation/removal may result in marine mammal take. Acoustic propagation modeling and density-based exposure estimation was conducted to estimate potential impacts to marine mammals incidental to cofferdam installation/removal at the landfall sites. The results are provided in Supplement K of Appendix II-E.

HRG Surveys

HRG surveys may be conducted to support pre-construction site clearance activities as well as post-construction facilities surveys. HRG survey equipment has the potential to be audible to marine mammals (MacGillivray et al. 2014) including those with operating frequencies below 180 kHz. HRG survey sources with operating frequencies >180 kHz are outside the hearing range of marine mammals and will not result in exceedance of received sound levels above exposure criteria as defined by (NMFS 2018b). Most types of HRG survey equipment produce impulsive sounds that could have similar effects on marine mammals as described previously for impact pile driving; however, the sounds produced by HRG survey equipment are typically at higher frequencies, lower source levels, and have a much higher repetition rate than impact pile driving. This means that any effects on the hearing ability of marine mammals (TTS or PTS) are unlikely. Since some of the HRG survey equipment proposed for use during the HRG surveys produce sounds with frequency ranges overlapping that of marine mammal hearing and vocalizations, they could result in behavioral disturbance and/or masking (Richardson et al. 1995; Nowacek et al. 2007; Southall et al. 2007). However, the impulsive nature of these sounds, limited duration of the survey activities, and short distances over which they would be audible suggest that any masking experienced by marine mammals would be highly localized and short term.

Vessel Noise

Offshore construction may occur over a period of several years, during which a number of different vessels will be utilized for transportation and installation activities within the Offshore Development Area. Vessel use will also occur during O&M and vessel activity is further described in Section 5.6. Vineyard Mid-Atlantic vessels will follow the measures outlined below under the vessel strike avoidance subheading to reduce the possible risk of injury on marine mammals. Vessel activities also introduce sound into the water that may impact marine mammals.

Sounds produced by large vessels generally dominate underwater ambient noise at frequencies from 20–300 Hz (Richardson et al. 1995). However, some sound energy is also produced at higher frequencies (Hermannsen et al. 2014); low levels of high-frequency sound from vessels have been shown to elicit responses in harbor porpoise (Dyndo et al. 2015). Ship noise, through masking, can reduce the effective communication distance of a marine mammal if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Dunlop 2015; Erbe et al. 2016; Jones et al. 2017; Putland et al. 2017; Cholewiak et al. 2018).

Baleen whales are thought to be more sensitive to sound at these low frequencies than toothed whales (e.g., MacGillivray et al. 2014), possibly causing localized avoidance of the Offshore Development Area during times with increased vessel traffic. Reactions of gray and humpback whales to vessels have been studied, and there is limited information available about the reactions of right whales and rorquals (fin, blue, and minke whales). Reactions of humpback whales to boats are variable, ranging from approach to avoidance (Payne 1978; Salden 1993). Baker et al. (1982, 1983) and Baker and Herman (1989) found humpbacks often move away when vessels are within several kilometers. Humpbacks seem less likely to react overtly when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984, 1986). Fin whale sightings in the western Mediterranean were negatively correlated with the number of vessels in the area (Campana et al. 2015). Minke whales and gray seals have shown slight displacement in response to construction-related vessel traffic (Anderwald et al. 2013). As described above (foundation installation section), NARW mother-calf pairs communicate quietly, which may result in an increased vulnerability to masking as a result of increased vessel noise (Videsen et al. 2017; Kraus et al. 2019). Additionally, analyses of NARW fecal samples indicate that noise from large commercial vessels increases their stress levels (Rolland et al. 2012).

Routine vessel activities such as transits between ports and the Lease Area or OECC are not expected to impact marine mammals, especially given the relatively high amount of vessel traffic already present in the region. As part of various construction related activities, including foundation installation, dynamic positioning (DP) thrusters may be utilized to hold vessels in position or move slowly. Sound produced through use of DP thrusters is similar to that produced by transiting vessels and DP thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities. Sound produced by DP thrusters would be preceded by, and associated with, sound from ongoing vessel noise and would be similar in nature; thus, any marine mammals in the vicinity of the activity would be aware of the vessel's presence, further reducing the potential for startle or flight responses on the part of marine mammals. Monitoring of past projects that entailed use of DP thrusters has shown a lack of observed marine mammal responses as a result of exposure to sound from DP thrusters (NMFS 2018b). Therefore, vessel sounds within the Offshore Development Area would not be at levels expected to cause anything more than possible localized and temporary behavioral changes in marine mammals and would not be expected to result in significant negative effects on individuals or at the population level.

Wind Turbine Generators (WTGs)

Operating WTGs produce low levels of sound with source levels up to 151 dB SPL_{rms} in the 60 to 300 Hz frequency range (Dow Piniak et al 2012). The sound generated by WTGs is produced within the nacelle, the enclosed housing that stores the turbine generating parts, which is then transmitted through the foundation and radiated into the water. Measurements at the Block Island Wind Farm found that sound would likely decline to ambient levels at a distance of 1 km (0.5 NM) from the WTGs and an average sound level was recorded to be between 112–120 dB when wind speed was 2–12 meters per second [m/s] (6.5–39.4 feet per second [ft/s]]) (HDR 2019). These measurements and the available literature indicate that noise generated during the operational phase of wind farms is minor and does not cause injury or lead to permanent avoidance (Wahlberg and Westerberg 2005; Bergström et al. 2013). The Vineyard Mid-Atlantic WTGs may be larger in size than those studied at the Block Island Wind Farm; however, larger turbines are expected to produce similar sound. As the size of turbines increases so does the mechanical forces working on gears and bearings. However, an increased turbine size means an increase in distance from the noise source in the nacelle to the water (Tougaard et al. 2020).

Pre-Installation and Cable Installation Activities

Prior to offshore cable installation, pre-installation activities may include debris and boulder clearance and minimal to no sand bedform leveling. Boulder clearance (if required) is expected to be accompanied by a grab tool suspended from a vessel's crane, which lifts individual boulders clear of the alignment and relocates them elsewhere within the OECC. Alternatively, a route clearance plow may be towed by a vessel along the cable alignment to push boulders aside. Sand bedform leveling may be accomplished by one or a combination of the following techniques: controlled flow excavation, offshore excavator, or a route clearance plow. Following boulder clearance and sand bedform leveling (if necessary), pre-lay surveys and pre-lay grapnel runs will be performed to verify seafloor conditions and confirm that the cable alignments are suitable for installation (free of obstructions). The pre-lay surveys are expected to be performed using multibeam echosounders and potentially magnetometers. The offshore cable will then be buried beneath the stable seafloor, likely using jetting techniques or a mechanical plow. Further detail pertaining to the pre-installation activities is included in Section 3.5.3 of COP Volume I.

Sounds from pre-installation and cable installation activities are considered non-impulsive and are not expected to produce sounds above those of routine vessel activities (see Section 4.6.2.6), and thus are not expected to result in harassment to marine mammals. The sound produced by multibeam echosounders falls outside of the range of marine mammal hearing, at or above 180 kHz, and is therefore discounted in terms of potential impacts to marine mammals. To assess the potential impacts of sand bedform leveling, sounds from dredging activities were reviewed. Dredging produces distinct sounds during each specific phase of operation: excavation, transport, and placement of sand bedform leveling material (Central Dredging Association 2011; Jiminez-Arranz et al. 2020). Engines, pumps, and support vessels used throughout all phases of pre-installation and installation activities may introduce low-level, continuous noise into the marine environment. The sounds produced during excavation vary depending on the sediment type—the denser and more consolidated the sediment is, the more force the dredger needs to impart, and the higher sound levels that are produced (Robinson et al. 2011). Sounds from mechanical dredges (such as an excavator) occur in intervals as the dredge lowers a bucket, digs, and raises the bucket. During the sediment transport phase, many factors—including the load capacity, draft, and speed of the vessel—influence the sound levels that are produced (Reine et al. 2014). SPL source levels during backhoe dredge operations range from 163 to 179 dB re 1 μPa-m (Nedwell et al. 2008; Reine et al. 2012). Dredging activities generally produce low-frequency sounds, with most energy below 1,000 Hz and frequency peaks typically occurring between 150 and 300 Hz (McQueen et al. 2018). Sound produced by dredging and other pre-installation and cable installation activities would be proceeded by, and associated with, sound from ongoing vessel noise and would be similar in nature; thus, any marine mammals in the vicinity of the activity would be aware of the vessel's presence.

Given the low source levels and transitory nature of these sources, exceedance of PTS and TTS levels are not likely for harbor seals and porpoises, according to measurements and subsequent modeling by Heinis et al. (2013). For other marine mammal species, PTS is not likely, but if dredging continues in one area for relatively long periods, TTS and behavioral thresholds could be exceeded (Todd et al. 2015). Behavioral reactions and masking of low-frequency calls in baleen whales and seals are considered more likely to occur due to the low-frequency spectrum over which the sounds occur. Of the few studies that have examined behavioral responses from dredging noise, most have involved other industrial activities, making it difficult to attribute responses specifically to dredging noise (e.g., Bryant et al 1984). Some found no observable response (e.g., for beluga whales; Hoffman 2012), while others showed avoidance behavior (bowhead whales in a playback study of drillship and dredge noise in Richardson et al. (1999). Diederichs et al. (2010) found short-term avoidance of dredging activities by harbor porpoises near breeding and calving areas in the North Sea. Pirotta et al. (2013) found that, despite a documented tolerance of high vessel presence, as well as high availability of food, bottlenose dolphins spent less time in the area during periods of dredging. The study also showed that with increasing intensity in the activity, bottlenose dolphins avoided the area for longer durations (with one instance being as long as 5 weeks; Pirotta et al. 2013). Brief behavioral effects or acoustic masking over small spatial scales may occur for baleen whales (including the NARW) due to the low-frequency nature of these sound sources. Masking and behavioral reactions from dredging may be more likely for baleen whales and pinnipeds due to the low-frequency spectrum over which the sounds occur and the overlap with their best hearing sensitivity. While behavioral responses may occur from pre-installation and cable installation activities, they are expected to be short term and of low intensity. In particular, minimal to no sand bedform leveling is anticipated and therefore this activity (if required) will be of a short duration. Therefore, pre-installation and cable installation activities are expected to have negligible impacts on mysticetes (including the NARW), odontocetes, and pinnipeds.

Offshore Cable Installation and Cable Operation

During offshore cable installation, mechanical or water jetting equipment may be used to install the cable, but it is expected to produce intermittent sound at relatively low levels. Cable installation may involve vessels that use DP thrusters. As discussed above in the section on vessel noise, the impacts of noise exposure associated with the use of DP thrusters is expected to be low because noise from those vessels is likely to be similar to or less than the background vessel traffic noise in the area.

If high-voltage alternating current (HVAC) offshore cables are installed, they are expected to generate non-impulsive, low-frequency tonal vibration sound in the water. High voltage direct current (HVDC) cables do not produce a similar tonal sound because the current is not alternating. The sound pressure levels expected to be produced during HVAC cable operations are likely undetectable within the ambient soundscape of the Offshore Development Area (Meibner et al. 2006).

Aircraft

Aircraft may be used for a variety of activities during construction, O&M, and decommissioning. In addition to vessels, helicopters may be used for crew transfer and visual inspections of the offshore facilities. Fixed-wing aircraft or drones (autonomous underwater/surface vessels or aerial drones) may be used to support environmental monitoring and mitigation. Helicopters produce sound that could be audible to marine mammals. Sounds generated by aircraft, both fixed wing and helicopters, are produced within the air, but can transmit through the water surface and propagate underwater. In general, underwater sound levels produced by fixed wing aircraft and helicopters are typically low-frequency (16-500 Hz) and range between 84-159 dB re 1 µPa (Richardson et al. 1995; Patenaude et al. 2002; Erbe et al. 2018). Most sound energy from aircraft reflects off the air-water interface; only sound radiated downward within a 26-degree cone penetrates below the surface water (Urick 1972). Aircraft noise is typically in the low- to mid-frequency ranges used by marine mammals and therefore has the potential to cause temporary change in behavior and localized displacement of marine mammals to the extent it transmits from air through the water surface (Richardson et al. 1985a; Richardson and Würsig 1997; Nowacek et al. 2007).

Consistent with how sound from aircraft may enter the water, marine mammals tend to react to aircraft noise more often when the aircraft is lower in altitude, closer in lateral distance, and flying over shallow water (Richardson et al. 1985b; Patenaude et al. 2002). Temporary reactions by marine mammals include short surfacing, hasty dives, aversion from the aircraft or dispersal from the incoming aircraft (Bel'kovich 1960; Kleĭnenberg et al. 1964; Richardson et al. 1985a; Richardson et al. 1985b; Luksenburg and Parsons 2009). The response of cetaceans to aircraft noise largely depends on the species as well as the animal's behavioral state at the time of exposure (e.g., migrating, resting, foraging, socializing) (Würsig et al. 1998). A study conducted in the Beaufort Sea in northern Alaska observed a general lack of reaction in bowhead and beluga whales to passing helicopters (Patenaude et al. 2002). Patenaude et al.

(2002) reported behavioral response by only 17% of the observed bowhead whales to passing helicopters at altitudes below 150 m (492.1 ft) and within a lateral distance of 250 m (820.2 ft). Similarly, most observed beluga whales did not show any visible reaction to helicopters passing when flight altitudes were over 150 m (492.1 ft) (Patenaude et al. 2002). Although the sound emitted by aircraft has the potential to result in temporary behavioral responses in marine mammals, aircraft used within the Offshore Development Area would only occur at low altitudes over water during takeoff and landing at an offshore location where one or more vessels are located. Due to the intermittent nature and the small area potentially ensonified by this sound source, the potential for disturbance of marine mammals is expected to be negligible. Thus, the use of helicopters to conduct crew transfers or inspections is likely to provide an overall benefit to marine mammals in the form of reduced vessel activity and associated ship strike risk.

Potential Detonation of UXO and/or Discarded Military Munitions (DMM)

As described in Section 3.10.2 of COP Volume I, if potential UXO and/or DMM are discovered in the Lease Area or OECC, the Proponent will prioritize avoidance of UXO/DMM wherever possible by micro-siting structures and cables around the object. Where avoidance is not possible (e.g., due to layout restrictions, presence of archaeological resources, etc.), UXO/DMM will be relocated or otherwise disposed of (e.g., via deflagration [burning without detonating], detonation, or dismantling the UXO/DMM to extract explosive components). At present, Vineyard Mid-Atlantic is conservatively estimating three UXO detonations in the OECC and two within the Lease Area.

Underwater detonations create broadband impulsive sounds with high peak pressures and rapid rise times (Richardson et al. 1995). UXO/DMMs with more net explosive weight will produce higher peak pressures (see Supplement J of Appendix II-E). At close ranges, these sounds have the potential to cause non-auditory injury to marine mammals and at longer ranges, auditory injury and behavioral disturbance are possible. The unique nature of sounds and pressure into the water column from underwater detonations, including the high peak pressure levels and the fact that they are typically just a single impulsive event, means threshold criteria for UXO/DMMs detonations are different than for other anthropogenic sounds. The greatest risk of injury for marine mammals is assumed when the animal is located at the same depth or slightly elevated above the explosion (Brand 2021). Injuries from the shock wave can include a sudden increase in cerebrospinal fluid pressure, middle and inner ear damage, and/or lung and intestinal hemorrhaging. Significant masking effects would be unlikely during UXO/DMMs explosions given the intermittent nature of these sounds and short signal duration (Madsen et al. 2006).

Most UXO assessment work in the US has been performed by or for the US Navy, who have worked closely with NMFS to choose and define appropriate criteria for effects based on the best available science. Effects thresholds were based on three key sound pressure metrics as indicators of injury and behavioral disturbance: unweighted peak compressional pressure level (L_{pk}), frequency-weighted sound exposure level (SEL or $L_{E,W}$), and acoustic impulse (J_p).

The onset of PTS (auditory injury) and TTS (behavioral disturbance) were assessed using a dual criteria of L_{pk} and frequency-weighted SEL $L_{E,w.}$ All SEL modeling assumed a single detonation per day as the assessment criteria. For non-auditory injury and mortality, ranges to injury thresholds were calculated using metrics (L_{pk} and J_p) representing onset of injury to animal's lungs and gastrointestinal tracts from compression-related injury of tissues near enclosed air volumes or gas bubbles (blast shock pulse).

Underwater acoustic modeling of detonations of UXO/DMM occurring within the Offshore Development Area was conducted. Technical details of the modeling methods, assumptions, and results can be found in Supplement J of Appendix II-E.

Avoidance, Minimization, and Mitigation Measures for Noise

Seasonal Restrictions

The Proponent does not intend to conduct pile driving between January 1 and April 30 when higher numbers of NARW are expected to be present in the Offshore Development Area. This will reduce the potential impacts to NARW and other species with similar seasonal presence in the region. To concentrate impact pile driving during the remainder of the year, the Proponent may start (or continue) pile driving at night and/or in poor visibility conditions. To support activities in these conditions, additional monitoring and mitigation measures will also be proposed.

Noise Abatement System (NAS)

Pile driving NAS are effective in reducing sound propagated into the surrounding marine environment. Several recent studies summarizing the effectiveness of NAS have shown that broadband sound levels are likely to be reduced by anywhere from seven to 17 dB, depending on the environment, pile size, and the size, configuration and number of systems used (Buehler et al. 2015; Bellmann et al. 2020a). Recent *in situ* measurements during installation of large monopiles (~8 m) for WTGs in comparable water depths and conditions indicate that attenuation levels of 10 dB are readily achieved for a single bubble curtain (Bellmann 2019; Bellmann et al. 2020b). Large bubble curtains tend to perform better and more reliably, particularly when deployed with two rings (Koschinski and Ludemann 2013; Bellmann 2014; Nehls et al. 2016; Bellmann et al. 2020a). A California Department of Transportation study tested several small, single, bubble curtain systems and found that the best NAS resulted in 10–15 dB of attenuation (Buehler et al. 2015). Buehler et al. (2015) concluded that attenuation greater than 10 dB could not be reliably predicted from small, single bubble curtains because sound transmitted through the seabed and re-radiated into the water column is the dominant sound in the water for bubble curtains deployed immediately around the pile. Combinations of systems (e.g., double big bubble curtain, hydrosound damper plus single big bubble curtain) could potentially achieve much higher attenuation. The Proponent will use NAS(s) to reduce sound levels by a target of approximately 10 dB during pile driving. The type and number of NAS to be used during construction have not yet been determined, but preference will be given to systems effective at attenuating low frequency sounds. For example, the HSD shows the highest potential for noise reduction at lower frequencies (<200 Hz) and is often seen paired with a double big bubble curtain for monopiles with larger diameters (Bellmann et al. 2020).

Sound Field Verification (SFV)

To assess the efficacy of mitigation measures like NAS and to determine the distance of pre-defined acoustic thresholds, the Proponent proposes to conduct sound field verification (SFV) when construction commences. SFV involves the measurement of underwater sounds produced by pile driving at various distances from the piles. The specific SFV framework will be further developed as the permitting of Vineyard Mid-Atlantic progresses, but it is expected that sound measures will be taken for a minimum of one of each of the pile types for comparison with modeling results.

PSOs and Trained Observers

The Proponent will contract qualified, trained PSOs to conduct marine mammal monitoring during all pile driving and HRG survey activities throughout the construction, O&M, and decommissioning phases. All PSOs will have met Bureau of Ocean Energy Management (BOEM) and NMFS training and/or experience requirements as stipulated in the Vineyard Mid-Atlantic BOEM lease. PSO duties will include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the installation vessels, support vessels, and pile driving and certain other noise generating activities; and documenting exposure to sound levels that may result in impacts to marine mammals. PSOs will not have any further responsibilities while on duty.

Other personnel working offshore will receive environmental training, which will stress individual responsibility for marine mammal awareness and reporting as well as marine debris awareness.

Visual Monitoring

PSOs will conduct observation from the best available safe vantage point on the construction or nearby support vessel to ensure visibility of the pre-start clearance and shutdown zones (as defined below). The observers will scan systematically with the unaided eye, standard handheld (7x) and/or high magnification (25x) binoculars to search continuously for marine mammals during all observation periods. When a marine mammal is observed, PSOs will record all relevant information, regardless of the distance from the construction activity. As described further below, when a marine mammal is seen within or about to enter the pre-start clearance and/or shutdown zone applicable to that species, the pile installation crew will be notified immediately so that the appropriate mitigation measures can be implemented. Additionally, a PAM system is expected to be utilized to supplement visual monitoring during pre-start clearance and pile driving periods to allow initiation of pile driving when visual PSOs are unable to observe the entire pre-start clearance zone due to poor visibility. The specifics of the PAM system will be determined in consultation with BOEM and NMFS.

Should nighttime pile driving occur, a PAM system as well as PSOs using night vision devices (NVD) and infrared (IR) thermal imaging cameras would be used to monitor the pre-start clearance and/or shutdown zones and implement any necessary mitigation measures.

Pre-start Clearance and Shutdown Zones

As practicable, pre-start clearance and shutdown zones will be established to minimize and avoid potential impacts of underwater sound on marine mammals during pile driving, drilling, certain HRG survey activities for sources operating below specified frequencies (i.e., based on species' hearing ranges), and UXO/DMM detonation (if required). Pre-start clearance zones are typically zones in which marine mammal observations are conducted for a specified period prior to the commencement of the noise-generating activity. The duration and distance of the pre-start clearance zone will vary by marine mammal hearing group. If a marine mammal is observed either visually or acoustically within or about to enter the applicable species-specific pre-start clearance zone, the activity will be delayed or will not begin, and the observed animal will be allowed to leave the pre-start clearance zone on their own volition.

A shutdown zone is an area surrounding pile driving, drilling, and certain HRG activities that may be defined relative to Level A Harassment Zones (as defined in NMFS 2018) or based on other criteria as appropriate. The size of Level A Harassment zones is based on environmental conditions and marine mammal hearing groups (see Table 4.7-4), and biologically appropriate and practicable zones vary by individual species. If a marine mammal is detected within or about to enter the applicable shutdown zone for that species, PSOs will request a shutdown of pile driving. The shutdown would stop pile driving if the lead installation engineer determines that doing so would not jeopardize the installation outcome, human safety, or vessel safety. If shutdown is determined to not be technically feasible due to human safety concerns or to maintain installation feasibility, a reduction in hammer energy of the greatest extent possible will be assessed and implemented. Pile driving will only be reinitiated after a shutdown once the pre-start clearance zones are confirmed to be clear of marine mammals for the defined minimum species-specific periods.

Ramp-up and Soft-start Procedures

A soft-start method will be followed at the beginning of pile driving events while ramp-up measures will be followed at the initiation of HRG survey operations. Soft-start measures are intended to allow for a gradual increase in sound levels before the full pile driving hammer energy is reached. This provides a "warning" to marine mammals in the area and allows time for them to move away, avoiding any potential injury or impairment of their hearing abilities. Soft-start measures will be used at the beginning of each pile driving event or any time pile driving has stopped for longer than 30 minutes. If a marine mammal is detected within or about to enter the shutdown zone (either visually or acoustically) during the soft-start procedure, pile driving will be delayed unless it is determined by the lead installation engineer that doing so would jeopardize the installation outcome or risk human or vessel safety. The duration of a delay in the soft-start procedure would be determined using the same procedure described above for detections within the shutdown zone during the pre-start clearance period.

Equipment and Technology

The Proponent will consider the best currently available technology to mitigate the potential impacts and result in the least practicable adverse impacts during construction, O&M, and decommissioning. This includes a variety of marine mammal detection and sound mitigation methodologies. Examples of potential technologies include PAM recorders, thermal cameras, and NAS. The Proponent will collaborate with BOEM and NMFS to integrate practicable technology choices in equipment, mitigation, and monitoring to meet the necessary standards for permitting and successful consultations.

4.7.2.2 Vessel Activity

Offshore construction, O&M, and decommissioning within the Offshore Development Area may occur over a period of several years. During this time, many different vessels will be utilized, as further described in Section 5.6. The potential for vessel strike is one of the primary threats to marine mammals (Redfern et al. 2013). Mitigation and monitoring measures, as described below, will be implemented during construction, O&M, and decommissioning to reduce the risk of vessel strike to the maximum extent possible.

The greatest potential for vessels to interact with marine mammals will be during transits to and from the Offshore Development Area. Expected use of vessels during construction and O&M, including the anticipated number of vessel trips and representative vessel types, is described in Sections 3.10.4 of and 4.4.2 of COP Volume I.

Studies suggest that vessel collisions pose a greater threat to baleen whales than to other marine species due to their size, mobility, and surface behavior (Kraus et al. 2005; Parks et al. 2011; Davies and Brillant 2019). Vessel collision has been documented as the leading cause of mortality for NARW since the 1970s (Moore et al. 2006). Generally, the number of vessel strike on marine mammals are thought to be an underestimate due to underreporting and loss of carcasses related to predation, rapid deterioration, and water currents (Barkaszi et al. 2021). Research indicates that most vessel collisions with whales resulting in serious injury or death occur when a ship is travelling at speeds over 26 km/hr (14 kts) (Laist et al. 2001). Conn and Silber 2013 and Wiley et al. (2016) concluded that reducing ship speed is one of the most reliable ways to avoid ship strikes. Similarly, Currie et al. (2017) found a significant decrease in close encounters with humpback whales in the Hawaiian Islands, and therefore reduced likelihood of ship strike, when vessels speeds were below 23 km/hr (12.5 kts).

Shallow-diving cetaceans and seals may be at higher risk of vessel strikes due to a greater amount of time spent at the surface than deep-diving species. Similarly, whale calves and juveniles comprise a greater proportion of vessel strikes than adults, which may be caused by the relatively large amount of time that they spend at the surface or in shallow coastal areas (Laist et al. 2001). Humpback, NARW, and fin whale are the most susceptible cetacean species to vessel strike (Laist et al. 2001; NMFS 2023d).

Several studies have reported a shift in the distribution and behavior of marine mammals in high traffic areas (Erbe 2002; Jelinski et al. 2002; Nowacek et al. 2004). Therefore, increased vessel activity associated with construction could result in marine mammals avoiding the area, which would reduce the risk of collision with oncoming vessels, but the potential for vessel collision may increase if whales are displaced into higher shipping traffic areas (such as commercial shipping corridors) by sound from impact pile driving. This issue is of greatest concern for the NARW. Displacement from foraging areas or migratory pathways due to noise could increase NARW overlap with vessel traffic and fishing activities, leading to a greater risk of vessel strike and fisheries interaction (e.g., entanglement; BOEM 2022).

To minimize the potential for vessel interactions with marine mammals, trained visual observers aboard each vessel will maintain a vigilant watch for all marine mammals, and vessel operators will slow down or maneuver their vessel, as appropriate, to avoid striking protected species. Vessel operators and/or observers aboard each vessel will monitor NMFS NARW reporting systems at least once per day for the presence of NARW.

The Proponent will follow NMFS guidelines for vessel strike avoidance, including vessel speed restrictions and separation distances, that are applicable at the time of construction and operations.[52] Current NMFS guidelines for survey vessel separation distances are summarized below:

- Vessels will maintain separation distances of >500 m (1,640 ft) from all ESA-listed whales (including NARW) or large unidentified whales.

- Vessels will maintain separation distances of >100 m (328 ft) from all other large whales (e.g., humpback whales).

- Vessels will maintain, to the greatest extent possible, separation distances of >50 m (164 ft) from all other marine mammals, with the exception of delphinids and pinnipeds that approach the vessel, in which case the vessel operator must avoid excessive speed or abrupt changes in direction.

[52] Except where following these requirements would put the safety of the vessel or crew at risk.

Current NMFS guidelines for separation distances for all other vessel types are summarized below:

- Vessels will maintain separation distances of >500 m (1,640 ft) from NARW or large unidentified whales.
- Vessels will maintain separation distances of >100 m (328 ft) from all other (non-NARW) baleen whales and sperm whales.
- Vessels will maintain, to the greatest extent possible, separation distances of >50 m (164 ft) from all other marine mammals, with the exception of delphinids and pinnipeds that approach the vessel, in which case the vessel operator must avoid excessive speed or abrupt changes in direction.

With respect to vessel speed restrictions, all vessels will comply with the final amendments to the North Atlantic Right Whale Vessel Strike Reduction Rule at 50 CFR Part 224. All vessel speeds will be reduced to 18.4 km/hr or less (≤10 kts) when mother/calf pairs, pods, or large assemblages of marine mammals are observed.

Reporting of Dead or Injured Marine Mammals

Reporting of dead or injured marine mammals observed during construction and O&M activities, and the actions taken immediately after an observation, will vary depending on the likely cause of the incident. If a marine mammal is injured or killed as a result of Vineyard Mid-Atlantic activities, that activity will be stopped immediately, as long as it can be accomplished safely. Once the activity(ies) are stopped, the incident will be reported as required by permits or guidance from relevant agencies.

4.7.2.3 Habitat Modification

Temporary to long-term seafloor disturbance may occur from the installation, maintenance, and decommissioning of foundations (for the WTG and ESP), scour protection, export cables, inter-array and inter-link cables, and cable protection (if required). Long-term habitat modification may result from installation of foundations, scour protection, and cable protection (if required). Additional temporary habitat modification may result from installation, maintenance, and decommissioning of export, inter-array, and inter-link cables; pre-installation activities (such as a pre-lay grapnel run, boulder clearance, etc.); and usage of equipment that contacts the seafloor (such as jack-up vessels, vessel anchors or spud legs). Additional details are available in Section 3.11 of COP Volume I.

In accordance with Proponent’s lease stipulations, the WTGs and ESP(s) will be oriented in west-northwest to east-southeast rows and north to south columns with 1.3 km (0.68 NM) spacing between positions. Such large distances between individual foundations will minimize the extent of marine mammals being prevented from using natural habitat, including migration and feeding. All seafloor disturbance and associated suspended sediments is expected to be short-term and temporary with minimal effects on marine mammal habitat or prey items.

Regarding habitats of concern, NOAA's Office of National Marine Sanctuaries is in the early stages of the process to designate a new National Marine Sanctuary in Hudson Canyon off the coast of New York and New Jersey. The Hudson Canyon is 88 km (47 NM) from the closest point of the Offshore Development Area. No Vineyard Mid-Atlantic vessels are expected to transit through the Hudson Canyon or the potential Sanctuary, when designated. Additionally, as described in Appendix II-E, the maximum exposure ranges to injury and behavioral thresholds do not exceed ~15 km (8 NM) for nearly all marine mammals (the only exception is harbor porpoise with a maximum exposure range to behavioral thresholds of 47 km [25 NM]; see Appendix II-E) and therefore impacts associated with pile driving noise will not reach waters within the Hudson Canyon or potential Sanctuary.

4.7.2.4 Presence of Structures

The presence of foundations (monopiles and piled jackets), scour protection, and cable protection will result in a conversion of the existing primarily sandy bottom habitat to a hard bottom habitat with areas of vertical structural relief (Wilhelmsson et al. 2006; Reubens et al. 2013; Bergström et al. 2014; Coates et al. 2014; Kaldellis et al. 2016; Degraer et al. 2020). Artificial structures can create increased habitat heterogeneity important for species diversity and density (Langhamer 2012; Smyth et al. 2015). The WTG and ESP foundations will extend through the water column, which may serve to increase settlement of meroplankton or planktonic larvae on the structures in both the pelagic and benthic zones (Boehlert and Gill 2010). As further described in Section 4.7.2.9, fish and invertebrate species are also likely to aggregate around the foundations and scour protection which could provide increased prey availability and structural habitat (Boehlert and Gill 2010; Bonar et al. 2015). Increased resources around offshore wind farms would in turn contribute to greater foraging resources for fish and zooplankton predators, attracting marine mammals (Barnette 2017; Fernandez-Betelu et al. 2022).

The presence of offshore wind structures (WTGs, ESPs, and their associated foundations [monopiles for WTGs and monopiles or jackets for ESPs]) is expected to alter atmospheric and oceanographic processes to a limited extent, as discussed in Section 3.2.2.4. The extraction of energy from the wind creates a downstream wake effect where wind speeds are reduced and there is less wind stress at the sea surface boundary. Similarly, the presence of structures in the water will create turbulence in the water column around and downstream of the structures as currents move past the structures. Some studies of these effects at European wind farms suggest that the magnitude of effect is likely to be small relative to natural processes, while other studies have produced contradictory results showing greater or lesser impacts. One recent modeling study cited by those raising concerns suggests that large scale physical oceanographic effects from development of multiple wind farms could result in changes to ecosystem dynamics within the North Sea (Christiansen et al. 2022). However, the North Sea is a shallow-water environment with primarily wind-driven currents (Sünderman and Pohlmann 2011) where wake effects in the atmosphere are likely to have a greater impact. Thus, modeling results from that region should not be translated directly to the oceanographic conditions of the New York Bight, which includes tidal-diurnal flows and a longshore current flowing towards the west along Long Island (see Appendix II-B). Other differences, including the spacing and size of turbines installed in the North Sea compared to those being considered off New York, further exacerbate the comparison.

In their assessment of whether the presence of structures (WTGs, ESPs, and associated foundations) may alter physical oceanographic patterns, Miles et al. (2017) conducted laboratory measurements and found that water flows are reduced immediately downstream of foundations but return to ambient levels within a relatively short distance (BOEM 2023a). The downstream area affected by reduced flows is dependent on pile diameter. For monopiles, effects are expected to dissipate within 91 to 122 m (300 to 400 ft) (BOEM 2023a). Hub height and oceanographic conditions (e.g., currents, stratification, depth) also influence physical oceanographic impacts of foundations. Individual foundations may increase vertical mixing and deepen the thermocline, potentially increasing pelagic productivity locally (English et al. 2017; Kellison and Sedberry 1998; BOEM 2023a). In their modeling study, Johnson et al. (2021) found that offshore wind structures have the potential to deepen the thermocline in the wind farm area by 1 to 2 m (3.3 to 6.6 ft) and may lead to a greater retention of cooler water in the wind farm area during the summer.

Though individual structures installed as part of Vineyard Mid-Atlantic are expected to have highly localized physical oceanographic effects, potential changes in primary productivity due to these effects may occur and they may also alter typical distributions of fish and invertebrates at various life stages (including zooplankton) on the OCS, which are normally driven by primary productivity associated with cold pool upwelling (Matte and Waldhauer 1984; Lentz 2017; Chen et al. 2018; BOEM 2023a). Any potential alterations to primary productivity could have impacts on marine mammal prey species. However, there have been varied results in the studies that assess these potential impacts (BOEM 2023a). The vertical structures in the water column associated with WTG and ESP foundations may increase vertical mixing driven by currents flowing around the foundations (Carpenter et al. 2016; Schultze et al. 2020; Christiansen et al. 2022). While this mixing could affect shelf sea systems especially in seasonally stratified waters, enhanced mixing may also positively affect some marine ecosystems (Dorrell et al. 2022). During times of stratification (e.g., summer), increased mixing due to the presence of structures could potentially result in increased pelagic primary productivity (English et al. 2017; Degraer et al. 2020). However, this increased primary productivity may not result in increases in marine mammal prey species due to the increased productivity being consumed by filter feeders colonizing the structures (Maar et al. 2009; Slavik et al. 2019). Overall, potential physical oceanographic effects to prey species such as zooplankton are likely localized and are not likely to measurably affect the availability of prey resources for marine mammals (BOEM 2024).

4.7.2.5 Marine Debris and Discharges/Intakes

In accordance with applicable federal, state, and local laws, comprehensive measures will be implemented prior to and during construction, O&M, and decommissioning activities to avoid, minimize, and mitigate impacts related to marine debris disposal. Any items that may become marine debris will be appropriately discarded onshore and disposed of or recycled at a licensed waste management and/or recycling facility. The law prohibits any solid waste disposal or marine debris at sea. The Proponent will require vessel operators, employees, and contractors who engage in offshore activities to participate in a marine trash and debris prevention training program.

Vineyard Mid-Atlantic includes either HVAC or HVDC ESP(s). HVAC equipment can be air cooled, whereas HVDC equipment requires water cooling. After leaving the heat exchangers, the warmed seawater will be discharged below the water's surface through pipes that are attached to the foundation. The Proponent will be conducting an assessment of any potential thermal impacts as part of the National Pollutant Discharge Elimination System (NPDES) permitting process for the cooling water intake structure. Any thermal impacts to water quality or marine organisms are anticipated to be limited to the immediate area surrounding the discharge. Drifting plankton in the vicinity may experience stress or mortality primarily due to water temperature changes; however, any impacts are expected to be spatially limited (BOEM 2024), with large areas of the surrounding water mass unaffected. Such limited thermal impacts are not likely to measurably affect the availability of prey resources for marine mammals.

The potential effects from the intake of HVDC cooling water includes entrainment of zooplankton and ichthyoplankton (prey items of marine mammals) and intake association/attraction if prey become aggregated on intake screens (BOEM 2024). As discussed in Section 4.6, due to the expected intake volume and because more than 25% of the intake volume will be used for cooling, the Proponent plans to conduct an assessment of potential entrainment and impingement as part of the NPDES permitting process for the cooling water intake structure. Through this process, best available technology for minimizing impacts will be further considered. For example, intake screen designs can be modified to reduce intake velocities, so it is expected that impingement will not be a significant impact for most prey species.

To estimate the impacts of entrainment from an HVDC cooling water intake structure (CWIS), an assessment using anticipated flow rates and local zooplankton data was completed as described in Appendix II-N. Model results provided estimates of the composition and magnitude of intake mortality for ichthyoplankton and other zooplankton. As described further in Appendix II-N, the water usage rate and total intake volume used for the initial entrainment analysis are still considerably lower than most similarly-sized traditional fossil fuel power plants. Based on the magnitudes of the results, ecological and socioeconomic effects from the entrainment of plankton as marine mammal prey by the HVDC CWIS will likely be minimal.

Section 7.5 includes additional discussion of potential impacts from marine debris and accidental releases and discharges, as well as measures that will be adopted to avoid, minimize, or mitigate potential impacts to marine mammals.

4.7.2.6 Entanglement and Entrapment

Entanglement risk to marine mammals is not expected to occur as a result of the Vineyard Mid-Atlantic activities, including fisheries monitoring surveys (see Section 4.7.2.7). The Proponent will use steel anchor cables on construction vessels, which will be taut during deployment, eliminating the potential for entanglement of marine mammals. Additionally, metocean buoys and anchor or tow lines used during cable installation will be kept taut at all times; therefore, if a marine mammal comes in contact with the line, entanglement risk will be eliminated. No underwater cables are expected to result in entanglement risk; these cables have large diameters and will be buried to target cable burial depth beneath the stable seafloor of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters.[53] WTG and ESP structures themselves are not expected to pose entanglement risk to marine mammals due to the large, static nature of the structures (Inger et al. 2009). However, WTG and ESP structures may cause a secondary entanglement risk to marine mammals through ghost gear and/or marine debris caught on the structures themselves. Species with larger appendages (e.g., humpback whales) have a greater risk of entanglement with ropes, lines, and cables that are used for fishing gear. The structures have large monopile or piled jacket diameters, without protrusions, preventing much of the ghost gear and/or marine debris from being snagged on the structures. The Proponent will inspect the foundations and scour protection at regular intervals for the presence of marine debris (see Section 4.2.2 of COP Volume I) and will remove ghost gear and/or marine debris which may result in the entanglement of marine mammals.

4.7.2.7 Fisheries Survey Gear Utilization

A draft preliminary fisheries monitoring plan for pre-, during, and post-construction fisheries surveys has been developed for Vineyard Mid-Atlantic and is included as Appendix II-U. A preliminary list of potential surveys includes:

- Seasonal trawl survey following the Northeast Area Monitoring and Assessment Program (NEAMAP) survey protocol;

- Baited remote underwater video;

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[53] Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

- Highly migratory species acoustic telemetry;
- Drop camera survey;
- Hydraulic surfclam dredge survey; and/or
- Ecosystem monitoring plankton survey.

The number of surveys to be conducted is expected to be a subset of those listed above and in Appendix II-U. Further refinement will be based on future research and agency and stakeholder feedback. Fisheries monitoring surveys are anticipated to be carried out by qualified scientists.

Marine mammals can ingest or become entangled in fisheries survey gear. Most recorded marine mammal entanglements are directly or indirectly attributable to ropes and lines associated with fishing gear (Benjamins et al. 2014; Harnois et al. 2015; McIntosh et al. 2015). Depending on the severity, entanglement can lead to reduced foraging and swimming capacity and eventual mortality due to injury or drowning. Entanglement in fishing gear is listed as a threat to all of the mysticete, odontocete, and pinniped species in the Offshore Development Area (Hayes et al. 2020, 2022, 2023; NMFS 2024) with evidence of fishery interactions causing injury or mortality for each of these species in the Greater Atlantic Regional Fisheries Office/NMFS entanglement/stranding database (Hayes et al. 2022, 2023; NMFS 2024). 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. Several commercial fisheries have documented bycatch, with the most common recorded bycatch occurring with pelagic longlining, bottom trawling, and sink gillnetting (Hayes et al. 2020, 2021); however, pelagic longlining and sing gillnetting will not be used for biological monitoring for Vineyard Mid-Atlantic.

Bottom trawling gear may be used for biological monitoring, as it has been for other offshore wind projects and regional monitoring programs, but unlike in commercial fishing, mysticete, odontocete, and pinniped entanglement is unlikely to affect marine mammals at the population level. Fisheries monitoring plans developed for offshore wind activities require coordination and permitting with the appropriate federal agencies and would follow BOEM's guidance for fisheries surveys *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf* (BOEM 2023b), which includes risk-reduction measures consistent with NMFS recommendations. The Proponent will obtain authorization under the Marine Mammal Protection Act for fisheries survey gear utilization, which will further specify mitigation procedures and minimization measures to reduce potential impacts to negligible levels. In addition, there have been no documented entanglement cases associated with biological monitoring for Block Island wind farm, the CVOW-Pilot Project, or the Vineyard Wind 1 Project (BOEM 2024).

Mitigation Measures

To protect marine mammals and avoid or minimize the risk of entanglement or capture of marine mammals, all fisheries monitoring surveys for Vineyard Mid-Atlantic will be conducted in accordance with appropriate mitigation measures. These mitigation measures are detailed in Appendix II-U and summarized here. Gear will not be deployed if there is a risk of interaction with marine mammals. Marine mammal monitoring will be conducted prior to deploying gear, throughout the duration of gear deployment (unless on-demand gear), and for 15 minutes after haul back. If a marine mammal(s) is sighted within 1.8 km (1 NM) of the planned location and 15 minutes before gear deployment, the gear deployment will be suspended until there are no sightings of marine mammals for at least 30 minutes within 1.8 km (1 NM) of the sampling station or the vessel operator will move the vessel away from the marine mammal to a different section of the sampling area. Additionally, all fixed gear will comply with the Atlantic Large Whale Take Reduction Plan regulation (50 CFR § 229.32) during fisheries monitoring surveys. Finally, any survey-related lines will have weak links and/or a breaking strength of less than 771 kg (1,700 pounds).

Given the implementation of these mitigation measures, minimal risk to marine mammals is expected from fisheries monitoring surveys.

4.7.2.8 Electromagnetic Fields

Electromagnetic fields (EMFs) are areas of electric and magnetic energy that occur naturally but may also be caused by anthropogenic sources. In the context of offshore wind farms, EMFs are mainly produced by power export cables carrying electricity to shore (Copping et al. 2020). Certain marine mammals are capable of detecting naturally occurring EMFs (Kirschvink et al. 1986; Walker et al. 1992; Walker et al. 2003; Vanselow et al. 2009; Granger et al. 2020). EMFs consist of two components: electric fields and magnetic fields. Due to cable configuration and shielding, electric fields are not expected in the marine environment from Vineyard Mid-Atlantic cables and the intensity of any generated magnetic fields will be minimized through cable burial or the placement of cable protection.

Limited research has been conducted on the impacts of EMF on marine mammals. The studies which have been conducted demonstrate cetaceans are unlikely to be affected by subsea cable EMFs. Kirschvink et al. (1990) observed statistical increases in strandings near naturally occurring EMFs as well as behavioral disturbances such as altered migration routes and short-term changes in swim direction. Behavioral changes were not observed in harbor porpoises exposed to operating subsea cable EMFs (Walker 2001; Gill et al. 2005; Slater et al. 2010). Species that feed near the benthos have been observed to be at greater risk to behavioral disturbance due to EMF exposure than those that feed in the water column (Normandeau Associates et al. 2011). Species likely to occur within the Offshore Development Area are not benthic foragers. Nonetheless, as further described in Section 4.5.2.4, modeling of magnetic fields from potential Vineyard Mid-Atlantic cables was completed and the model results indicate that magnetic fields are likely only able to be sensed, if at all, directly over the buried cable centerline. Because they breathe at the sea surface and have large migratory ranges, marine mammals would not be expected to spend significant amounts of time at the seafloor in the vicinity of specific submarine export cables. Accordingly, the area potentially affected by magnetic fields created by Vineyard Mid-Atlantic's offshore cables is likely too small to result in behavioral and/or displacement of cetaceans within the Offshore Development Area (Normandeau Associates et al. 2011; Gill et al. 2014; Copping et al. 2016). Thus, EMFs associated with Vineyard Mid-Atlantic's offshore cable system are not expected to impact marine mammals.

4.7.2.9 Alteration in Prey Availability

The marine mammal species found within the Offshore Development Area feed on various pelagic and benthic fish species, cephalopods, and crustaceans. Elevated noise levels, installation of structures that disturb the seafloor and other factors associated with Vineyard Mid-Atlantic vessels and equipment may cause some prey species to leave the immediate area of operations, temporarily reducing the availability of prey within the area and thus potentially disrupting feeding and behavior. Displaced prey species are expected to return shortly after construction is completed. Although pathological or physiological effects are also possible (Hawkins and Popper 2017; Weilgart 2017), the number of prey items affected would be a very small percentage of the stocks available in the region.

The most common behavioral responses by fish to anthropogenic noise are avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Vabø et al. 2002; Handegard and Tjøstheim 2005; Sarà et al. 2007; Becker et al. 2013). Increased sound levels from the construction activities have the potential to temporarily affect local prey populations, which might indirectly affect marine mammals by altering prey abundance, behavior, and distribution (McCauley 2003; Popper and Hastings 2009; Slabbekoom et al. 2010; Danil and St. Leger 2011; von Benda-Beckmann et al. 2015). Marine fish are typically sensitive to noise in the 100 to 500 Hz range, which coincides with the primary frequency range of vessels and pile driving activities. Noise generated by impact pile driving, as well as other Offshore Development Area activities, has the potential to elicit behavioral responses in fish, and impact pile driving has the potential to cause injury or even mortality as a result of the high peak pressure levels near the source (Yelverton et al. 1975; Hastings and Popper 2005). Any effects from construction sounds are anticipated to be limited to the time during which the sounds are produced and relatively short distances from the sound source.

During the O&M phase, numerous studies have documented significantly higher fish concentrations including species like cod and pouting (*Trisopterus luscus*), flounder (*Platichthys flesus*), eelpout (*Zoarces viviparus*), and eel (*Anguila anguilla*) near the foundations than in surrounding soft bottom habitat (Langhamer and Wilhelmsson 2009; Bergström et al. 2013; Reubens et al. 2013). The presence of the foundations and resulting fish aggregations is expected to be a long-term habitat impact, but the increase in prey availability could potentially be beneficial for marine mammals. Pinnipeds and some odontocete species are likely to benefit the most from increases in the availability of prey species that are attracted to the physical structures. Numerous surveys at offshore wind farms, oil and gas platforms, and artificial reef sites have documented increased abundance of smaller odontocete, and pinniped species attracted to the increase in pelagic fish and benthic prey (Hammar et al. 2010; Lindeboom et al. 2011; Mikkelsen et al. 2013; Russell et al. 2014; Arnould et al. 2015). Currently there are no quantitative data on how large whale species (i.e., mysticetes) may be impacted by offshore wind farms (Kraus et al. 2019). Given the likely benefits to some marine mammal species from increased prey abundance, overall impacts to marine mammal habitat are anticipated to be negligible.

4.7.2.10 Suspended Sediments and Deposition

Temporary increases in suspended sediments and subsequent sediment deposition may occur in the Lease Area and OECC from the installation, maintenance, and decommissioning of export cables, inter-array cables, inter- link cables, foundations, scour protection, and cable protection. The majority of these activities would occur during construction with potential for limited activities during O&M if cables require repair or maintenance; however, any maintenance impacts would be expected to be far less than those from construction activities. Impacts from suspended sediments and deposition would be temporary and confined to a small area close to the location of the installation or maintenance activity. Sediment plume modeling conducted for the Block Island Wind Farm resulted in a larger modeled plume than the actual sediment plume, without any evidence of the jet plow causing a sediment plume in the water column (Elliot et al. 2017). Further description of the potential for suspended sediments and deposition is provided in Section 3.2.

Areas affected by temporarily suspended sediments are likely to overlap with areas impacted by pile driving and offshore cable installation. Marine mammals are likely to avoid such areas as previously described and are likely to be absent in areas impacted by temporarily suspended sediments before sediments are settled at the bottom. Suspended sediment and deposition causing activities within the Offshore Development Area are not expected to pose a risk to marine mammals.

4.7.2.11 Artificial Light

Artificial lighting will be required during the construction, O&M, and decommissioning of the Offshore Development Area. During construction and decommissioning, there will be a temporary increase in lighting from construction equipment and vessels with navigational, deck, and interior lights. During O&M, WTGs and ESP(s) will be lit in compliance with applicable Federal Aviation Administration (FAA), US Coast Guard, BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) guidelines for lighting and marking. Vessel use and associated lighting will also occur, though at a significantly lower frequency than during construction and decommissioning. Other temporary lighting (e.g., helicopter hoist status lights on WTGs, helipad lights on the ESP[s], temporary outdoor lighting on the ESP[s] if any maintenance occurs at night or during low-light conditions) may be used for safety when necessary.

Vessels transiting to or working within the Offshore Development Area will utilize artificial lighting as required by vessel regulations, with small amounts of downward-focused lighting that could penetrate the water. Similarly, navigational lighting on structures placed in the Offshore Development Area will be close to sea level and some light could penetrate into the water. Artificial light that enters the water may result in attracting or deterring certain prey species of marine mammals (e.g., finfish and invertebrates). However, the amount of artificial lighting that penetrates the sea surface is expected to be minimal and localized from vessels and structures. Therefore, artificial light is unlikely to have a large enough effect to cause adverse impacts to marine mammals or their prey species.

Lighting at the top of WTG structures for aviation safety will likely be too high above sea level to penetrate the water surface, meaning it is unlikely to cause adverse impacts to marine mammals or their prey species. Further, Vineyard Mid-Atlantic will minimize lighting by using an Aircraft Detection Lighting System (ADLS) or similar system that automatically activates all aviation obstruction lights when aircraft approach the structures. The use of an ADLS will substantially reduce the amount of time that the aviation obstruction lights are illuminated.

4.7.2.12 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to marine mammals during Vineyard Mid-Atlantic are summarized in Table 4.7-8. Fisheries monitoring survey mitigation measures are presented in Section 4.7.2.7.

Table 4.7-6 Summary of Monitoring and Mitigation Measures

Category	Description
Seasonal Pile Driving Restrictions	
Seasonal pile driving restrictions	• The Proponent does not intend to conduct pile driving between January 1 and April 30.
Noise Abatement System	
Noise abatement system	• The Proponent expects to implement NAS(s) to reduce sound levels by a target of approximately 10 dB during pile driving.
Protected Species Observers (PSOs) and Trained Observers	
Observer qualification and training	• The Proponent will contract qualified, trained PSOs to conduct marine mammal monitoring during pile driving, HRG surveys, and UXO/DMM (if necessary) mitigation activities. • Personnel working offshore will receive environmental training, stressing individual responsibility for marine mammal awareness and reporting as well as marine debris awareness (see Training section).
Visual Monitoring	
Visual monitoring methods	• PSOs will conduct observations from the best available safe vantage point on the construction vessel or nearby support vessel to ensure visibility of the pre-start clearance zones. • When conducting observations during pile driving, PSOs will scan systematically with the unaided eye, using standard handheld (7x) and/or high magnification (25x) binoculars to search continuously for marine mammals during all observation periods. • When a marine mammal is observed, PSOs will record all relevant information, regardless of the distance from the construction activity.
Nighttime visual monitoring methods	• During nighttime operations, a PAM system as well as PSOs using night vision devices and infrared thermal imaging cameras would be used to monitor the pre-start clearance and/or shutdown zones and implement any necessary mitigation measures.
Ramp-up and Soft-start Procedures	
Ramp-up and soft start	• Soft-start measures will be used at the beginning of each pile driving event or any time pile driving has stopped longer than 30 minutes. • Ramp-up measures will be followed at the beginning of HRG survey operations.

Table 4.7-6 Summary of Monitoring and Mitigation Measures (Continued)

Category	Description
Ramp-up and Soft-start Procedures (Continued)	
Ramp-up and soft start	• If a marine mammal is detected within or about to enter the shutdown zone (either visually or acoustically) during the soft-start procedure, pile driving will be delayed unless it is determined by the lead engineer that doing so would jeopardize the installation outcome or risk human or vessel safety.
Equipment Technology	
Equipment	• The Proponent will consider the best currently available technology to mitigate the potential impacts and result in the least practicable adverse impacts to marine mammals during construction, O&M, and decommissioning.
Vessel Strike Avoidance	
General measures	• Vessel operators and/or observers aboard each vessel will monitor NMFS NARW reporting systems at least once per day for the presence of NARW.
Survey vessel separation distances	• Vessels will maintain separation distances of >500 m (1,640 ft) from all ESA-listed whales (including NARW) or large unidentified whales. • Vessels will maintain separation distances of >100 m (328 ft) from all other large whales (e.g., humpback whales). • Vessels will maintain, to the greatest extent possible, separation distances of >50 m (164 ft) from all other marine mammals, with the exception of delphinids and pinnipeds that approach the vessel, in which case the vessel operator must avoid excessive speed or abrupt changes in direction.
All other vessel separation distances	• Vessels will maintain separation distances of >500 m (1,640 ft) from NARW or large unidentified whales. • Vessels will maintain separation distances of >100 m (328 ft) from all other (non-NARW) baleen whales and sperm whales. • Vessels will maintain, to the greatest extent possible, separation distances of >50 m (164 ft) from all other marine mammals, with the exception of delphinids and pinnipeds that approach the vessel, in which case the vessel operator must avoid excessive speed or abrupt changes in direction.
Speed reduction	• With respect to vessel speed restrictions, all vessels will comply with the final amendments to the North Atlantic right whale Vessel Strike Reduction Rule at 50 CFR Part 224. • All vessel speeds will be reduced to 18.4 km/hr or less (≤10 kts) when mother/calf pairs, pods, or large assemblages of marine mammals are observed.

Table 4.7-6 Summary of Monitoring and Mitigation Measures (Continued)

Category	Description
Reporting of Dead or Injured Marine Mammals	
Reporting	• Reporting of dead or injured marine mammals observed during construction and O&M activities, and the actions taken immediately after an observation, will vary depending on the likely cause of the incident. • If a marine mammal is injured or killed as a result of Vineyard Mid-Atlantic's activities, that activity will be stopped immediately, so as long as this can be accomplished safely. Once the activity(ies) are stopped, the incident will be reported as required by permits or guidance from relevant agencies.
Siting	
Siting	• In accordance with Proponent's lease stipulations, foundations will be oriented in an west-northwest to east-southeast grid pattern with 1.25 km (0.677 NM) spacing between WTG/ESP positions.
Marine Debris	
Marine debris	• In accordance with applicable federal, state, and local laws, comprehensive measures will be implemented prior to and during construction, O&M, and decommissioning activities to avoid, minimize, and mitigate impacts related to marine debris disposal. • The Proponent will require vessel operators, employees, and contractors who engage in offshore activities to participate in a marine trash and debris prevention training program (see Training section).
Reduced Entanglement Risk	
Reduced entanglement risk	• The Proponent will use steel anchor cables on construction vessels. • Lines will remain taut. • Fisheries surveys will incorporate mitigation measures to minimize and avoid the risk of entanglement. Gear will not be deployed if there is a risk of interaction with marine mammals. Marine mammal monitoring will be conducted prior to deploying gear, throughout the duration of gear deployment (unless on-demand gear), and for 15 minutes after haul back.

Table 4.7-6 Summary of Monitoring and Mitigation Measures (Continued)

Category	Description
Training	
Training	• Vineyard Mid-Atlantic will provide Site Induction Training to all vessel personnel, construction personnel, survey personnel, and the marine mammal monitoring team prior to the start of all in-water construction activities and as new personnel, as listed above, join Vineyard Mid-Atlantic. • All vessel personnel, construction personnel, survey personnel, and the marine mammal monitoring team will receive Protected Species Identification and Reporting training, Marine Trash and Debris Prevention training, Fisheries Protocols training, Dedicated Visual Observer (VO) training, Vessel Speed and Vessel Strike Avoidance training, and Communications training. • The training will be recorded on a course log sheet to document the training. The course log sheet will be reported to NMFS. • The third-party PSO and PAM analyst provider(s) will provide a suite of formal observer and analyst training. In addition to the Vineyard Mid-Atlantic Site Induction Training, all PSOs and PAM analysts will receive a standard suite of training from the PSO and PAM analyst provider, which may include, but is not necessarily limited to PSO Certification training and project-specific construction training. The standard training will also include a two-day refresher training course with the respective PSO and PAM analyst provider and at least one Vineyard Mid-Atlantic Project Compliance representative present prior to the start of in-water construction activities each year. • All PSO and PAM analysts, PSO and PAM provider Project Leads and Project Managers, will participate in a Vineyard Mid-Atlantic led Rehearsal of Concept (ROC) style drill with Vineyard Mid-Atlantic Compliance and relevant engineering personnel prior to the start of in-water activities. ROC drills will be designed to test the knowledge of all project personnel to ensure in-depth understanding of all permit requirements.

4.8 Sea Turtles

This section addresses the potential impacts of Vineyard Mid-Atlantic on sea turtles in the Offshore Development Area. An overview of the affected environments and sea turtle species is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to sea turtles during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

4.8.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

As listed in Table 4.8-1, there are four species of sea turtles that routinely occur in the Western North Atlantic outer continental shelf (OCS) region: loggerhead sea turtles (*Caretta caretta*), green sea turtles (*Chelonia mydas*), Kemp's ridley sea turtles (*Lepidochelys kempii*), and leatherback sea turtles (*Dermochelys coriacea*). The populations of loggerhead and green sea turtles that occur in the Offshore Development Area are listed as threatened under the Endangered Species Act (ESA) and Kemp's ridley and leatherback sea turtles are listed as endangered. None of these species are year-round residents of the northern Mid-Atlantic Bight(MAB), but they seasonally forage and migrate through these waters during the summer and autumn months.

Table 4.8-1 Sea Turtles that Could be Present in the Offshore Development Area

Common Name (Species Name) and Stock	Stock/Distinct Population Segments[1]	Regulatory Status	Habitat	Occurrence in the New York Bight	Abundance
Green sea turtle *(Chelonia mydas)*	North Atlantic distinct population segments (DPS)	Threatened	Coastal and Continental Shelf	Uncommon	167,424 mature females[1]
Kemp's ridley sea turtle *(Lepidochelys kempii)*	Not Applicable (N/A)	Endangered	Coastal and Continental Shelf	Uncommon (Summer and fall)	28,133 9+ year old females[2]

Table 4.8-1 Sea Turtles that Could be Present in the Offshore Development Area (Continued)

Common Name (Species Name) and Stock	Stock/Distinct Population Segments[1]	Regulatory Status	Habitat	Occurrence in the New York Bight	Abundance
Leatherback sea turtle *(Dermochelys coriacea)*	Atlantic	Endangered	Coastal and Continental Shelf	Common (Summer and fall)	20,659 nesting females[3]
Loggerhead sea turtle *(Caretta caretta)*	Northwest Atlantic DPS	Threatened	Coastal and Continental Shelf	Common (Summer and fall)	40,000 – 60,000 individuals in the Northwest Atlantic[4]

Notes:

1. Seminoff et al. (2015)
2. Gallaway et al. (2016)
3. NMFS and USFWS (2020)
4. NEFSC and SEFSC (2011)

4.8.1.1 Loggerhead Sea Turtle (Caretta caretta)

The loggerhead sea turtle is widely distributed, occurring in tropical, subtropical, and temperate waters of the Atlantic, Pacific, and Indian oceans (Valverde and Holzwart 2017). Adults generally forage in coastal and shelf waters but can pass through oceanic waters during migrations. This species' distribution extends into more temperate waters than other sea turtles and is the most abundant sea turtle species found in the United States (US) Atlantic (TEWG 2009).

Loggerhead sea turtles are among the largest of the hard-shelled Cheloniidae sea turtles, with carapace lengths (CLs) reaching 120 centimeters (cm) (47 inches [in]) (TEWG 2009). They have a reddish-brown carapace, with a dull brown integument (outer protective layer) dorsally and a light-to-medium yellow integument ventrally (Conant et al. 2009). When in pelagic habitats, juvenile loggerheads feed on invertebrates associated with pelagic *Sargassum* as well as salps and jellyfish (Bjorndal 1997). Once they reach a size of 40–60 cm (16–24 in) CL, they recruit to coastal and inshore waters of the continental shelf throughout the US Atlantic to feed on a wide range of animals at the seafloor and within the water column, including crabs, mollusks, jellyfish, and vegetation at or near the surface (Bjorndal 1997). Loggerhead sea turtles spend approximately 3.8% of the time (or 2.3 minutes per hour) at the surface and are otherwise submerged, foraging, or resting (Thompson 1988). Adults generally forage in coastal and shelf waters but can pass through oceanic waters during migrations.

Status

Loggerhead sea turtles are listed as threatened under the US ESA and are listed as threatened in the state of New York and endangered in New Jersey. Nine distinct population segments (DPSs) comprise the loggerhead sea turtle species, as listed under the ESA. Five loggerhead DPS are listed as endangered (North Pacific, South Pacific, North Indian, Northeast Atlantic, and Mediterranean Sea) and four are listed as threatened (Northwest Atlantic, South Atlantic, Southeast Indo-Pacific, and Southwest Indian). These DPSs are genetically distinct and, in some cases, each DPS exhibits further genetic differentiation among nesting sites that warrant consideration as subregional management units. Based on genetic samples obtained from fisheries interactions, loggerheads that seasonally occur within the Offshore Development Area are likely all from the Northwest Atlantic DPS (Stewart et al. 2019). The Northwest Atlantic DPS is the world's largest DPS of loggerhead turtles, and only one other management region (Northwest Indian Ocean) has comparable nesting numbers (Wilson et al. 2020), and these two regions combined account for 90% of global loggerhead nesting (Witherington et al. 2009).

There are ten subregional management units within the Northwest Atlantic DPS, which include nesting aggregations along (1) Virginia through northeastern Florida, (2) central eastern Florida, (3) southeastern Florida, (4) Dry Tortugas, Florida, (5) Cay Sal, Bahamas, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012). The greatest abundance of loggerhead nesting occurs at central eastern and southeastern Florida beaches (~75% of nesting for the entire DPS) (Stewart et al. 2019). Genetic analyses of 683 loggerhead turtles caught as bycatch north of Cape Hatteras indicated that smaller turtles (straight carapace lengths [SCL] < 63 cm [25 in]) are primarily from Central East Florida (64%) with minor contributions from Southeast Florida, Northwest Florida, and Quintana Roo, Mexico. Larger turtles (SCL > 63 cm [25 in]) within this region are primarily from Southeast Florida (44%), the northern US (33%), Central East Florida (12%), and Quintana Roo, Mexico (5%) (Stewart et al. 2019).

Like other sea turtle species along the US Atlantic Coast, loggerhead turtles are vulnerable to multiple anthropogenic impacts, including habitat loss, pollutant ingestion, climate change and bycatch.

Distribution

Loggerhead sea turtle distribution in the Northwest Atlantic is influenced by water temperature and water depth (BOEM 2012). Results from the Cetacean and Turtle Assessment Program (CeTAP) aerial surveys found that 84 percent of loggerhead sea turtle sightings occurred in waters less than 80 meters (m) (262.5 feet [ft]) suggesting that they prefer shallow waters (CeTAP 1982). During the Atlantic Marine Assessment Program for Protected Species (AMAPPS) shipboard surveys, loggerhead sea turtles were observed within the New York Bight in summer and fall but tended to be absent during the winter months and spring months (Palka et al. 2021). During AMAPPS aerial surveys conducted from June–September 2021, 148 sightings of 161 individual loggerhead sea turtles were observed near the Offshore Development Area (NEFSC and SEFSC 2022). Loggerhead was the most abundant sea turtle species off the New York coast observed during aerial surveys conducted by the New York State Energy Research and Development Authority (NYSERDA) with a common presence in the Offshore Development Area in summer and a rare occurrence in the region during other seasons (Normandeau and APEM Ltd. 2021). The MAB of the Northwest Atlantic continental shelf region is a seasonal foraging area for loggerheads. Loggerhead thermal habitat and seasonal duration will likely increase in northern regions of the northwestern Atlantic shelf. This change in spatiotemporal range for sea turtles in a region of high anthropogenic use may prompt adjustments to the localized protected species conservation measures (Patel et al. 2021).

Neither the Offshore Development Area nor the surrounding waters of the MAB are considered Critical Habitat for loggerhead sea turtles. Critical Habitat within coastal waters extends from western Mississippi through North Carolina and juvenile Critical Habitat associated with pelagic *Sargassum* algae extends from Texas to the oceanic waters (>200 m [656 ft] deep) offshore of Maryland. Nonetheless, loggerhead turtles were regularly observed in waters in the northern MAB by manned aerial surveys and the NYSERDA Digital Aerial Baseline Surveys, predominantly in the summer (Normandeau and APEM Ltd. 2021). Surveys of the northern MAB found that loggerhead sea turtles occur throughout the region, with the most sightings during the summer and fall months (over 92% of sightings occurred in August and September). Similarly, the predicted monthly densities of loggerhead sea turtles in the Offshore Development Area and surrounding waters are highest from June–October with the peak density in October (DiMatteo et al. 2023). During August – December 2022 and April – September 2023, there were 22 visual sightings of loggerhead sea turtles recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

Abundance

The complex nature of sea turtle dive-surfacing behavior can lead to results from abundance surveys that are site-specific, ambiguous, and highly variable. Previous aerial surveys have estimated that between approximately 40,000 and 60,000 loggerheads seasonally inhabit the northwest Atlantic, particularly the MAB. For context, between approximately 500,000 and 1,000,000 loggerheads inhabit the South Atlantic Bight (NEFSC and SEFSC 2011). Owing to the limited time loggerheads spend at the surface and given that turtles < ~40 cm (16 in) SCL are typically unobservable, these may be underestimates (Hatch et al. 2022). Stable isotope analysis and satellite telemetry distribution data indicate that 30–50% of loggerheads that nest and reside along the US eastern seaboard seasonally forage within the MAB (Ceriani et al. 2017). For instance, ~84% of the turtles that nest in the northern US management unit likely forage in the MAB (Pfaller et al. 2020). For a major nesting beach in central east Florida, ~25%

of nesting turtles forage in the MAB regions (Ceriani et al. 2017). Given data that suggest Florida hosts a nesting population of ~51,319 turtles (Ceriani et al. 2019), such percentages imply the MAB is an important foraging ground for adult, female loggerheads and that loggerhead sea turtles should be expected to occur in the vicinity of the Offshore Development Area in summer and fall.

4.8.1.2 Green Sea Turtle (Chelonia mydas)

Green sea turtles are globally distributed, occurring primarily in tropical and subtropical waters, though occasionally extending into more temperate regions (Valverde and Holzwart 2017). Adults and larger juveniles typically forage in coastal waters. The green sea turtle is the largest of the hard-shelled turtles but has a comparatively small head and exceeded in size only by the leatherback (Valverde and Holzwart 2017). A typical adult is 90 to 120 cm (35 to 47 in) SCL and weighs 130 to 160 kilograms (kg) (287 to 353 pounds [lbs]). They have dark brown, grey, or olive colored shells and a much lighter, yellow-to-white underside. Green turtles have a serrated beak on the lower jaws which they use to forage on seagrasses and macroalgae. The life history of green turtles involves a series of stages of development from hatchling to adult. After emerging from the nest, hatchlings swim to offshore areas, where they live for several years in pelagic habitats. Juveniles leave the open ocean habitat after three to five years and travel to nearshore foraging grounds in shallow coastal habitats, where they mature to 20 to 35 years old and may live for at least 70 years. Every two to five years they undertake reproductive migrations and return to nest on a beach in the general area where they hatched decades earlier.

<u>Status</u>

Green sea turtles were listed under the ESA in 1978 and subsequently separated into two ESA-listing designations: endangered for breeding DPSs in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range (81 FR 20058 2016). Green sea turtles are also listed as threatened under New York and New Jersey state law. On April 6, 2016, National Marine Fisheries Service (NMFS) listed 11 DPSs of green sea turtle. Three DPSs are endangered (Central South Pacific, Central West Pacific, and Mediterranean) and eight are threatened (Central North Pacific, East Pacific, North Atlantic, South Atlantic, East Indian-West Pacific, North Indian, Southwest Indian, Southwest Pacific). The primary DPS known to occur in the Offshore Development Area, the North Atlantic DPS, is listed as threatened.

<u>Distribution</u>

Green sea turtles are generally considered a species that occurs in the tropics and subtropics; the only Critical Habitat for green turtles of the North Atlantic DPS is around Culebra Island, east of Puerto Rico. Even so, green turtles regularly occur within the MAB, as indicated from stranding records and satellite telemetry data. Green turtles that were rehabilitated after becoming cold-stunned in the northern MAB and subsequently released from Long Island, New York with satellite transmitters showed use of the waters of Long Island Sound through months of July through October (Robinson et al. 2020). These turtles transitioned to southern or offshore waters during the months of January through June. Compared to similarly tracked loggerhead and Kemp's ridley turtles, green turtles occupied warmer waters (Robinson et al. 2020). Green turtles routinely cold stun north of the Offshore Development Area (e.g., in Cape Cod) and would thus at least intermittently migrate through this area.

NYSERDA surveys only detected a single green turtle off the New York coast (Normandeau and APEM Ltd. 2021). There were recorded observations of green turtles within the New York Bight during the summer in the AMAPPS shipboard surveys conducted from 2010-2017 (Palka et al. 2021). During AMAPPS aerial surveys conducted from June–September 2021, 13 sightings of 13 individual green sea turtles were observed near the Offshore Development Area (NEFSC and SEFSC 2022). Of the cold stunned green turtles that were rehabilitated and subsequently tracked by Robinson et al. (2020), only 2 of the 12 were a size that might be detectable from aerial surveys (42.0 and 58.9 cm [16.5 and 23.2 in] SCL), suggesting that abundances may be higher than indicated by aerial surveys. One hundred forty-seven green sea turtle observations were recorded in Sea Turtle Stranding and Salvage Network (STSSN) reports of New York and New Jersey waters from 2019-2022, though these reports are not always updated regularly (SEFSC 2023). Observations included 112 cold-stunning events in the months of November and December. As the DPS continues to increase (owing to protections and demographic momentum) and waters in the MAB continue to warm (owing to climate change) more green turtles in this region may be expected. The predicted monthly densities of green sea turtles in the Offshore Development Area and surrounding waters are highest from June–September with the peak density in September (DiMatteo et al. 2023). During August – December 2022 and April – September 2023, there were no visual sightings of green sea turtles recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

Abundance

The North Atlantic DPS is estimated to have 167,424 mature females at 73 nesting sites. Nesting occurs across the southeastern US, Mexico, and the wider Caribbean with the center of abundance, more than 100,000 mature females, nesting at Tortuguero, Costa Rica (Seminoff et al. 2015). The homing behavior of green turtles results in detectable genetic structure across regions within the DPS; however, genetics-based estimates of the contributions of individual nesting beaches to the waters in the MAB do not appear to be available. For the waters around North Carolina, green turtles primarily originate from beaches in Mexico (30.6%), Florida (25.9%), and Costa Rica (25.9%), with smaller percentages (<5%) from other locations in the Caribbean, South America, and West Africa (Putman and Naro-Maciel 2013). Given the ocean circulation patterns and the locations of green turtle nesting sites relative to major current systems, similar relative contributions could be expected for the northern MAB as well (Putman and Naro-Maciel 2013). Throughout the North Atlantic, green turtle abundance appears to be increasing, including the recruitment of juvenile green turtles to the eastern US coast (Putman et al. 2020a).

4.8.1.3 Kemp's Ridley Sea Turtle (Lepidochelys kempii)

Kemp's ridley sea turtles are the smallest of the Chelonidae species, with CLs reaching 70 to 75 cm (27 to 29 in) (Shaver et al. 2016; Avens et al. 2017). It has a triangular-shaped head and a nearly circular-shaped carapace that is almost as wide as it is long. The carapace is grayish-green in color, integument coloration is olive-gray dorsally and light yellow ventrally. The plastron (bottom shell) is a pale cream-white (76 FR 58781). Kemp's ridley are notable among sea turtles for their restricted in-water and nesting distributions. They show similar habitat transitions between life history stages, with hatchlings located primarily offshore and adults spending their time in nearshore habitats (76 FR 58781; USFWS and NMFS 2015). When in pelagic habitats, juvenile Kemp's ridleys feed on small invertebrates associated with pelagic *Sargassum* such as mollusks and crabs (Bjorndal 1997). Once they recruit to nearshore habitats, their diet often includes crabs, though they are opportunistic and will eat other benthic invertebrates and fish (especially discards from shrimp trawl bycatch). Kemp's ridleys spend approximately 11% of their time at the surface and are otherwise submerged, foraging, or resting (Renaud 1995). Kemp's ridley sea turtles typically forage and migrate close to the coastline and in shallow water depths of <50m (154 ft) (Shaver et al. 2016).

<u>Status</u>

The Kemp's ridley sea turtle was listed as endangered in 1970 (35 FR 18319 1970). The Kemp's ridley sea turtle is also listed as endangered under the New York and New Jersey state law. There is only one population of Kemp's ridley sea turtles, and nearly all nesting occurs in the western Gulf of Mexico, with upwards of 90% along the coast of Tamaulipas near Rancho Nuevo. Two other nesting areas exist in Veracruz, Mexico and Texas, US; scattered nests are documented in Campeche, Mexico, and Alabama, Florida, Georgia, South Carolina, and North Carolina (Valdivia et al. 2019). Kemp's ridley sea turtles and the closely related olive ridley sea turtles (*Lepidochelys olivacea*) are the only turtle species that exhibit a synchronized mass nesting behavior where large numbers of females gather offshore and then come to shore as a group to nest in an arribada. While hybrids among turtle species can be common, there are no instances of detected hybridization between the two ridley species (Plotkin 2007).

<u>Distribution</u>

Kemp's ridley sea turtles are distributed throughout the Gulf of Mexico and along the US Atlantic seaboard as far north as Nova Scotia; their range encompasses the Offshore Development Area. Whereas the MAB is habitat for adult loggerhead and leatherback sea turtles, Kemp's ridley that occur in this area are predominantly younger juveniles (< 40 cm [16 in] SCL). As with other sea turtle species, the distribution of Kemp's ridley is influenced by water temperature and water depth. Kemp's ridley sea turtles that occur in southern New England

(SNE) can be seen in Long Island Sound, as well as further north along the Rhode Island coastline, and in Cape Cod Bay, Massachusetts (CeTAP 1982; Waring et al. 2012). They are more common in the New York Bight region and along the Long Island coastline. Following the tracks of Kemp's ridley sea turtles that were rehabilitated after becoming cold-stunned in the region and subsequently released with satellite transmitters from Long Island, 2 out of 12 individuals migrated northwards into Massachusetts waters, before migrating southwards by November. It has recently been suggested that ocean temperature changes and rates of cold-stunning may be related (Griffin et al. 2019; Liu et al. 2019). As waters in this region become warmer, turtles may remain longer; however, because temperatures will eventually (and at times rapidly) become inhospitable to turtles this climatic pattern may act as an "ecological trap," whereby large numbers of turtle cold-stun because they do not leave the region at seasonally appropriate times. Juvenile Kemp's ridley sea turtles are susceptible to cold-stunning (especially in years when the seasonal temperature drop occurs earlier in the fall) as they are migrating south to overwinter along the Florida coast (Liu et al. 2019). STSSN records indicate 141 Kemp's ridley sea turtles were cold stunned on the New York and New Jersey coasts between 2019 and 2022.

In the surveys conducted by NYSERDA, Kemp's ridley sea turtles were observed off the coast of New York primarily in the summer, with smaller numbers in the fall, a single sighting in the spring, and no sightings in winter (Normandeau and APEM Ltd. 2021). Opportunistic sampling from fishing and whale watching vessels indicate the presence of Kemp's ridley sea turtles in the MAB, 85% of the 14 records reported by Kenney and Vigness-Raposa (2010) were during the summer months (Kenney and Vigness-Raposa 2010). The shipboard AMAPPS surveys did not detect Kemp's ridley sea turtles in the Offshore Development Area, but small numbers of sightings occurred south of Long Island in summer months (Palka et al. 2021). Similarly, during AMAPPS aerial surveys conducted from June–September 2021, two sightings of two individual Kemp's ridley sea turtles were observed near the Offshore Development Area (NEFSC and SEFSC 2022). Kemp's ridley sea turtles are not predicted to occur within the Offshore Development or surrounding area from December–May and have the highest predicted monthly densities from June–October (DiMatteo et al. 2023). STSSN records indicate that Kemp's ridleys are the second most common species to be found stranded within New York and New Jersy after loggerhead. During August – December 2022 and April – September 2023, there were eight visual sightings of Kemp's ridley sea turtles recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B). Assessing their abundance in this region with available data is challenging due to several factors. First, most of the individuals that occur along the eastern US coast are juveniles that have recently recruited from oceanic to more coastal habitats. These individuals tend to be too small to be detected in aerial surveys, as they are <40 cm (16 in) SCL. Second, the shallow bays and estuaries that are often preferred habitats of Kemp's ridleys in the region have historically been excluded from survey designs. These two factors result in underestimates of Kemp's ridley abundance from aerial surveys and may also explain their relatively high numbers in stranding records. A third confounding issue is that the number of juvenile turtles entering the Atlantic Ocean from the Gulf of Mexico likely differs among years due to variation in hatchling production and ocean circulation dynamics and sporadic pulses of large numbers of young Kemp's ridley are possible (Putman et al. 2020a, 2020b).

Abundance

Kemp's ridley sea turtles have the smallest population size, most restricted nesting habitat, and are considered the most endangered sea turtle in the world (Bevan et al. 2016; NMFS et al. 2011). The entire Kemp's ridley sea turtle population is listed as endangered under the ESA (NMFS 2015). The number of nests increased exponentially through the 1990s as a result of beach protections and the development of Turtle Excluder Devices (TEDs) for shrimp trawls (Caillouet et al. 2018). However, in 2010, the number of nests decreased dramatically and have since shown wide annual variation, but with no clear trend through time (Caillouet et al. 2018). According to the International Union for Conservation of Nature (IUCN), there are estimated to be 22,341 mature female Kemp's ridley sea turtles globally (Wibbels and Bevan 2019). Historically, the primary threat to Kemp's ridleys was the harvest of both eggs and turtles. Small levels of harvesting continue to occur on some nesting beaches in Mexico, but extensive protections have dramatically decreased this from historical levels (76 FR 58781). Current threats include vehicles on beaches and coastal development in terrestrial habitats, oils spills, and bycatch in fisheries (76 FR 58781).

4.8.1.4 Leatherback Sea Turtle (Dermochelys coriacea)

Leatherback sea turtles are the only remaining species of the family Dermochelyidae and are characterized by an extreme reduction of the bones of the carapace and plastron and a lack of scutes (i.e., bony plates) (Pritchard 1997). They are the largest of the sea turtles, reaching over 180 cm (71 in) CL. They are black in coloration on their dorsal surfaces with varying patterns of white spotting; ventrally they are mottled pinkish-white and black (NMFS and USFWS 1992). The carapace has seven longitudinal ridges that taper to a blunt point. Their diet primarily consists of jellyfish and salps. They have also been known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed (USFWS and NMFS 2015). Juveniles are oceanic and likely spend their early years in tropical waters until they reach a length of ~100 cm (39 in), when they can be found in more temperate waters (Eckert et al. 2012). The leatherback sea turtle is a highly migratory pelagic species that can be found in boreal and tropical waters throughout the world's oceans (Dodge et al. 2014; Plotkin 2002). Mean dive duration for leatherback sea turtles is approximately 10 minutes with a mean surface interval time of five minutes, suggesting they spend about one-third of their time at the surface (Eckert et al. 1989).

Status

The leatherback sea turtle was listed as endangered in 1970 (35 FR 8,491 [1970]). There are seven leatherback DPSs, which include the Northwest Atlantic, Southwest Atlantic, Southeast Atlantic, Southwest Indian, Northeast Indian, West Pacific, and East Pacific. Many of these DPS (e.g., Eastern Pacific) are at extreme risk of extinction. The Northwest Atlantic DPS seasonally occurs within the MAB and the Offshore Development Area. Leatherback nesting had been increasing for this DPS (Mazaris et al. 2017), however, there have been significant decreases in recent years at numerous locations.

Distribution

Leatherback sea turtles have thermoregulatory adaptations, including counter-current heat exchange systems, a high oil content, and large body size that allow them to have the widest geographical distribution of all sea turtles (Spotila et al. 2017). They occur as far north as British Columbia, Newfoundland, and the British Isles in the Northern Hemisphere. During the non-breeding season, the leatherback turtle undertakes long-distance migrations between its tropical and subtropical nesting grounds and high latitude foraging grounds in continental shelf and pelagic waters (Eckert et al. 2012). Leatherbacks are expected to occur seasonally in the Offshore Development Area. Leatherback sea turtles were sighted in the New York Bight and were predominantly observed from summer through fall (Palka et al. 2021; Normandeau and APEM Ltd. 2021). The greatest anticipated potential for interactions with leatherback sea turtles can therefore be expected in the Offshore Development Area during the summer and fall.

NYSERDA surveys observed small numbers of leatherback sea turtles in the summer and fall, and no leatherbacks were observed in the winter or spring. A lack of winter and spring survey sightings are consistent with previous studies that suggest leatherback sea turtles are not expected to be present during these seasons (Kenney and Vigness-Raposa 2010). Several leatherback sea turtles were observed in the New York Bight during the AMAPPS shipboard surveys between 2000-2017 (Palka et al. 2021). During AMAPPS aerial surveys conducted from June–September 2021, 37 sightings of 40 individual loggerhead sea turtles were observed near the Offshore Development Area (NEFSC and SEFSC 2022). Thirty-four leatherback sea turtle observations were recorded in STSSN reports of New York and New Jersey waters from 2019-2022 (SEFSC 2023). Observations included 29 stranding observations and 5 incidental captures in the summer and fall of 2019-2022. The predicted monthly densities of leatherback sea turtles in the Offshore Development Area and surrounding waters are highest from August–October with the peak density in September (DiMatteo et al. 2023). Based on the information above, it is expected for leatherback sea turtles to occur in the Lease Area and may co-occur with activities in the Offshore Development Area, particularly during the summer and fall and in the OECC due to its preference for foraging in shallow, coastal waters. During August – December 2022 and April – September 2023, there were five visual sightings of leatherback sea turtles recorded during geophysical and geotechnical surveys conducted within the Vineyard Mid-Atlantic Lease Area (see Appendix II-B).

Abundance

The Northwest Atlantic DPS consists of 55 nesting aggregations that extend from the French Guiana and Suriname in the south, throughout the Caribbean Sea, and northward along the east coast of Florida and minimal nesting in South Carolina and North Carolina. The total index of nesting female abundance is 20,659. Presently, Trinidad hosts the largest rookery with ~29% of nesting females (NMFS and USFWS 2020). Nesting at relatively high abundance beaches (Trinidad, French Guiana, Suriname, and Costa Rica) appear to be in a downward trend.

4.8.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect sea turtles during the construction, O&M, and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 4.8-2.

Table 4.8-2 Impact Producing Factors for Sea Turtles

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Noise	•	•	•
Vessel Activity	•	•	•
Habitat Modification	•	•	•
Marine Debris and Discharges/Intakes	•	•	•
Entanglement and Entrapment	•	•	•
Fisheries Survey Gear Utilization	•	•	
Electromagnetic Fields		•	
Alteration in Prey Availability	•	•	•
Suspended Sediments and Deposition	•	•	•
Artificial Light	•	•	•

Potential effects to sea turtles were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

4.8.2.1 Noise

In general, there is much less information available on sea turtle hearing and response to sounds compared to marine mammals. Several papers discuss the morphology of the turtle ear (e.g., Christensen-Dalsgaard et al. 2012; Willis et al. 2013) and the hearing ability of sea turtles (e.g., Martin et al. 2012; Dow Piniak et al. 2012a, b; Lavender et al. 2014). Both Dow Piniak et al. (2016) and Ridgway et al. (1969) found that green sea turtles are most sensitive to underwater sounds between 50 and 1,600 hertz (Hz), with maximum sensitivity between 200 and 400 Hz. In loggerhead sea turtles, Bartol et al. (1999) found the range of effective hearing was between 250 and 750 Hz, while Martin et al. (2012) identified the greatest sensitivity in an adult to occur between 100 and 400 Hz. In post-hatchling and juvenile loggerheads, Lavender et al. (2014) estimated the range to be 50 to 1,100 Hz, with the greatest sensitivity between 100 and 400 Hz. Taken together, these studies indicate the upper limit of sea turtle hearing is approximately 1–1.5 kilohertz (kHz), with the greatest sensitivity from 100–400 Hz.

Acoustic Thresholds Used to Evaluate Potential Impacts to Sea Turtles

Injury, impairment, and behavioral thresholds for sea turtles were developed for use by the US Navy (Finneran et al. 2017) based on exposure studies (e.g., McCauley et al. 2000). Dual criteria (peak [PK] and sound exposure level [SEL]) have been suggested for permanent threshold shift (PTS) and temporary threshold shift (TTS), along with auditory weighting functions published by Finneran et al. (2017) used in conjunction with SEL thresholds for PTS and TTS. The behavioral threshold recommended in the Greater Atlantic Regional Fisheries Office (GARFO) acoustic tool (GARFO 2020) is a sound pressure level (SPL) of 175 decibels (dB) relative to one microPascal (re 1 μPa) (McCauley et al. 2000; Finneran et al. 2017).

Table 4.8-3 summarizes the acoustic thresholds used to evaluate potential impacts to sea turtles from pile driving activities, drilling, and unexploded ordnances (UXO)/discarded military munitions (DMM) detonations.

Table 4.8-3 Acoustic Metrics and Thresholds Used to Evaluate Potential Injury, TTS, and Behavioral Response for Sea Turtles

Faunal Group	Impulsive Signals				Non-Impulsive Signals	Behavior
	Injury (PTS)		Impairment (TTS)		Injury (PTS)	
	L_{pk}	L_E	L_{pk}	L_E	L_E	L_p
Sea Turtle	232	204	226	189	220	175

Notes:

1. L_{pk} = peak sound pressure (dB re 1 μPa).
2. L_E = sound exposure level (dB re 1 $\mu Pa^2 \cdot s$).
3. L_p = root mean square sound pressure (dB re 1 μPa).

Foundation Installation

Foundation installation is expected to require impact pile driving and may also require the use of a vibratory hammer and/or drilling. A vibratory hammer could be used to install the foundation through surficial sediments in a controlled fashion to avoid the potential for a "pile run," where the pile could drop quickly through looser surficial sediments and destabilize the installation vessel. During vibratory pile driving, longitudinal vibration motion at the hammer's operational frequency and corresponding amplitude causes the soil to liquify, allowing the pile to penetrate into the seabed. Drilling could also be required if pile driving encounters refusal (e.g., due to hard sediments, a large boulder, or bedrock). If drilling is required, a rotary drilling unit would likely be installed on top of the monopile or pin pile to remove obstructing material from the pile's interior. The modeling for foundation installation activities (i.e., impact pile driving, vibratory pile setting, and drilling) is described in Appendix II-E.

There is substantial overlap in the frequencies that sea turtles can detect and the sounds produced by impact and vibratory pile driving (see Appendix II-E). However, in the absence of absolute hearing threshold data, it is not possible to estimate how far away the sounds might be audible to sea turtles. Moein et al. (1994) and Lenhardt (2002) reported TTS for loggerhead turtles exposed to repeated low-frequency impulsive sounds. This suggests that sounds from impact pile driving might cause temporary hearing impairment in sea turtles if they do not avoid areas where such levels occur. However, it is unknown if lost or damaged sensory cells in the sea turtles' auditory system can regrow after a loss, as occurs in fish (Warchol 2011). Because of their rigid external anatomy, it is possible that sea turtles are protected from the impulsive sounds produced by pile driving (Popper et al. 2014). There is no direct evidence of injury to sea turtles from non-impulsive noise (Popper et al. 2014).

Additionally, several monitoring studies indicate that some sea turtles do show localized movement away from low-frequency impulsive sounds. For example, McCauley et al. (2000b) and Moein et al. (1995) reported that sea turtles displayed avoidance reactions to low-frequency, impulsive seismic signals at levels between 166–179 dB. Sea turtles were also observed adjusting their behavior in response to seismic survey sounds by DeRuiter and Doukara (2012). However, due to the nature of the studies, the extent of avoidance could not be determined. An avoidance response could help reduce the potential for auditory impacts since, when close to the sound source, received sound levels diminish rapidly with increasing distance from the source. Thus, even a small-scale avoidance response could result in a significant reduction in sound exposure. Pile driving activities are short-term, and the results of one investigation have suggested that, while sea turtles may avoid an area of active pile driving, they will return to the area upon completion (USCG 2006).

Acoustic masking is one of the main effects that anthropogenic sounds may have on marine animals (Peng et al. 2015; Vasconcelos et al. 2007). Masking can interfere with communication between individuals, localization of prey, avoidance of predators, and, in the case of sea turtles, identification of an appropriate nesting site (Nunny et al. 2008). While there is some evidence that sea turtles use sound to communicate, the few vocalizations described are restricted to the grunts of nesting females and the chirps, grunts, and complex hybrid tones of eggs and hatchlings (Mrosovsky 1972; Cook and Forrest 2005; Ferrara et al. 2014). Thus, potential masking is unlikely to interrupt communication among sea turtles. Similarly, sounds from impact pile driving will be produced far from potential nesting locations, so they will not disrupt the identification of suitable nesting sites. Nonetheless, the overlap of frequencies produced during impact and vibratory pile driving and sea turtle hearing range means that some degree of masking is likely (Popper et al. 2014). The impact of masking on sea turtles is currently unknown (Dow Piniak et al. 2012a; Lucke et al. 2014; Popper et al. 2014) but given the apparent limited use of sound by sea turtles, especially in locations where they will be produced by Vineyard Mid-Atlantic, any potential impacts are likely to be very limited.

Cofferdam Installation

At the horizontal directional drilling (HDD) offshore exit pit, a temporary cofferdam (or similar method) may be used depending on subsurface conditions and the depth of burial. If used, the cofferdams will be constructed of sheet piles likely using a vessel-mounted crane and vibratory hammer. Up to six cofferdams could be installed in total, with up to four cofferdams at a single landfall site. The cofferdams would also be removed likely using a vessel-mounted crane and vibratory hammer. The vibratory hammer would produce continuous (non-impulsive) sound.

As with vibratory pile driving during foundation installation (described above), non-impulsive sound from vibratory piling during cofferdam installation/removal may result in hearing damage or behavioral responses in sea turtles. Acoustic propagation modeling and density-based exposure estimation was conducted to estimate potential impacts to sea turtles from cofferdam installation/removal at the landfall sites. The results are provided in Supplement K of Appendix II-E.

Vessel Noise

As described in Section 4.7.2.2, vessel use will occur during both the construction and O&M periods within the Offshore Development Area. The expected noise associated with vessel use within the Offshore Development Area is further described in Section 4.7.2.1. Sea turtles are regularly exposed to commercial shipping traffic as well as other vessel noise; therefore, sea turtles may habituate to vessel noise as a result of the regular exposure (BOEM 2014). Sounds associated with vessel transit and operation are expected to be lower than those associated with pile driving noise. Therefore, it is expected that the risk associated with sea turtle exposure to vessel noise is low given the low model predicted estimates of exposure to pile driving sound.

Potential Detonation of Unexploded Ordnances (UXO) and/or Discarded Military Munitions (DMM)

As described in Section 3.10.2 of COP Volume I, if potential UXO and/or DMM are discovered in the Lease Area or OECC, the Proponent will prioritize avoidance of UXO/DMM wherever possible by micro-siting structures and cables around the object. Where avoidance is not possible (e.g., due to layout restrictions, presence of archaeological resources, etc.), UXO/DMM will be relocated or otherwise disposed of (e.g., via deflagration [burning without detonating], detonation, or dismantling the UXO/DMM to extract explosive components). The exact number and type of UXO/DMM that may be present, and which subset of those UXO/DMM cannot be avoided by micro-siting, are unknown at this time (further evaluation is ongoing).

Underwater detonations create broadband impulsive sounds with high peak pressures and rapid rise times (Richardson et al. 1995). UXO/DMMs with more net explosive weight will produce higher peak pressures (see Supplement J of Appendix II-E). At close ranges, these sounds have the potential to cause non-auditory injury to sea turtles and at longer ranges, auditory injury and behavioral disturbance are possible. The unique nature of sounds and pressure into the water column from underwater detonations, including the high peak pressure levels and the fact that they are typically just a single impulsive event, means threshold criteria for UXO/DMMs detonations are different than for other anthropogenic sounds. Significant masking effects would be unlikely during UXO/DMM explosions given the intermittent nature of these sounds and short signal duration (Madsen et al. 2006). There are currently no data available regarding the effects of UXO/DMM explosives on sea turtles; however, the death of a small number of sea turtles resulting from the deconstruction of oil and gas structures in the Gulf of Mexico was reported (Popper et al. 2014). Likely cause of death has been potentially attributed to rapid pressure changes on the air-filled lungs and air-filled cavities of sea turtles as a result of oil and gas deconstruction activities (Popper et al. 2014).

Underwater acoustic modeling of detonations of UXO/DMM occurring within the Offshore Development Area was conducted. Technical details of the modeling methods, assumptions, and results can be found in Supplement J of Appendix II-E.

Wind Turbine Generators (WTGs)

As stated in Section 4.7.2.1, operating wind turbine generators (WTGs) produce low levels of sound with source levels up to 151 dB root-mean-square sound pressure level (SPL_{rms}) in the 60 to 300 Hz frequency range (Dow Piniak et al. 2012b). This overlaps with the most sensitive hearing range of sea turtles (Bartol et al. 1999; Ridgway et al. 1969), but the low source levels mean it may only be detectable by sea turtles at short ranges. At longer distances from WTGs, it is unlikely for sea turtles to detect sound generated by WTGs when in the presence of ambient noise in the Offshore Development Area. With the larger turbines used by Vineyard Mid-Atlantic, an increased distance from the noise source in the nacelle to the water is expected (Tougaard et al. 2020). Additionally, sea turtles may habituate to the low WTG noise level produced in the Offshore Development Area (Moein et al. 1995). Due to the increased distance between the nacelle and the water and possible habituation, impacts to sea turtles from exposure to noise from WTGs is unlikely.

Seabed Preparation Activities

Prior to offshore cable installation, pre-installation activities may include debris and boulder clearance and minimal to no sand bedform leveling. Boulder clearance (if required) is expected to be accompanied by a grab tool suspended from a vessel's crane, which lifts individual boulders clear of the alignment and relocates them elsewhere within the OECC. Alternatively, a route clearance plow may be towed by a vessel along the cable alignment to push boulders aside. Sand bedform leveling may be accomplished by one or a combination of the following techniques: controlled flow excavation, offshore excavator, or a route clearance plow. Following boulder clearance and sand bedform leveling (if necessary), pre-lay surveys and pre-lay grapnel runs will be performed to verify seafloor conditions and confirm that the cable alignments are suitable for installation (free of obstructions). The pre-lay surveys are expected to be performed using multibeam echosounders and potentially magnetometers. The offshore cable will then be buried beneath the stable seafloor, likely using jetting techniques or a mechanical plow. Further detail pertaining to the pre-installation activities is included in Section 3.5.3 of COP Volume I.

Sounds from pre-installation activities are considered non-impulsive and are not expected to produce sounds above those of routine vessel activities (see Section 4.6.2.6), and thus are not expected to result in harassment to sea turtles. The sound produced by multibeam echosounders, at or above 180 kHz falls outside of the range of sea turtle hearing (up to 1.5 kHz) and is therefore discounted in terms of potential impacts to sea turtles. To assess the potential impacts of sand bedform leveling, sounds from dredging activities were reviewed. Dredging produces distinct sounds during each specific phase of operation: excavation, transport, and placement of sand bedform leveling material (Central Dredging Association 2011; Jiminez-Arranz et al. 2020). Engines, pumps, and support vessels used throughout all phases of pre-installation activities may introduce low-level, continuous noise into the marine environment. The sounds produced during excavation vary depending on the sediment type—the denser and more consolidated the sediment is, the more force the dredger needs to impart, and the higher sound levels that are produced (Robinson et al. 2011). Sounds from mechanical dredges (such as an excavator) occur in intervals as the dredge lowers a bucket, digs, and raises the bucket. During the sediment transport phase, many factors—including the load capacity, draft, and speed of the vessel—influence the sound levels that are produced (Reine et al. 2014). SPL source levels during backhoe dredge operations range from 163 to 179 dB re 1 μPa-m (Nedwell et al. 2008; Reine et al. 2012). Dredging activities generally produce low-frequency sounds, with most energy below 1,000 Hz and frequency peaks typically occurring between 150 and 300 Hz (McQueen et al. 2018), which is detectable by sea turtles. Sound produced by dredging and other pre-installation activities would be proceeded by, and associated with, sound from ongoing vessel noise and would be similar in nature; thus, any sea turtles in the vicinity of the activity would be aware of the vessel's presence.

While behavioral responses may occur from some pre-installation activities, they are expected to be short term and of low intensity. In particular, minimal to no sand bedform leveling is anticipated and therefore this activity (if required) will be of a short duration. Therefore, pre-installation activities are expected to have negligible impacts on sea turtles.

4.8.2.2 Vessel Activity

Expected use of vessels to support Vineyard Mid-Atlantic activities during construction and O&M, including the anticipated number of vessel trips and representative vessel types, is described in Sections 3.10.4 of and 4.4.2 of COP Volume I. Vessel activity is a concern for sea turtles because they are susceptible to injury or death if struck by a boat and the issue is increasing as a management concern (Ataman et al. 2021; Fuentes et al. 2021).

However, quantifying the magnitude of this risk is challenging, in part because sea turtles spend a majority of their time below the water surface where they will not be struck by a passing vessel. Nonetheless, a particularly thorough study across the coast of Florida found that the proportion of stranded turtles with vessel strike injuries increased from 1986 through 2014, coincident with the increasing number of registered vessels across the state (Foley et al. 2019). While these vessels are largely associated with recreational boating activities, it nonetheless suggests that increasing vessel traffic is likely to have a negative impact on sea turtles. Estimated sea turtle mortalities from vessel strikes in Florida alone (Foley et al. 2019) exceed mortality estimates for some major industrial fisheries operating across the entire southeast such as shrimp trawlers (Babcock et al. 2018). The ability of turtles to evade oncoming vessels decreases with vessel speed and boats traveling at speeds > 4 kilometers per hour (km/hr) (~ 2.16 knots [kts]) are unlikely to be avoided by most turtles (Hazel et al. 2007). Avoidance by turtles is likely to be increased when auditory and visual information from vessels is available to turtles; thus, risks may be increased in noisy or lower-visibility environments. Hazel et al. (2007) speculate that visual detection of oncoming boats best explains the avoidance behaviors of turtles observed in the wild. Reductions in vessel speed and watchful crew will help reduce the risks associated with potential vessel strikes. Proposed mitigation and monitoring measures to reduce vessel strike risk to marine mammals will provide protection to sea turtles as well. Further detailed vessel strike avoidance measures are described in Section 4.7.2.2.

4.8.2.3 Habitat Modification

The infrastructure associated with marine energy structures typically functions as reef-like habitat that is colonized by a variety of encrusting and sessile organisms along with fish and other species that use such habitats for shelter, foraging, and spawning. Sea turtles have been shown to shelter and forage at artificial reefs and there may be positive impacts on species, such as loggerhead sea turtles if prey items are concentrated or enhanced by the addition of these structures as they are likely to be (Perry and Heyman 2020). However, there could be some indirect negative impacts from fishing activities that are likely to increase with the development of reef habitats and associated fish communities. Incidental capture by recreational or commercial fishers could occur and entanglement/drowning is a risk for turtles as lost fishing gear (e.g., snagged rope, nets, or monofilament line) may accumulate around these structures through time (Barnette 2017). The Proponent will inspect the foundations and scour protection at regular intervals for the presence of marine debris (see Section 4.2.2 of COP Volume I) and will remove ghost gear and/or marine debris which may result in the entanglement of sea turtles. Assuming fisheries precautions are taken against bycatch and regular cleaning of the structures occurs, it is likely that any modification to habitat would be a net positive for sea turtles.

4.8.2.4 Marine Debris and Discharges/Intakes

Throughout the life of Vineyard Mid-Atlantic, vessels and equipment operating in the Offshore Development Area will generate sanitary and other waste fluids, trash, and miscellaneous debris.

Accidental discharges, releases, and disposal can pose a risk to sea turtles, as turtles are known to ingest debris in oceanic and nearshore habitats. The MAB is currently considered a lower-risk area for marine debris ingestion by sea turtles (Schuyler et al. 2016). Entanglement in marine debris lost overboard from vessels or from the structures during operation is also a concern. However, much of this problem appears to be related to lost fishing gear (e.g., monofilament lines and nets) (Carr et al. 1987; Laist 1997), and the scale of this issue is not likely to be a concern.

Although not anticipated given the spill prevention measures described in Section 7.5, accidental releases of pollutants such as fuel or oil that collect at the ocean surface can be problematic for turtles, given that they must surface to breathe, which directly exposes them to these pollutants and causes damage to their respiratory system (Wallace et al. 2020). The Proponent will require vessel operators, employees, and contractors who engage in offshore activities to participate in a marine trash and debris prevention training program. All waste streams will be properly managed in accordance with federal and state laws and best management practices will be implemented to avoid the accidental release of debris into the marine environment and therefore not create additional risk to sea turtles.

Vineyard Mid-Atlantic includes either high voltage alternating current (HVAC) or high voltage direct current (HVDC) electric service platform(s) [ESP(s)]. HVAC equipment can be air cooled, whereas HVDC equipment requires water cooling. After leaving the heat exchangers, the warmed seawater will be discharged below the water's surface through pipes that are attached to the foundation. The Proponent will be conducting an assessment of any potential thermal impacts as part of the National Pollutant Discharge Elimination System (NPDES) permitting process for the cooling water intake structure. Any thermal impacts to water quality or marine organisms are anticipated to be limited to the immediate area surrounding the discharge. Drifting plankton in the vicinity may experience stress or mortality primarily due to water temperature changes; however, any impacts are expected to be spatially limited (BOEM 2024), with large areas of the surrounding water mass unaffected. Such limited thermal impacts are not likely to measurably affect the availability of prey resources for sea turtles.

The potential effects from the intake of HVDC cooling water includes entrainment of zooplankton and ichthyoplankton (prey items of sea turtles) and intake association/attraction if prey become aggregated on intake screens (BOEM 2024). As discussed in Section 4.6, due to the expected intake volume and because more than 25% of the intake volume will be used for cooling, the Proponent plans to conduct an assessment of potential entrainment and impingement as part of the NPDES permitting process for the cooling water intake structure. Through this process, best available technology for minimizing impacts will be further considered. For example, intake screen designs can be modified to reduce intake velocities, so it is expected that impingement will not be a significant impact for most prey species.

To estimate the impacts of entrainment from an HVDC cooling water intake structure (CWIS), an assessment using anticipated flow rates and local zooplankton data was completed as described in Appendix II-N. Model results provided estimates of the composition and magnitude of intake mortality for ichthyoplankton and other zooplankton. As described further in Appendix II-N, the water usage rate and total intake volume used for the initial entrainment analysis are still considerably lower than most similarly-sized traditional fossil fuel power plants. Based on the magnitudes of the results, ecological and socioeconomic effects from the entrainment of plankton as sea turtle prey by the HVDC CWIS will likely be minimal.

Section 7.5 includes additional discussion of potential impacts from marine debris and accidental releases and discharges, as well as measures that will be adopted to avoid, minimize, or mitigate potential impacts to sea turtles.

4.8.2.5 Entanglement and Entrapment

The direct risk of entanglement from the construction and operation of the infrastructure associated with wind turbines is extremely low for turtles. Entanglement risk of sea turtles associated with fisheries monitoring surveys is limited and is discussed in Section 4.8.2.6. The large monopile foundations are not shaped in a way that pose a risk to turtles, and the potential to “snag” rope or fishing gear (owing to lack of protrusions) is likely lower than other artificial reef designs (Barnette 2017). However, sea turtles may be at higher risk of secondary or tertiary entanglement due to their larger appendages which have a higher likelihood for entanglement with ropes, lines, and cables (Maxwell et al. 2022). Entrapment as a result of fisheries bycatch is also of concern for sea turtles. Loggerhead sea turtles are the species of greatest concern for sea turtle bycatch, as the continental shelf provides sea turtle habitat overlap with areas of high fishing activity (Moore et al. 2008).

As stated in Section 4.8.2.3, the Proponent will inspect the foundations at regular intervals for the presence of marine debris (e.g., monofilament and other fishing gear) and will remove ghost gear and/or marine debris which may result in the entanglement of sea turtles. Therefore, it is unlikely that secondary entanglement of sea turtles in such debris would occur.

4.8.2.6 Fisheries Survey Gear Utilization

A draft preliminary fisheries monitoring plan for pre-, during, and post-construction fisheries surveys has been developed for Vineyard Mid-Atlantic and is included as Appendix II-U. Sea turtles are not expected to be impacted by any of the anticipated fisheries survey activities except for trawl surveying. The capture and mortality of sea turtles in fisheries using bottom trawls are well documented (Henwood and Stuntz 1987; NMFS and USFWS 1992). Although sea turtles are capable of extended dive durations, entanglement and submersion in fishing gear leads to rapid oxygen consumption and drowning (Lutcavage and Lutz 1997) and even trawls of shorter durations (as in shrimp fisheries) can pose risks of mortality (Wibbels 1989). Based on available research, restricting tow times to 30 minutes or less is expected to prevent sea turtle mortality in trawl nets (Epperly et al. 2002; Sasso and Epperly 2006). Vineyard Mid-Atlantic's trawl tows will not exceed a maximum trawl time of 20 minutes (see Appendix II-U). In addition, TEDs are well-established modifications to trawls that essentially eliminate the risk of sea turtle mortality as they allow turtles to pass through the nets (Shiode and Tokai 2004) and TEDs will be used during any Vineyard Mid-Atlantic trawl surveys.

To further protect sea turtles from the impacts of fisheries survey activities, all fisheries monitoring surveys for Vineyard Mid-Atlantic will follow the mitigation measures listed in Appendix II-U. In addition to the use of short tow durations and use of TEDs in trawl surveys, the risk assessment and proposed mitigation measures outlined in Appendix II-U are effective in reducing potential impacts from fisheries monitoring surveys on sea turtles such that there will be no population-level effects.

4.8.2.7 Electromagnetic Fields (EMF)

When electricity runs through a wire it produces an electric field and a magnetic field that radiates outward. The configuration and sheathing of the inter-array, inter-link and export cables that transmit electricity from WTGs and ESPs will block electric fields, however, magnetic fields readily pass through sheathing into the environment. Although the intensity of any generated magnetic fields will be minimized through cable burial or the placement of cable protection, this is a potential concern because many and diverse species rely on Earth's magnetic field to guide their movements over a wide range of spatial scales (Putman 2022). Within the marine environment in particular, the ontogenetic shifts in habitat and seasonal migrations that characterize the life cycles of many animals are hypothesized to have evolved owing to the species' abilities to extract map-like and compass-like information from Earth's magnetic field (Putman 2018). Given that Earth's magnetic field is relatively weak, this implies an exquisite sensitivity of the receptor systems of these animals – even though the receptor mechanism for how animals detect magnetic fields remains uncertain (Putman 2022).

Sea turtles have been at the forefront of research into how animals use Earth's magnetic field for navigation. Use of the magnetic field as a compass (i.e., maintaining a heading) has been demonstrated in loggerhead and leatherback turtles (Lohmann 1991; Lohmann and Lohmann 1993) and use of the magnetic field as a map (i.e., to assess position) has been demonstrated in loggerhead and green turtles (Lohmann et al. 2001; Lohmann et al. 2004). The magnetic compass of loggerheads functions independently of light; distinguishes poleward and equatorward (rather than north and south) by comparing the direction of magnetic field lines to the gravity vector (Light et al. 1993); can be entrained to visual cues (light) and vestibular cues (the orbital movement of waves) (Goff et al. 1998); and is disrupted by a strong (~1000x earth strength) but brief (4 millisecond) magnetic pulse (Irwin and Lohmann 2005). The magnetic map of loggerheads is based on their ability to independently detect both the inclination angle (the angular difference between the magnetic vector and gravity vector) and the total field intensity (magnetic field strength) and relate these values to geographic regions (Lohmann and Lohmann 1994; Lohmann and Lohmann 1996). In laboratory studies, magnetic fields differing by 1% of inclination angle (i.e., 0.7°) and 1% of total field intensity (i.e., 0.5 microtesla [μT]) elicited significantly different orientation behavior in hatchling loggerheads (Fuxjager et al. 2011). While no formal experiments have been conducted to determine the threshold of magnetic sensitivity in sea turtles, it is known that the sensitivity to magnetic cues allows turtles to assess both latitudinal and longitation (Putman et al. 2011); to orient along their oceanic migratory route (Lohmann et al. 2012); and to maintain relatively fine-scaled population structure for females homing to their nesting beaches (Brothers and Lohmann 2018).

EMF modeling conducted for Vineyard Mid-Atlantic (see Appendix II-O[54]) examined how magnetic field (MF) deviations from the Earth's geomagnetic field would be altered under a range of different scenarios (e.g., whether the transmission lines were HVAC carrying 1700 amps, HVDC carrying 2,300 amps, buried at 1.2 m (4 ft), or placed directly on the seabed and covered with cable protection). While there are slight differences among these arrangements, the orders of magnitude of potential impact are similar. In all scenarios, the amount that Earth's total field intensity is predicted to deviate decreases rapidly with distance from the cable. Overall, the analysis shows >96->99% reductions in magnetic field levels at lateral distances of ±7.6 m (±25 ft) from the centerlines of HVAC cables or HVDC cable bundles. The 60-Hz HVAC offshore export cables under consideration are considerably above the frequency range of Earth's steady (i.e., direct current [DC]) geomagnetic field to which magnetosensitive marine species such as sea turtles are specifically tuned for navigation/migration purposes, and thus may not be detected by sea turtles. Nonetheless, frequencies of 0.1 to 85 megahertz (MHz), with magnetic magnitudes as low as 1 nanotesla (nT) (0.01 milligauss [mG]), have been reported to disrupt magnetic orientation in other animals – potentially by interacting with chemical reactions that allow detection of the magnetic field (Granger et al. 2022; Leberecht et al. 2022). The "broadband electromagnetic noise" potentially produced by these cables has not been investigated, nor have the effects of electromagnetic noise on turtles.

In contrast to the uncertainty surrounding the HVAC cables, HVDC cable bundles will contribute to highly localized DC MF deviations from the Earth's geomagnetic field in the immediate vicinity of the cable bundles that would be detectable to sea turtles. This includes MF deviations at 3 m (10 ft) from the centerline of a cable bundle that range between -81.1 mG and +81.2 mG (-15.9% and +16.0% of the Earth's geomagnetic field) across the buried cable and surface-laid cable modeling scenarios. At the slightly greater distance of 7.6 m (25 ft) from

[54] Modeling was focused on export cables because inter-array cables are expected to have lower currents and magnetic fields. Inter-link cables are expected to have similar or lower magnetic fields.

the centerline of a cable bundle, MF deviations decreased to a range of -13.0 mG to +13.0 mG (-2.6% to +2.6% of the Earth's geomagnetic field). The percent change in MF deviations from the Earth's geomagnetic field is sufficiently strong out to at least 7.6 m (25 ft) from the center of a cable whereby changes in turtle orientation could occur. The field change out to 22.9 m (75 ft) of the cable center is 1.2 mG (0.23% of the Earth's magnetic field) and may also be detectable to turtles. Previous experiments with sea turtles demonstrate brief (3-8 minute) exposures to a change in the magnetic field of only 5 mG (0.5 μT) can result in significant differences in orientation (Fuxjager et al. 2011). Thus, it seems plausible that a change of 1.2 mG could also be detectable to turtles, especially given the sensitivity shown in other species is potentially an order of magnitude lower than this value (Kirschvink and Gould 1981; Walker and Bitterman 1989; Dennis et al. 2007; Deigo-Rasilla and Phillips 2021).

How the offshore cables influence the inclination angle or the local direction of magnetic north was not modeled, but alterations to those aspects of the magnetic field could also influence turtle behavior (Klimley et al. 2021). Presumably, whatever impacts there are to turtles would be greater in shallower depths along the OECC because a larger percentage of the water column would be exposed to detectable magnetic distortions. Sea turtle behaviors in these areas include both foraging and migration, and magnetic cues are especially important to sea turtles during migration (Avens and Lohmann 2003; Avens and Lohmann 2004; Putman 2018). Nonetheless, given that the scale of movement for turtles in this setting is quite large as they migrate towards broad, seasonal foraging grounds, the navigational task associated with migration may require less precise use of magnetic cues compared to female turtles attempting to relocate a specific nesting site. If this is the case, the effects of any one export cable would likely be negligible and the Vineyard Mid-Atlantic cables are unlikely to result in significant impacts on sea turtle migration.

4.8.2.8 Alteration in Prey Availability

During the construction phase, disturbances to the seafloor may reduce benthic invertebrates that serve as prey to loggerhead sea turtles in the immediate area, but no long-term reduction in prey populations is expected. Moreover, the reef-like habitat created by these structures may be expected to increase prey abundances in this region over the lifetime of the WTG and ESP structures (Perry and Heyman 2020).

4.8.2.9 Suspended Sediments and Deposition

The impact of suspended sediments is unlikely to be a high risk for sea turtles. Any increase in suspended sediments is likely to be primarily during construction activities and impacts would be temporary and confined to a small area close to the location of the installation activity. Even so, green, loggerhead, and Kemp's ridley sea turtles forage across a wide range of habitats, including in turbid waters of estuaries and bays (Witzell and Schimid 2004; Thomson et al. 2013) and any potential impacts are likely to be negligible. Further description of the potential for suspended sediments and deposition is provided in Section 3.2.

4.8.2.10 Artificial Light

Artificial lighting will be required during the construction, O&M, and decommissioning of the Offshore Development Area. During construction and decommissioning, there will be a temporary increase in lighting from construction equipment and vessels with navigational, deck, and interior lights. During O&M, WTGs and ESP(s) will be lit in compliance with applicable Federal Aviation Administration (FAA), US Coast Guard, Bureau of Ocean Management (BOEM), and Bureau of Safety and Environmental Enforcement (BSEE) guidelines for lighting and marking. Vessel use and associated lighting will also occur, though at a significantly lower frequency than during construction and decommissioning. Vineyard Mid-Atlantic will minimize lighting by using an Aircraft Detection Lighting System (ADLS) or similar system that automatically activates all aviation obstruction lights when aircraft approach the structures. The use of an ADLS will substantially reduce the amount of time that the aviation obstruction lights are illuminated.

During certain life-stages and under certain circumstances, sea turtles are highly attracted to artificial light. Immediately upon hatching, young turtles will orient towards bright lights when crawling on land but typically not after entering the sea (Salmon and Wyneken 1990; Lorne and Salmon 2007). Older turtles are attracted to "lightsticks" affixed to longline fishing gear underwater, resulting in bycatch (Wang et al. 2007). Interestingly, these same lightsticks reduce sea turtle entanglement in gillnets, presumably by allowing sea turtles to see and avoid the nets (Wang et al. 2010). Regardless, risk of impacts to turtles from artificial lights on vessels or structures above the surface of the water in offshore areas are likely to be low as there is no evidence of turtles being attracted to or avoiding lights in such contexts. Anthropogenic lighting onshore can be problematic for adult females choosing nesting sites (Weishampel et al. 2016) and cause disorientation for hatchlings attempting to locate the ocean (Lorne and Salmon 2007). However, there are no sea turtle nesting beaches in this region, so these issues do not pose a risk.

4.8.2.11 Summary of Avoidance, Minimization, and Mitigation Measures

Mitigation and monitoring measures will be implemented to reduce potential impacts on threatened and endangered sea turtle species during Vineyard Mid-Atlantic activities. Avoidance, minimization, and mitigation measures for sea turtles will follow the same measures proposed for marine mammals (see Table 4.7-8). Measures proposed to reduce potential impacts on marine mammals are stricter than those required for sea turtles. Therefore, the measures are considered conservative and more protective when applied to sea turtle species. For example, implementing the use of noise abatement system(s) (NAS) for the protection of sea turtles minimizes the potential for both injurious and behavioral sound interaction. Further detail on specific mitigation and monitoring measures during construction activities can be found in Section 4.7.2.12 (see Table 4.7-8).

Additional mitigation measures that will be implemented to reduce potential impacts on threatened and endangered sea turtles[55] include:

- Between June 1 and November 1, a Trained Lookout will be aboard all transiting vessels to monitor sea turtles. This can be the same protected species observer (PSO) or Trained Lookout monitoring for marine mammals.

- Trained Lookouts will monitor the Sea Turtle Sighting Hotline[56] prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains on duty that day.

- Trained Lookouts will maintain a vigilant watch and monitor a Vessel Strike Avoidance Zone of 500 m (1,640 ft) at all times to maintain a minimum separation distance from ESA-listed species.

- Any sightings will be communicated, in real time, to the captain for proper reporting.

- If a sea turtle is sighted within 100 m (328 ft) or less of the operating vessel's forward path, the vessel operator will slow down to 2 meters per second (m/s) (4 kts) (unless unsafe to do so) and then proceed away from the turtle at a speed of 2 m/s (4 kts) or less until there is a separation of at least 100 m (328 ft), at which time the vessel may proceed with normal operations.

- If a sea turtle is sighted within 50 m (164 ft) of the forward path of the operating vessel, the engine will be shifted to neutral when safe to do so and then the vessel will proceed away from the turtle at a speed of 2 m/s (4 kts) (if safe to do so). The vessel will resume normal operations once the sea turtle has passed.

- Vessel captains will avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. If operation safety prevents avoidance of such areas, vessels will reduce their speed to 2 m/s (4 kts) while transiting through such areas.

- All vessel crew will be briefed on the identification of sea turtles and best practices for avoiding vessel collisions.

- Vessels deploying fixed gear will have adequate disentanglement equipment onboard. Any disentanglement will follow the Northeast Atlantic Coast STDN Disentanglement Guidelines and procedures described in Careful Release Protocols for Sea Turtle Release with Minimal Injury.

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[55] These measures are consistent with mitigation measures described in the New York Bight Programmatic Environmental Impact Statement (BOEM 2024).

[56] http://seaturtlesightings.org/

5 Socioeconomic Resources

5.1 Demographics, Employment, and Economics

This section addresses the potential impacts and benefits of Vineyard Mid-Atlantic on demographics, employment, and economic baseline characteristics of the jurisdictions affected by Vineyard Mid-Atlantic. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and measures proposed by Vineyard Mid-Atlantic LLC (the "Proponent") to avoid, minimize, and mitigate potential effects to demographics, employment, and economics during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

5.1.1 Description of Affected Environment

The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities. With respect to demographics, employment, and economics, the Onshore Development Area includes the communities surrounding Vineyard Mid-Atlantic's onshore facilities, operations and maintenance (O&M) facilities, construction staging areas, and port facilities. For purposes of this section, a subset of representative potential ports is evaluated. These port facilities, which are located in New York, New Jersey, Connecticut, Massachusetts, and Rhode Island, are representative of facilities that may be utilized. See Table 3.10-1 of COP Volume I for a full list of ports that may be used during construction, and Table 4.4-1 for ports that may be used during O&M.

Table 5.1-1 lists the representative communities included in the Onshore Development Area for the purposes of this section.

Table 5.1-1 Vineyard Mid-Atlantic Affected Environment for Demographics, Employment, and Economics

County	Vineyard Mid-Atlantic Components		Port Usage[1]		
	Component	Municipality	Port Name	Activity	Municipality
New York					
Nassau County	Atlantic Beach Landfall Site; Jones Beach Landfall Site	Hempstead	N/A	N/A	N/A
	Onshore cable routes	Hempstead; Garden City			

Table 5.1-1 Vineyard Mid-Atlantic Affected Environment for Demographics, Employment, and Economics (Continued)

County	Vineyard Mid-Atlantic Components		Port Usage[1]		
	Component	Municipality	Port Name	Activity	Municipality
New York					
	Onshore Substation Site Envelopes A, B, C, and D[2]/ Onshore reactive compensation station (RCS) (if used)[3]	[redacted]			
	East Garden City Substation Point of Interconnection (POI)	Hempstead			
Suffolk County	Onshore cable routes	Babylon	Greenport Harbor	O&M	Long Island
	Onshore Substation Site Envelope D[2]/Onshore RCS (if used)[3]	[redacted]			
	Ruland Road Substation POI	Huntington			
Albany County	Not Applicable (N/A)	N/A	Port of Coeymans	Construction	Coeymans
Kings County	N/A	N/A	South Brooklyn Marine Terminal	Construction and O&M	Brooklyn
Queens County	Onshore cable routes	Queens	N/A	N/A	N/A
	Rockaway Beach Landfall Site	Queens			
	Eastern Queens Substation POI	Queens			

Table 5.1-1 Vineyard Mid-Atlantic Affected Environment for Demographics, Employment, and Economics (Continued)

County	Vineyard Mid-Atlantic Components		Port Usage		
	Component	Municipality	Port Name	Activity	Municipality
New York (Continued)					
Richmond County	N/A	N/A	Atlantic Salt Terminal	O&M	Staten Island
New Jersey					
Gloucester County	N/A	N/A	Paulsboro Marine Terminal	Construction	Paulsboro
Salem County	N/A	N/A	New Jersey Wind Port	Construction	Salem
Connecticut					
Fairfield County	N/A	N/A	Bridgeport	Construction with O&M	Bridgeport
Rhode Island					
Providence County	N/A	N/A	Port of East Providence (South Quay Terminal)	Construction	Providence
Massachusetts					
Bristol County	N/A	N/A	New Bedford Marine Commerce Terminal	Construction	New Bedford
Essex County	N/A	N/A	Salem Harbor	Construction	Salem

Notes:

1. Table 5.1-1 reflects representative ports. A full list of ports that may be used during Vineyard Mid-Atlantic are provided in Table 3.10-1 and 4.4-1 of COP Volume I.
2. [redacted]
3. The onshore substation site envelopes could also be used for an RCS, however both an RCS and onshore substation site would not be located in the same onshore substation site envelope.

Demographic, employment, and economic baselines, including existing socioeconomic activities and resources in the onshore and coastal environment that may be affected by Vineyard Mid-Atlantic are described in the following sections. Many of the coastal and ocean amenities that attract visitors to these regions are free for public access, thereby generating limited direct employment, wages, or gross domestic product (GDP). Nonetheless, these nonmarket features function as key attributes of the Onshore Development Area's coastal economy.

5.1.1.1 Demographics

Demographic characteristics of states and counties that are representative of the Onshore Development Area are summarized in Table 5.1-2. These data are compiled from United States (US) Census Bureau statistics and describe general population attributes of the Onshore Development Area (US Census Bureau 2023).

Table 5.1-2 Population

Jurisdiction	Land Area (mi²)	Population (2010)	Population (2020)	Percentage Change of Population (base year and recent year)	Population Density
New York	47,124	19,378,102	20,201,249	4.25%	428.7
Nassau County	118	1,339,532	1,395,774	4.20%	6,694.7
Suffolk County	911	1,493,350	1,525,920	2.81%	1,674.7
Albany County	523	304,204	314,848	3.50%	602.1
Kings County	69	2,504,700	2,736,074	9.24%	39,437.8
Queens County	109	2,230,722	2,405,464	7.83%	22,124.5
Richmond County	57.52	468,730	495,747	5.76%	8,618.2
New Jersey	7,355	8,791,894	9,288,994	5.65%	1,263.0
Gloucester County	322	288,288	302,294	4.86%	938.8
Salem County	332	66,083	64,837	-1.89%	195.4
Connecticut	4,842	3,574,097	3,605,944	0.89%	744.7
Fairfield County	837	916,829	957,419	4.43%	1,143.9
Rhode Island	1,034	1,052,567	1,097,379	4.26%	1,061.4
Providence County	409	626,667	660,741	5.44%	1,613.6
Massachusetts	7,801	6,547,629	7,029,917	7.37%	901.2
Bristol County	553	548,285	579,200	5.64%	1,047.2
Essex County	493	743,159	809,829	8.97%	1,644.3

New York

Nassau County, comprising the westerly end of Long Island (see Figure 5.1-1), consists of five municipalities and is the fifth most populous county of the state's 62 counties. Based on the US Census Bureau's 2020 Census, the population of Hempstead, Nassau County's largest municipality, is 739,409 residents. Nassau County is more densely populated than the statewide average, and its population increased by 4.20% from 2010 to 2020 (US Census Bureau 2023).

Suffolk County, comprising the easterly and of Long Island (see Figure 5.1-1), consists of 13 municipalities and is the 14th most populous county of the state's 62 counties. Based on the US Census Bureau's 2020 Census, the population of Brookhaven, Suffolk County's largest municipality, is 485,773 residents. Suffolk County is more densely populated than the statewide average, and its population increased by 2.81% from 2010 to 2020 (US Census Bureau 2023).

[redacted]

Albany County (see Figure 5.1-2) consists of ten municipalities and is the fourth most populous county of the state's 62 counties. Based on the US Census Bureau's 2020 Census, the population of the City of Albany, Albany County's largest municipality, is 99,224 residents. Albany County is more densely populated than the statewide average, and its population increased by 3.50% from 2010 to 2020 (US Census Bureau 2023).

Kings County (see Figure 5.1-3) consists of the borough of Brooklyn and is the most populous county of the state's 62 counties. Based on the US Census Bureau's 2020 Census, the population of Kings County is 2,736,074 residents. Kings County is more densely populated than the state average, and its population increased by 9.24% from 2010 to 2020 (US Census Bureau 2023).

Queens County (see Figure 5.1-3) consists of the borough of Queens and is the second most populous county of the state's 62 counties. Based on the US Census Bureau's 2020 Census, the population of Queens County is 2,405,464 residents. Queens County is more densely populated than the state average, and its population increased by 7.83% from 2010 to 2020 (US Census Bureau 2023).

Richmond County (see Figure 5.1-4) consists of the borough of Staten Island and is the 11th most populous county of the state's 62 counties. Based on the US Census Bureau's 2020 Census, the population of Richmond County is 495,747 residents. Richmond County is more densely populated than the state average, and its population increased by 5.76% from 2010 to 2020 (US Census Bureau 2023).

New Jersey

Gloucester County (see Figure 5.1-5), located in the southwesterly portion of the state along the Delaware River, consists of 24 municipalities and is the 14th most populous county of the state's 21 counties. Based on the US Census Bureau's 2020 Census, the population of Washington Township, Gloucester County's largest municipality, is 48,667 residents. Gloucester County is more densely populated than the statewide average, and its population increased by 4.86% from 2010 to 2020 (US Census Bureau 2023).

Salem County (see Figure 5.1-5), located in the southwesterly portion of the state along the Delaware River, consists of 15 municipalities. It is the least populous county of the state's 21 counties. Based on the US Census Bureau's 2020 Census, the population of the Pennsville Township, Salem County's largest municipality, is 12,043 residents. Salem County is less densely populated than the statewide average, and its population decreased by 1.89% from 2010 to 2020 (US Census Bureau 2023).

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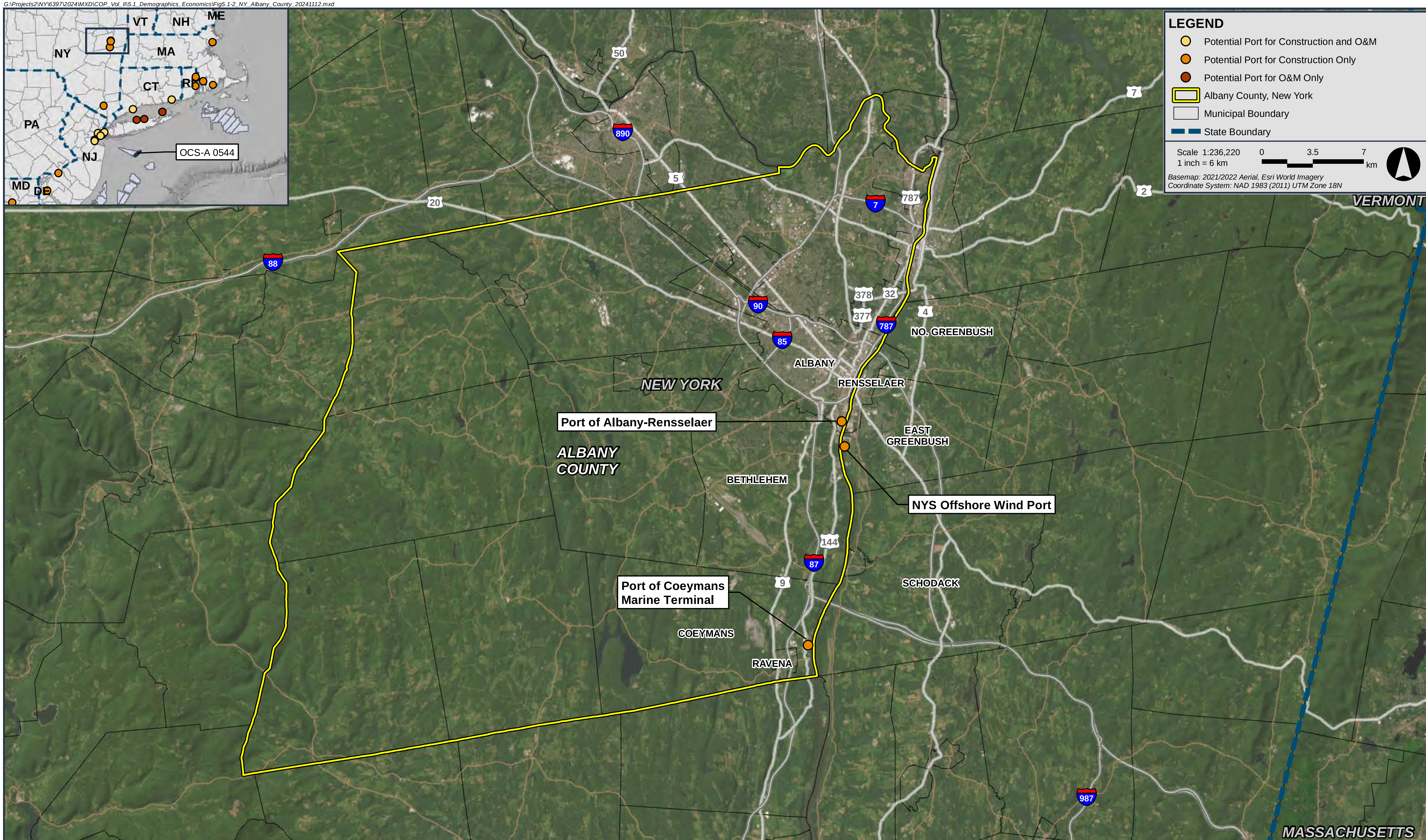

Figure 5.1-2
Albany County, New York

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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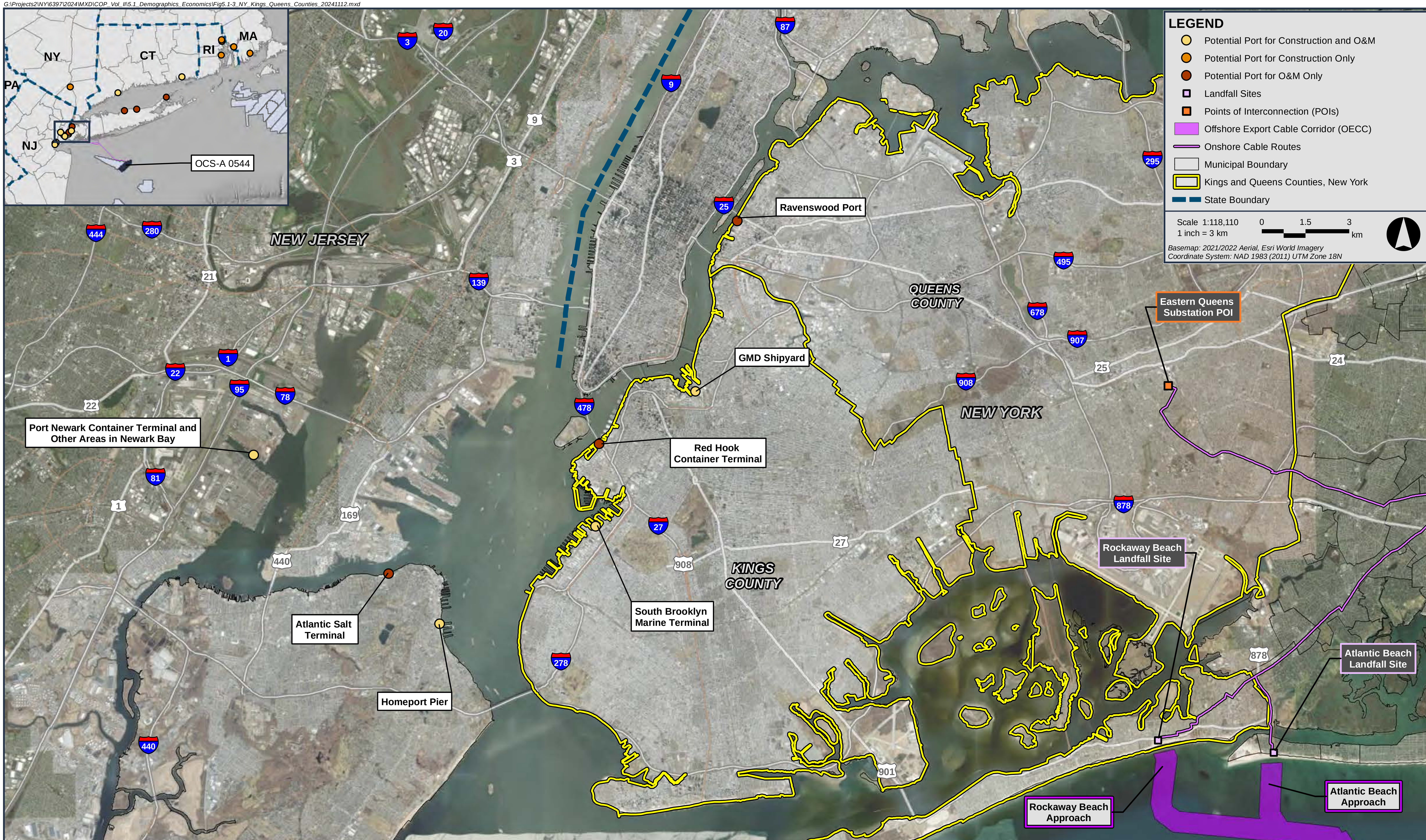

Figure 5.1-3
Kings and Queens Counties, New York

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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Figure 5.1-4
Richmond County, New York

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

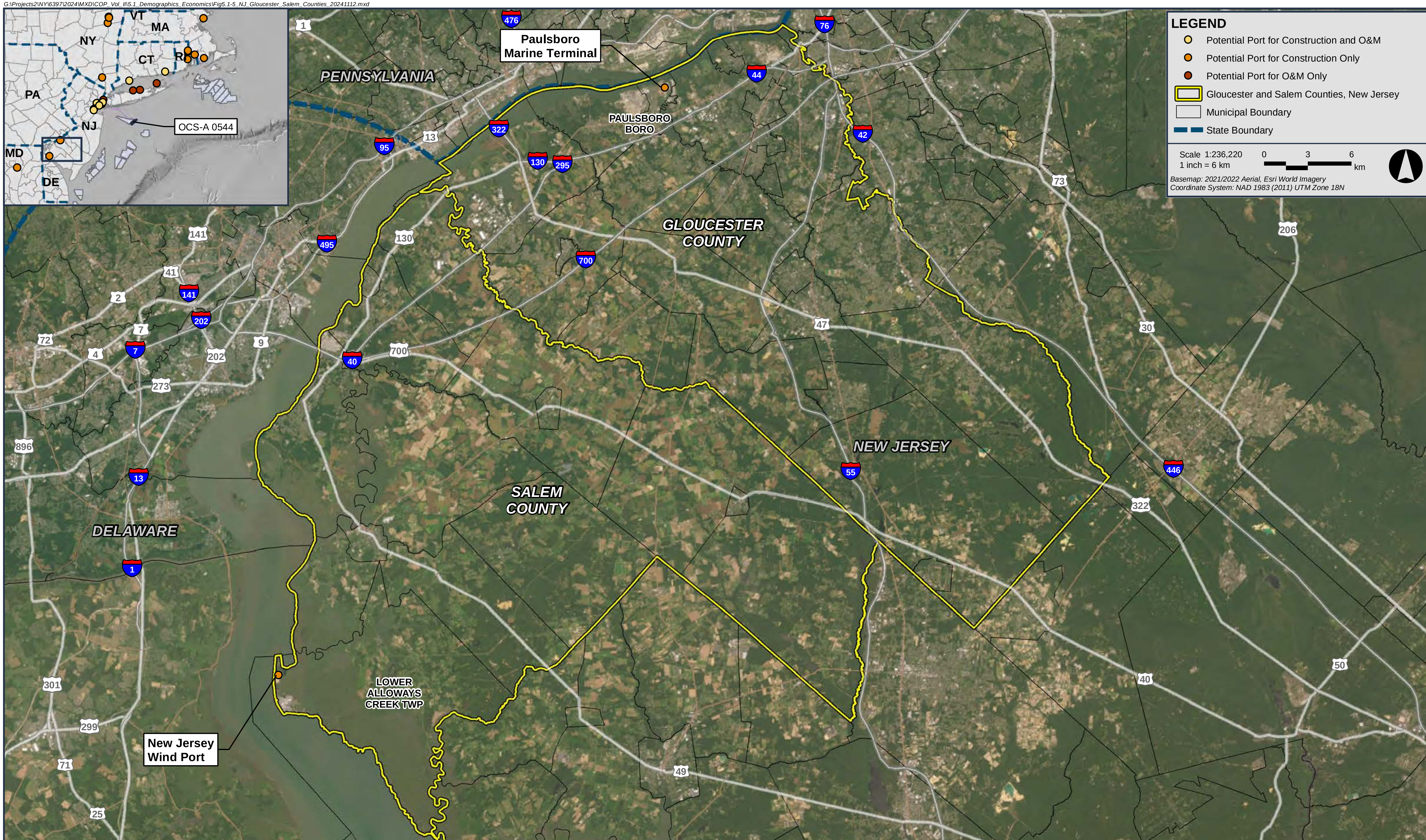

Figure 5.1-5

Gloucester and Salem Counties, New Jersey

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Connecticut

Fairfield County (see Figure 5.1-6), located in the southwesterly portion of the state, consists of 23 municipalities. It is the most populous county of the state's eight counties. Based on the US Census Bureau's 2020 Census, the population of the City of Bridgeport, Fairfield County's largest municipality, is 148,654 residents. Fairfield County is more densely populated than the statewide average, and its population increased by 4.43% from 2010 to 2020 (US Census Bureau 2023).

Rhode Island

Providence County, located in the northernmost region of Rhode Island (see Figure 5.1-7), consists of 16 municipalities and is the most populous county of the state's five counties. Based on the US Census Bureau's 2020 Census, the population of Providence County's largest municipality, the City of Providence, is 190,284 residents. Providence County is more densely populated than the statewide average, and its population increased by 5.44% from 2010 to 2020 (US Census Bureau 2023).

Massachusetts

Bristol County, located in the southeast coastal region of Massachusetts (see Figure 5.1-8), consists of 20 municipalities and is the sixth most populous county of the state's 14 counties. Based on the US Census Bureau's 2020 Census, the population of Bristol County's largest cities, New Bedford and Fall River, is 101,044 and 94,000 residents, respectively. Bristol County is more densely populated than the statewide average, and its population increased by 5.64% from 2010 to 2020 (US Census Bureau 2023).

Essex County, located in the northeast coastal region of Massachusetts (see Figure 5.1-9), consists of 34 municipalities and is the third most populous county of the state's 14 counties. Based on the US Census Bureau's 2020 Census, the population of Essex County's largest cities, Lynn and Lawrence, is 100,843 and 88,508 residents, respectively. Essex County is more densely populated than the statewide average, and its population increased by 8.97% from 2010 to 2020 (US Census Bureau 2023).

5.1.1.2 Housing

The following section describes the general housing characteristics of states and representative counties within the Onshore Development Area. Data from the US Census Bureau (2023a), summarized in Table 5.1-3, identify the total number of housing units, vacant housing units including those units intended for seasonal, recreational, or occasional use, and the number of housing units available for rental. These data are useful for understanding the availability and cost of housing within the Onshore Development Area.

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

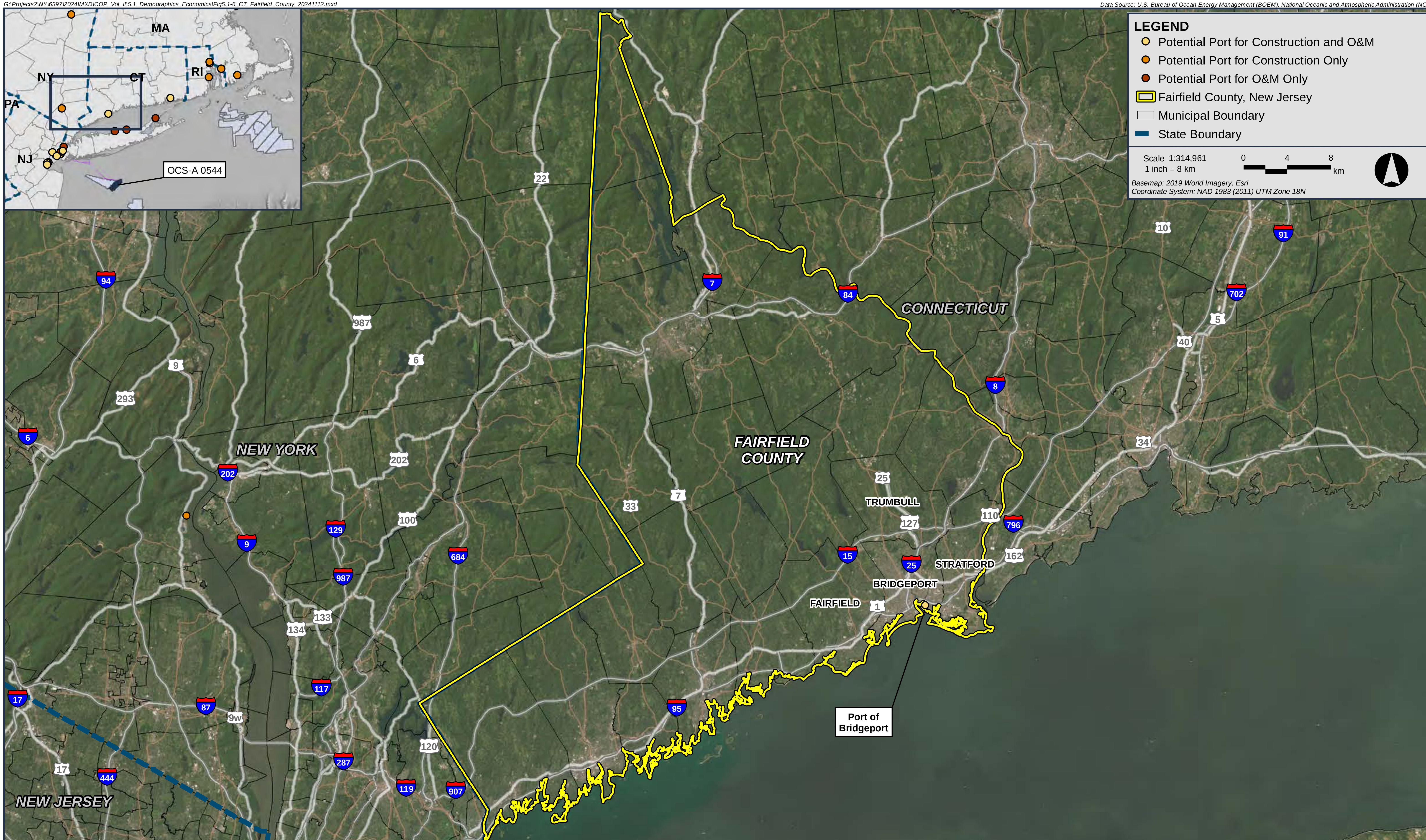

Figure 5.1-6
Fairfield County, Connecticut

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

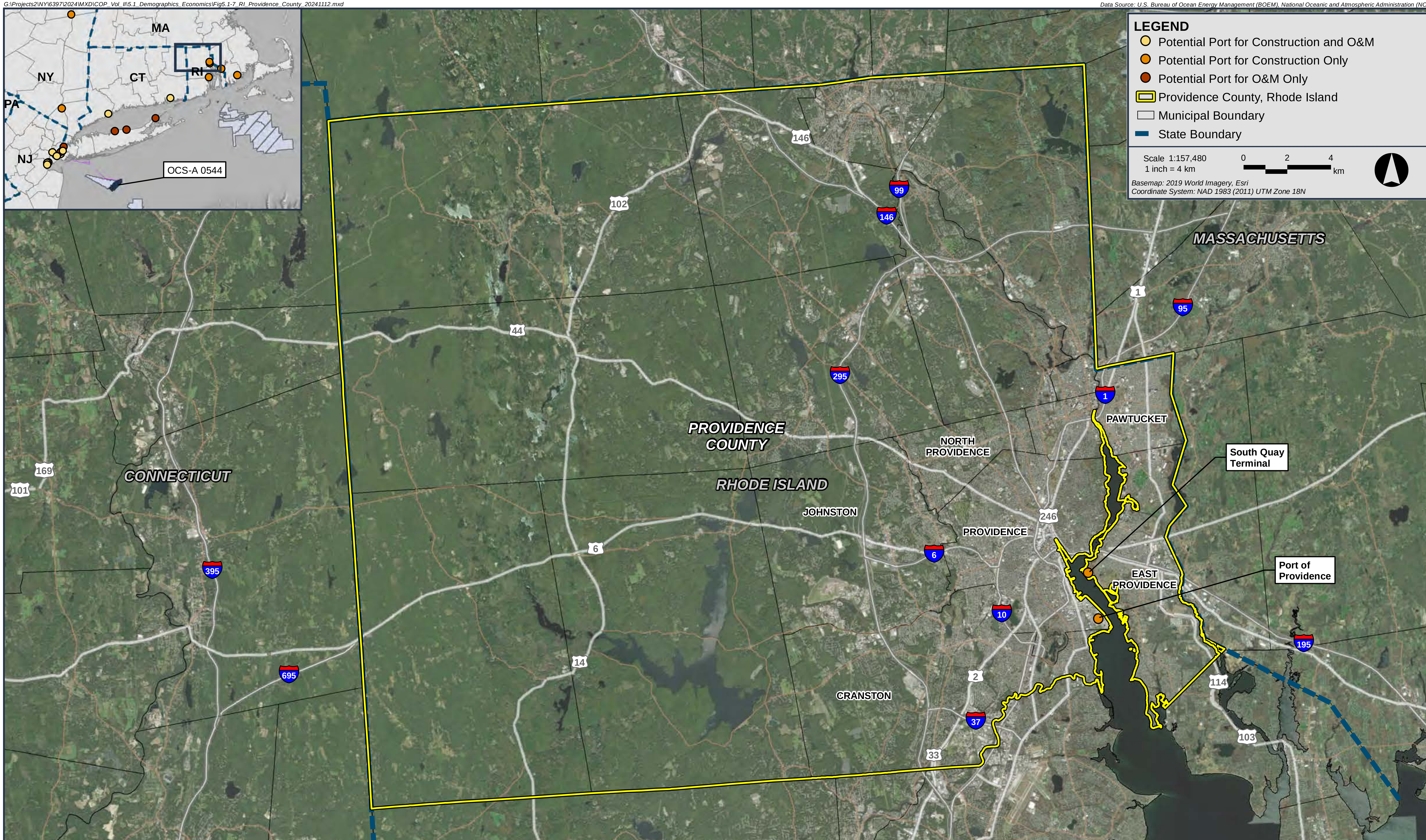

Figure 5.1-7
Providence County, Rhode Island

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

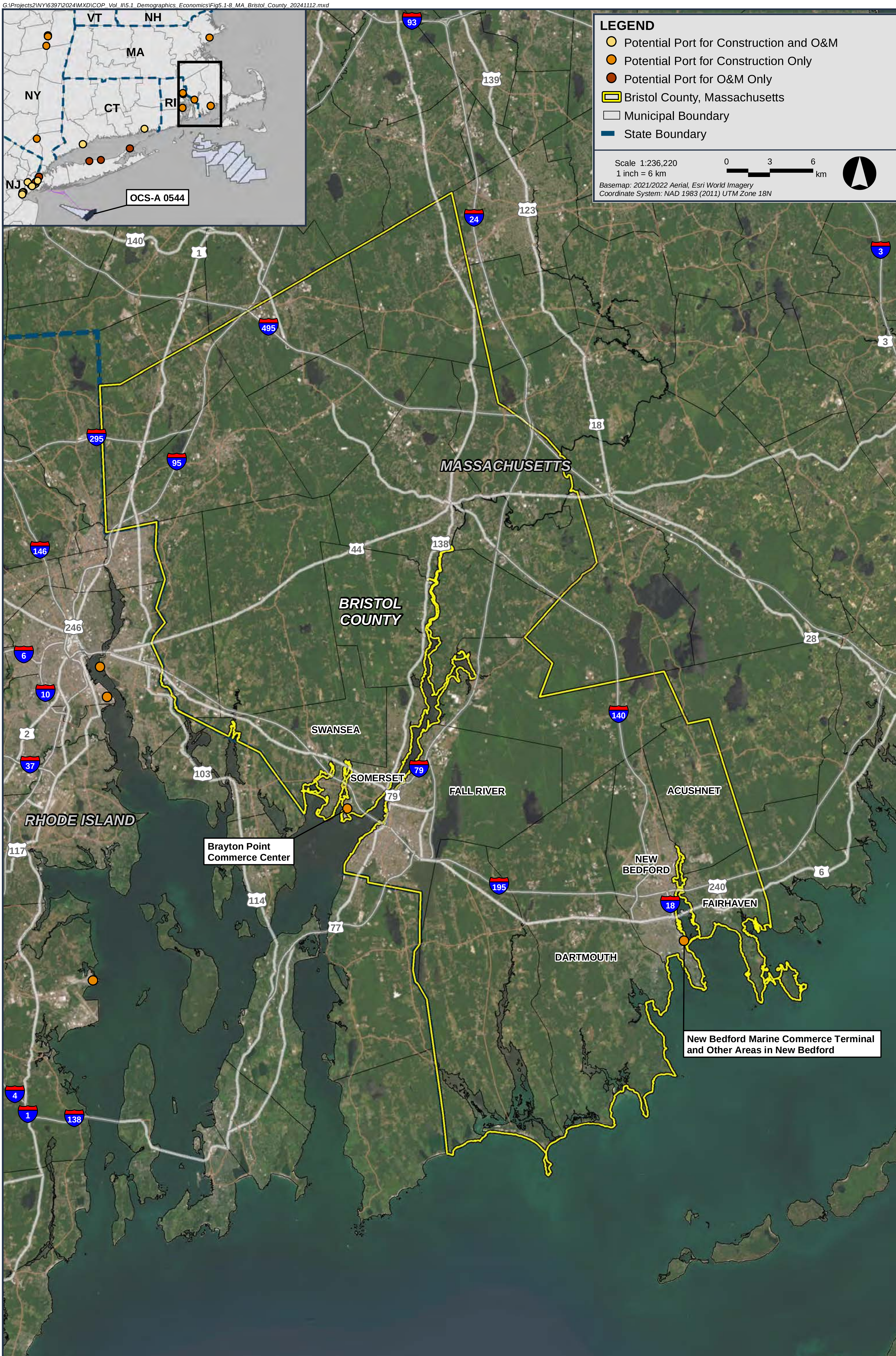

Figure 5.1-8
Bristol County, Massachusetts

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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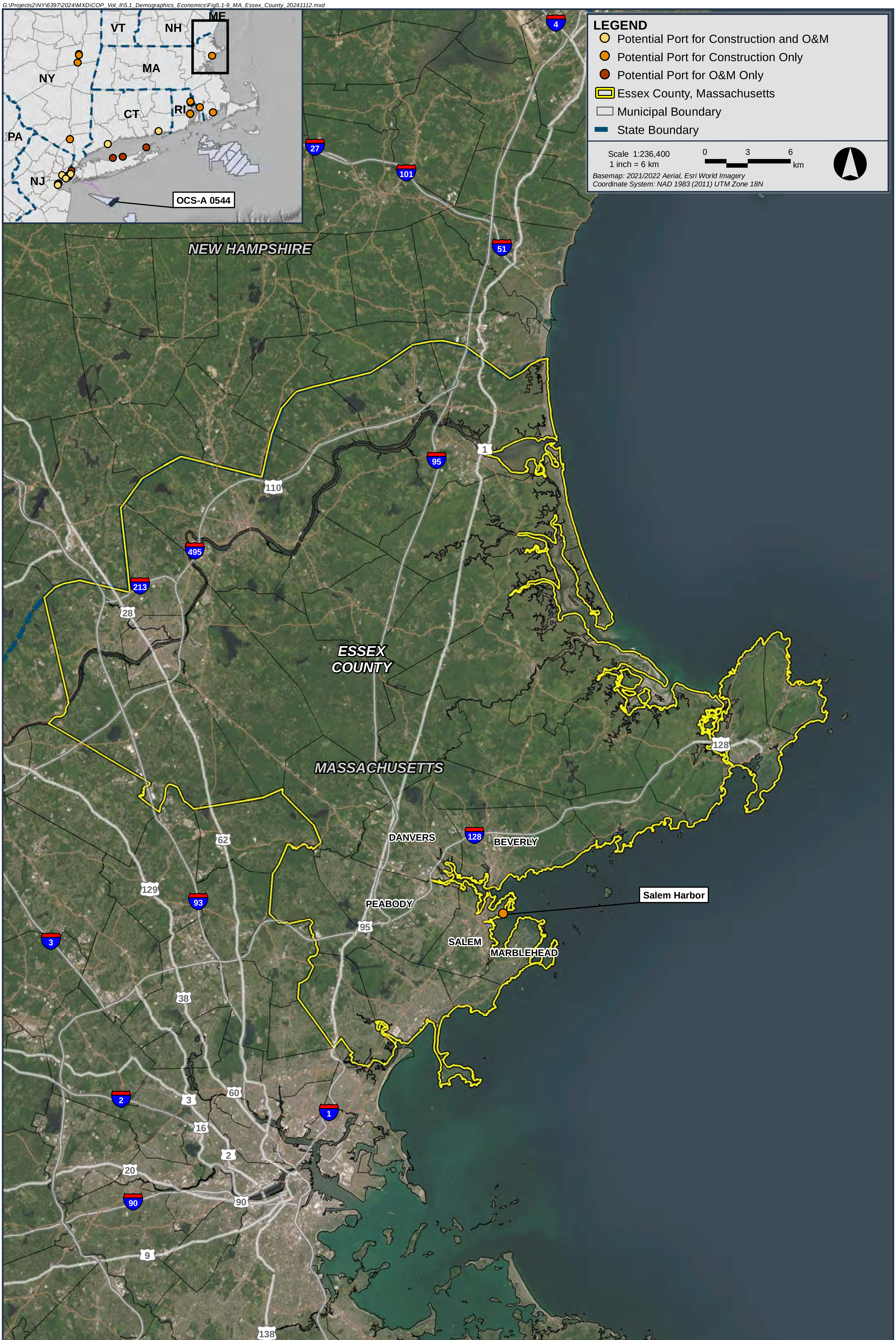

Figure 5.1-9
Essex County, Massachusetts

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Table 5.1-3 Housing

Jurisdiction	Housing Units	Vacant Housing Units	Housing Units for Rent	Housing Units for Seasonal, Recreational, or Occasional Use	Home-owner Vacancy Rate	Rental Vacancy Rate	Median Value	Median Gross Rent
New York	**8,494,452**	**889,929**	**142,703**	**315,085**	**1.2%**	**3.9%**	**$384,100**	**$1,507**
Nassau County	479,982	22,211	3,725	3,931	0.9%	4.5%	$633,800	$2,131
Suffolk County	578,977	68,291	3,130	44,840	0.8%	3.2%	$490,800	$2,113
Albany County	146,137	13,962	2,745	1,689	1.6%	4.5%	$263,800	$1,196
Kings County	1,079,551	81,594	22,066	9,328	1.4%	3.0%	$865,300	$1,715
Queens County	896,825	79,966	14,409	10,103	1.2%	3.0%	$677,700	$1,847
Richmond County	183,524	13,524	3,338	813	2.0%	5.9%	$637,100	$1,602
New Jersey	**3,756,340**	**318,178**	**50,434**	**132,358**	**1.0%**	**3.9%**	**$401,400**	**$1,577**
Gloucester County	117,041	7,045	735	310	0.8%	3.1%	$265,200	$1,435
Salem County	27,738	2,995	449	124	1.3%	5.8%	$208,200	$1,165
Connecticut	**1,531,332**	**121,525**	**23,547**	**27,866**	**1.1%**	**4.7%**	**$323,700**	**$1,374**
Fairfield County[1]	125,378	7,881	2,103	467	1.3%	5.0%	$372,000	$1,446
Rhode Island	**483,053**	**50,834**	**5,915**	**17,659**	**1.0%**	**4.8%**	**$343,100**	**$1,195**
Providence County	276,370	22,735	3,452	1,628	0.9%	4.5%	$310,500	$1,161
Massachusetts	**2,999,314**	**258,319**	**35,407**	**118,416**	**0.7%**	**3.3%**	**$483,900**	**$1,588**
Bristol County	243,297	13,436	2,374	2,375	0.6%	2.6%	$385,000	$1,116
Essex County	326,936	16,877	3,274	5,312	0.6%	2.8%	$535,300	$1,580

Notes:

1. The US Census Bureau has adopted the State of Connecticut's nine Council of Governments/planning regions as county-equivalent geographic units. Data are for the Greater Bridgeport planning region which is a portion of the Fairfield County-equivalent geographic unit.
2. Data are from the US Census Bureau's American Community Survey, 5-year Estimate (2018-2022).

New York

Nassau and Suffolk Counties contain approximately 12.5% of all housing units in New York. In Nassau and Suffolk Counties, homeowner vacancy rates are less than the state average and the rental vacancy rate is greater than the state average. When compared to vacant housing units, the proportion of housing units designated for seasonal, recreational, or occasional use are markedly different in each county. Nassau County has a significantly lower proportion of housing units categorized for seasonal, recreational, or occasional use than that of the state. Suffolk County, however, has a significantly higher proportion of units designated for seasonal, occupational, or occasional use than that of the state, suggesting that Suffolk County has a significant seasonal population.

Kings and Queens Counties contain approximately 23.3% of all housing units in New York. In Kings County, homeowner vacancy rates are greater than the state average and the rental vacancy rate is less than the state average. In Queens County, homeowner vacancy rates are equal to the state average and the rental vacancy rate is less than the state average. The proportion of housing units designated for seasonal, recreational, or occasional use are similar in each county and are less than that of the state.

Richmond County contains approximately 2.2% of all housing units in New York. Both the homeowner and rental vacancy rates in Richmond County are greater than the state average. When compared to total housing units, the proportion of housing units categorized for seasonal, recreational, or occasional use in Richmond County is less than that of the state.

Albany County contains approximately 1.7% of all housing units in New York. Both the homeowner and rental vacancy rates in Albany County are greater than the state average. When compared to total housing units, the proportion of housing units categorized for seasonal, recreational, or occasional use in Albany County is less than that of the state.

New Jersey

Gloucester County contains approximately 3.1% of all housing units in New Jersey. Both the homeowner and rental vacancy rates in Gloucester County are less than the state average. When compared to total housing units, the proportion of housing units categorized for seasonal, recreational, or occasional use in Gloucester County is less than that of the state.

Salem County contains approximately 0.7% of all housing units in New Jersey. Both the homeowner and rental vacancy rates in Salem County are greater than the state average. When compared to total housing units, the proportion of housing units categorized for seasonal, recreational, or occasional use in Salem County is less than that of the state.

Connecticut

The Greater Bridgeport planning region, which is a portion of the Fairfield County-equivalent geographic unit, contains approximately 8.2% of all housing units in Connecticut. Both the homeowner and rental vacancy rates in the Greater Bridgeport planning region are greater than the state average. When compared to total housing units, the proportion of housing units categorized for seasonal, recreational, or occasional use in the Greater Bridgeport planning region is less than that of the state.

Rhode Island

Providence County contains approximately 57.2% of all Rhode Island housing units. The homeowner vacancy rate in Providence County is similar to (and slightly greater than) the state average and the proportion of housing units categorized for seasonal, recreational, or occasional use in Providence County is significantly lower than that of the state.

Massachusetts

Bristol and Essex Counties contain approximately 19.0% of all housing units in Massachusetts. Homeowner vacancy rates in Bristol and Essex County are the same, and lower than the state average. The rental vacancy rate in Bristol County is greater than that of Essex County and the state average. When compared to total housing units, the proportion of housing units categorized for seasonal, recreational, or occasional use in both counties is lower than that of the state; however, Essex County has a higher proportion of units designated for seasonal, occupational, or occasional use than Bristol County.

5.1.1.3 Employment

The following section provides general labor force, income, and employment rates of each state and county within the Onshore Development Area. Data from the US Census Bureau (2023a) are summarized in Table 5.1-4. Additional information about employment in specific industry sectors is provided in Section 5.1.1.4.

Table 5.1-4 Employment Information of the Onshore Development Area

Jurisdiction	Civilian Labor Force	Per Capita Income	Median Household Income	Unemployment Rate
New York	**10,253,938**	**$50,995**	**$119,240**	**6.2%**
Nassau County	739,080	$60,456	$159,334	4.6%
Suffolk County	821,787	$54,127	$141,671	4.8%
Albany County	169,862	$44,101	$110,201	5.2%
Kings County	1,359,468	$43,165	$84,136	7.3%
Queens County	1,236,423	$39,201	$92,848	7.0%
Richmond County	239,189	$43,199	$96,185	5.4%

Table 5.1-4 Employment Information of the Onshore Development Area (Continued)

Jurisdiction	Civilian Labor Force	Per Capita Income	Median Household Income	Unemployment Rate
New Jersey	**4,927,193**	**$50,995**	**$97,126**	**5.0%**
Gloucester County	164,382	$45,933	$99,668	5.2%
Salem County	31,822	$37,904	$73,378	8.0%
Connecticut	**1,947,575**	**$52,034**	**$90,213**	**5.9%**
Fairfield County[1]	173,331	$48,201	$83,147	7.7%
Rhode Island	**587,236**	**$44,538**	**$81,854**	**4.5%**
Providence County	351,656	$39,535	$75,293	4.8%
Massachusetts	**3,877,649**	**$53,513**	**$96,505**	**5.3%**
Bristol County	308,486	$42,006	$80,628	5.7%
Essex County	445,502	$50,932	$94,378	5.3%

Notes:

1. The US Census Bureau has adopted the State of Connecticut's nine Council of Governments/planning regions as county-equivalent geographic units. Data are for the Greater Bridgeport planning region which is a portion of the Fairfield County-equivalent geographic unit.
2. Data are from the US Census Bureau's American Community Survey, 5-year Estimate (2018-2022).

New York

Nassau, Suffolk, Richmond, and Albany Counties have unemployment rates less than the state average, while the unemployment rates in Kings and Queens Counties are greater than the state average. Per capita and median household incomes in Nassau and Suffolk Counties are greater than the state average. Per capita and median household incomes in Albany, Kings, Richmond, and Queens Counties are less than the state average. According to data from the US Census Bureau (2023b), 37.4% of Albany County residents, 56.0% of Nassau County residents, 39.9% of Suffolk County, 63.1% of Kings County, 71.4% of Richmond County residents, and 71.0% of Queens County residents work outside of their respective counties.

New Jersey

Gloucester and Salem Counties have unemployment rates slightly greater than the state average. Per capita income in each county is less than the state average. Median household income in Gloucester County is greater than that of the state, while median household income in Salem County is less than that of the state. According to data from the US Census Bureau (2023b), 70.6% of Gloucester County residents and 76.2% of Salem County residents work outside of their respective counties.

Connecticut

The Greater Bridgeport planning region has an unemployment rate greater than the state average. Per capita and household incomes in the Greater Bridgeport planning region are less than the state average. According to data from the US Census Bureau (2023b), 39.1% of The Greater Bridgeport planning region residents work outside of the county.

Rhode Island

Providence County has an unemployment rate greater than the state average. Per capita and household incomes in Providence are less than the state average. According to data from the US Census Bureau (2023b), 39.1% of Providence County residents work outside of the county.

Massachusetts

Bristol County has an unemployment rate approximately equal to or greater than the state average, while the unemployment rate in Essex County is less than the state average. Per capita and median household income in each county are less than the state average. According to data from the US Census Bureau (2023b), 53.5% of Essex County residents and 55.2% of Bristol County residents work outside of their respective counties.

5.1.1.4 Economy

The following section describes general economic characteristics and trends of each state and county within the Onshore Development Area by providing the GDP from the Bureau of Economic Analysis (2023) in Table 5.1-5, and the distribution of the civilian workforce by major industry sector using North American Industry Classification System (NAICS) codes based on US Census Bureau data (2023a) in Table 5.1-6. The National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management data on "Ocean Economy" activities are also provided in Table 5.1-7. The categories for these activities are based on NAICS codes that depend on the ocean for inputs and include Living Resources (such as commercial fishing, aquaculture, and seafood processing, and markets), Marine Construction, Marine Transportation, Offshore Mineral Resources, Ship and Boat Building, and Tourism and Recreation (NOAA 2023).

Table 5.1-5 GDP of the Onshore Development Area

Jurisdiction	Real GDP[1]		Percentage Change of GDP (2017-2022)	Percentage of US GDP	
	2017	2022		2017	2022
New York	**$1,624,800.7**	**$1,763,524.6**	**8.5%**	**8.3%**	**8.1%**
Nassau County	$100,715.9	$102,601.4	1.9%	0.5%	0.5%
Suffolk County	$98,952.9	$105,050.0	6.2%	0.5%	0.5%
Albany County	$31,742.9	$35,344.3	11.3%	0.2%	0.2%
Kings County	$90,473.2	$107,274.2	18.6%	0.5%	0.5%
Queens County	$98,123.5	$103,324.8	5.3%	0.5%	0.5%
Richmond County	$15,913.5	$17,538.8	10.2%	0.1%	0.1%
New Jersey	**$590,086.7**	**$646,731.3**	**9.6%**	**3.0%**	**3.0%**
Gloucester County	$13,431.3	$13.972.9	4.0%	0.1%	0.1%
Salem County	$5,158.3	$5,245.5	1.7%	0.0%	0.0%

Table 5.1-5 GDP of the Onshore Development Area (Continued)

Jurisdiction	Real GDP[1]		Percentage Change of GDP (2017-2022)	Percentage of US GDP	
	2017	2022		2017	2022
Connecticut	**$273,875.0**	**$276,668.8**	**1.0%**	**1.4%**	**1.3%**
Fairfield County	$91,838.5	$90,361.1	-1.6%	0.5%	0.4%
Rhode Island	**$58,771.6**	**$62,190.9**	**5.8%**	**0.3%**	**0.3%**
Providence County	$34,960.7	$36,416.7	4.2%	0.2%	0.1%
Massachusetts	**$530,129.4**	**$604,357.7**	**14.0%**	**2.7%**	**2.8%**
Bristol County	$25,856.4	$27,281.6	5.5%	0.1%	0.1%
Essex County	$44,185.3	$47,094.9	6.6%	0.2%	0.2%

Note:

1. Millions of chained 2017 United States Dollars (USD).

Table 5.1-6 Percentage of Workforce Employment by Industry in the Onshore Development Area

Economic Sector	New York	Nassau County	Suffolk County	Albany County	Kings County	Queens County	Richmond County	New Jersey	Gloucester County	Salem County	Connecticut	Fairfield County	Rhode Island	Providence County	Massachusetts	Bristol County	Essex County
Educational Services, and Health Care and Social Assistance	**28.8%**	30.9%	28.2%	27.5%	**28.9%**	**26.4%**	**32.3%**	**24.0%**	27.2%	26.6%	**26.5%**	25.8%	**26.8%**	26.9%	**27.9%**	25.9%	24.9%
Professional, Scientific, and Management, and Administrative and Waste Management Services	**12.6%**	13.2%	12.5%	12.6%	**15.1%**	**12.0%**	**11.3%**	**14.1%**	11.0%	8.4%	**11.9%**	13.8%	**11.2%**	10.8%	**15.3%**	10.2%	14.6%
Retail Trade	**9.8%**	9.0%	10.9%	10.2%	**8.9%**	**9.3%**	**9.2%**	**10.7%**	11.8%	9.7%	**10.7%**	11.5%	**11.1%**	11.6%	**9.9%**	12.5%	10.7%
Manufacturing	**5.8%**	4.3%	6.3%	6.1%	**2.9%**	**3.2%**	**2.3%**	**8.1%**	7.3%	11.4%	**10.6%**	8.4%	**10.8%**	11.2%	**9.0%**	10.6%	10.7%
Arts, Entertainment, and Recreation, and accommodation and Food Services	**8.6%**	6.7%	6.9%	8.2%	**9.2%**	**10.4%**	**6.4%**	**7.3%**	7.0%	5.6%	**8.1%**	7.9%	**9.4%**	9.1%	**7.7%**	8.0%	8.3%
Finance and Insurance, and Real Estate and Rental and Leasing	**8.0%**	10.0%	7.2%	7.3%	**7.6%**	**7.7%**	**8.6%**	**8.6%**	7.4%	4.9%	**9.0%**	8.8%	**6.8%**	6.5%	**7.3%**	5.8%	7.1%
Construction	**5.8%**	6.0%	7.9%	4.0%	**4.9%**	**7.4%**	**7.2%**	**6.1%**	6.9%	7.4%	**6.1%**	7.0%	**6.3%**	6.2%	**6.0%**	8.2%	6.2%
Other Services, Except Public Administration	**4.6%**	3.6%	4.0%	4.3%	**5.0%**	**5.9%**	**4.1%**	**4.2%**	3.6%	3.4%	**4.4%**	4.7%	**4.3%**	4.5%	**4.3%**	4.7%	4.4%
Transportation and Warehousing, and Utilities	**5.7%**	5.8%	5.6%	4.0%	**6.7%**	**8.7%**	**7.8%**	**6.5%**	7.1%	10.4%	**4.5%**	4.4%	**4.8%**	5.3%	**4.2%**	5.1%	5.0%
Public Administration	**4.7%**	5.0%	5.2%	12.0%	**3.9%**	**4.4%**	**6.4%**	**4.3%**	4.8%	5.5%	**3.6%**	2.8%	**4.3%**	3.9%	**3.8%**	3.9%	3.9%
Wholesale Trade	**2.1%**	2.8%	2.4%	1.5%	**2.0%**	**1.8%**	**1.8%**	**3.1%**	3.7%	3.9%	**2.2%**	2.4%	**2.3%**	2.5%	**2.0%**	3.1%	2.1%
Information	**2.8%**	2.5%	2.3%	1.9%	**4.8%**	**2.6%**	**2.5%**	**2.6%**	1.8%	1.0%	**2.0%**	2.2%	**1.4%**	1.2%	**2.1%**	1.3%	1.8%
Agriculture, Forestry, Fishing and Hunting, and Mining	**0.6%**	0.2%	0.3%	0.4%	**0.1%**	**0.1%**	**0.1%**	**0.3%**	0.3%	1.7%	**0.4%**	0.2%	**0.5%**	0.3%	**0.4%**	0.7%	0.4%

Table 5.1-7 presents the ocean economy statistics for the Onshore Development Area.

Table 5.1-7 Ocean Economy in the Onshore Development Area

Jurisdiction	Ocean Economy GDP (2012), Millions United States Dollar (USD)	Ocean Economy GDP (2021), Millions USD	Percentage Change of Ocean Economy GDP (2012-2021)	Ocean Economy as Percent of Total GDP (2021)	Individuals Employed in Ocean Economy (2021)	Number of Ocean Economy Establishments (2021)	Largest Ocean Economy Sector by Percentage of GDP
New York	**$22,700.0**	**$27,200.0**	**19.8%**	**1.4%**	**285,921**	**23,092**	**Tourism & Recreation**
Nassau County	$660.3	$1,500.0	127.2%	1.3%	20,999	1,672	Tourism & Recreation
Suffolk County	$1,700.0	$3,000.0	76.5%	2.6%	38,419	2,948	Tourism & Recreation
Albany County	$31.2	$140.3	349.7%	0.4%	1,008	40	Offshore Mineral Resources
Kings County	$984.1	$2,000.0	103.2%	1.7%	29,768	3,853	Tourism & Recreation
Queens County	$428.8	$893.2	108.3%	0.8%	12,677	1,452	Tourism & Recreation
Richmond County	$312.7	$458.7	46.7%	2.4%	6,683	902	Tourism & Recreation
New Jersey	**$8,000.0**	**$14,000.0**	**75.0%**	**2.0%**	**173,251**	**9,724**	**Marine Transportation**
Gloucester County	$110.4	$535.3	384.9%	3.4%	10,086	135	Suppressed
Salem County	$59.5	$125.5	110.9%	1.7%	1,931	75	Marine Transportation

Table 5.1-7 Ocean Economy in the Onshore Development Area (Continued)

Jurisdiction	Ocean Economy GDP (2012), Millions United States Dollar (USD)	Ocean Economy GDP (2021), Millions USD	Percentage Change of Ocean Economy GDP (2012-2021)	Ocean Economy as Percent of Total GDP (2021)	Individuals Employed in Ocean Economy (2021)	Number of Ocean Economy Establishments (2021)	Largest Ocean Economy Sector by Percentage of GDP
Connecticut	**$4,200.0**	**$6,500.0**	**54.8%**	**2.2%**	**61,385**	**3,189**	**Ship & Boat Building**
Fairfield County	$1,200.0	$1,400.0	16.7%	1.4%	17,626	1,459	Tourism & Recreation
Rhode Island	**$2,200.0**	**$3,300.0**	**50.0%**	**4.9%**	**41,174**	**2,435**	**Tourism & Recreation**
Providence County	$656.2	$872.0	32.9%	2.2%	13,775	916	Tourism & Recreation
Massachusetts	**$6,500.0**	**$8,300.0**	**27.7%**	**1.3%**	**86,859**	**5,891**	**Tourism & Recreation**
Bristol County	$222.7	$1,100.0	393.9%	3.5%	8,726	458	Living Resources
Essex County	$678.0	$1,100.0	62.2%	2.2%	16,133	1,278	Tourism & Recreation

New York

In 2022, the GDP of Nassau County was the fifth largest of the 62 New York counties. Growth of Nassau County's GDP was less than the state average from 2017 to 2022. Nassau County's workforce participation by industry sector, as shown in Table 5.1-6, is approximately consistent with the state's participation by industry sector (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Nassau County accounted for 5.5% of New York's ocean economy.

In 2022, the GDP of Suffolk County was the third largest of the 62 New York counties. Growth of Suffolk County's GDP was less than the state average from 2017 to 2022. Suffolk County's workforce participation by industry sector, as shown in Table 5.1-6, is approximately consistent with the state's participation by industry sector (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Suffolk County accounted for 11.0% of New York's ocean economy.

In 2022, the GDP of Albany County was the tenth largest of the 62 New York counties. Growth of Albany County's GDP was greater than the state average from 2017 to 2022. With the exception of public administration, Albany County's workforce participation by industry sector, as shown in Table 5.1-6, is approximately consistent with the state's participation by industry sector (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Albany County accounted for 0.5% of New York's ocean economy.

In 2022, the GDP of Kings County was the second largest of the 62 New York counties. Growth of Kings County GDP was greater than the state average from 2017 to 2022. Kings County workforce participation by industry sector, as shown in Table 5.1-6, is approximately consistent with the state's participation by industry sector (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Kings County accounted for 7.4% of New York's ocean economy.

In 2022, the GDP of Queens County was the fourth largest of the 62 New York counties. Growth of Nassau County's GDP was less than the state average from 2017 to 2022. Queens County workforce participation by industry sector, as shown in Table 5.1-6, is approximately consistent with the state's participation by industry sector (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Queens County accounted for 3.3% of New York's ocean economy.

In 2022, the GDP of Richmond County was the 14th largest of the 62 New York counties. Growth of Nassau County's GDP was greater than the state average from 2017 to 2022. Richmond County workforce participation by industry sector, as shown in Table 5.1-6, is approximately consistent with the state's participation by industry sector (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Richmond County accounted for 1.7% of New York's ocean economy.

New Jersey

In 2022, the GDP of Gloucester and Salem Counties were the 15th and 19th largest, respectively, of all 21 New Jersey counties. Growth of GDP for each county was less than the state average from 2017 to 2022 (see Table 5.1-5). The distribution of each county's workforce by industry sector, as shown in Table 5.1-6, is generally consistent with the state-wide distribution.

Both counties have slightly larger percentages of workforce in education services, health care, and social assistance compared to all of New Jersey (US Census 2023a). Based on NOAA (2023) data, the ocean economies of Gloucester County and Salem County accounted for 3.8% and 0.9%, respectively, of New Jersey's ocean economy.

Connecticut

In 2022, the GDP of Fairfield County was the largest of the eight Connecticut counties. GDP in Fairfield County declined from 2017 to 2022, while the state's GDP increased during the same time period. When compared to the distribution of the Connecticut workforce by industry sector, as shown in Table 5.1-6, the Fairfield County workforce is more concentrated than the state average in the "professional, scientific, and management, and administrative and waste management services" and "finance and insurance, and real estate and rental and leasing" sectors (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Fairfield County accounted for 21.5% of Connecticut's ocean economy.

Rhode Island

In 2022, the GDP of Providence County was the largest of the five Rhode Island counties. Growth of Providence's GDP was less than the state average from 2017 to 2022. Because of its size, Providence County's workforce participation by industry sector, as shown in Table 5.1-6, is approximately consistent with the state's participation by industry sector (US Census 2023a). Based on NOAA (2023) data, the ocean economy of Providence County accounted for 26.4% of Rhode Island's ocean economy.

Massachusetts

In 2022, the GDP of Bristol and Essex Counties were the sixth and fourth largest, respectively, of all 14 Massachusetts counties. Growth of GDP in each county was less than the state average from 2017 to 2022 (see Table 5.1-5). The distribution of each county's workforce by industry sector, as shown in Table 5.1-6, is generally consistent with the state-wide distribution. Both counties have slightly smaller percentages of workforce in education services, health care, and social assistance compared to all of Massachusetts. The percentage of Bristol County's workforce in professional, scientific, management, administrative and waste management services is also notably less than the state percentage, while the construction and retail trade sectors are greater than the state percentage (US Census 2023a). Based on NOAA (2023) data, the ocean economies of Bristol and Essex County each accounted for 13.3% of Massachusetts' ocean economy.

5.1.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect demographics, employment, and economics during the construction, O&M, and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.1-8.

Table 5.1-8 Impact Producing Factors for Demographics, Employment, and Economics

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Workforce Initiatives and Economic Activity	•	•	•
Housing	•		•
Procurement of Materials and Services	•	•	•
Port Utilization	•	•	•

Potential effects to demographics, employment, and economics were assessed using the maximum design scenario for Vineyard Mid-Atlantic as described in Section 1.5.

5.1.2.1 Workforce Initiatives and Economic Activity

Vineyard Mid-Atlantic is expected to result in significant long-term economic benefits, including considerable new employment opportunities that will include a diverse workforce across a range of professions, engaging labor for fabrication, component assembly, other construction tasks, and maintenance of the offshore facilities. Construction and O&M activities are also anticipated to diversify and generate jobs and revenues in the "ocean economy" sectors, particularly for vessel owners and operators, dockage, fueling, inspection/repairs, provisioning, and crew work within the communities near any of the ports described in Section 3.10.1 and 4.4 of COP Volume I. Job opportunities will be created that increase employment stability, particularly within those sectors heavily influenced by seasonal hiring.

The Proponent commissioned an Economic Impact Analysis (see Appendix II-S) based on internal direct expenditure and job creation estimates to approximate the associated indirect and induced economic impacts that would materialize across the New England and Mid-Atlantic regions during the development, construction, and operation of Vineyard Mid-Atlantic. These impact results include total estimated jobs, associated labor income, value added, and economic output. (Note the analysis specifically reviewed potential economic benefits to the Northeast region, including New England, New York, and New Jersey. Other benefits are expected to be realized domestically out of the Northeast region, however, those were not captured in Appendix II-S.) The outputs of this report serve as a conservative approximation of the expected minimum economic impacts associated with the buildout of Vineyard Mid-Atlantic. Furthermore, the economic impacts communicated in the Economic Impact Analysis do not capture the additional benefits associated with the various supply chain localization and facility investments that would likely be included in future Vineyard Mid-Atlantic offtake awards. Lastly, it is important to highlight that the schedule and phases described in the report are representative assumptions made for the sake of this impact analysis and are not intended to reflect the construction and operations schedules proposed or awarded in competitive offtake solicitations.

The indirect and induced expenditure and job creation estimates included in the Economic Impact Analysis were generated utilizing the IMPLAN model, for which the Proponent provided internal estimates of direct expenditure and direct full-time equivalent (FTE) job-years. As defined in Appendix II-S, direct benefits are realized directly from expenditures associated with the development, construction, and operation of Vineyard Mid-Atlantic, including through the purchase of goods and services from Northeast-based businesses; direct employment in Vineyard Mid-Atlantic; investment in supply chain and infrastructure development and workforce training; and other expenditures. Indirect benefits arise from the business-to-business transactions that are inherent within an industry's supply chain (for example, should a developer hire a contractor, and the contractor in turn leases a crane, that lease would be considered an indirect benefit). IMPLAN also reports induced benefits, which reflect household spending resulting from the direct investment. While induced benefits are included in this report, they are harder to track, measure, and verify, and they should therefore be viewed as less precise estimates than direct or indirect benefits.

When fully developed, constructed, and operational (assuming a 30-year operations period), Vineyard Mid-Atlantic is expected to generate substantial economic benefits. Based on the Economic Impact Analysis in Appendix II-S, Table 5.1-9 presents the projected jobs and expenditures during pre-construction, construction, and operations and maintenance.

Table 5.1-9 Total Northeast Economic Benefits of Vineyard Mid-Atlantic

Category		Total (2022-2061)	Pre-Construction and Construction (2022-2031)	Operations and Maintenance (2032-2061)
Jobs (FTE Job-Years)[1]	Direct	4,811	2,432	2,379
	Indirect	5,596	2,504	3,091
	Induced	7,415	3,427	3,989
	Total	**17,822**	**8,363**	**9,459**
Labor Income (millions in 2023$ present value)	Direct	738.7	448.4	290.3
	Indirect	424.8	207.7	217.1
	Induced	373.0	210.3	162.7
	Total	**1,536**	**866.3**	**670.1**
Value Added (millions in 2023$ present value)	Direct	1,650.3	590.9	1,059.4
	Indirect	762.9	316.1	446.7
	Induced	657.6	370.8	286.8
	Total	**3,070.7**	**1,277.8**	**1,792.9**

Table 5.1-9 Total Northeast Economic Benefits of Vineyard Mid-Atlantic (Continued)

Category		Total (2022-2061)	Pre-Construction and Construction (2022-2031)	Operations and Maintenance (2032-2061)
Output[2] (millions in 2023$ present value)	Direct	2,984.5	1,376.5	1,608.0
	Indirect	1,370.1	533.1	837.0
	Induced	1,023.3	577.1	446.2
	Total	**5,377.9**	**2,486.8**	**2,891.2**

Notes:

1. An FTE job year represents the FTE jobs multiplied by the number of employment years. One FTE job-year is the equivalent of one person working full time for 1 year (2,080 hours). Thus, two half-time employees would equal one FTE.
2. Output is the estimated value of all goods and services sold (i.e., expenditures other than payroll).
3. Values may not sum perfectly due to rounding.

Most of the direct pre-construction and construction jobs, and the direct O&M jobs, are anticipated to be located within the Onshore Development Area. A small number of personnel may temporarily relocate to the Onshore Development Area, including those with specialized technical skills or project-specific management experience. Additional workforce may be required for planned periodic maintenance of the onshore facilities, including the onshore export and grid interconnection cables, and periodic maintenance and repairs to the offshore facilities.

Economic activity associated with Vineyard Mid-Atlantic is expected to result in a substantial positive impact on state and local tax receipts. Anticipated positive impacts include increased personal income tax, payroll tax, sales tax, property tax, corporate tax, and other fee and tax revenues paid by the Proponent, its employees, and contractors (direct impacts) and taxes generated through the economic activities created in other areas of the economy through indirect and induced impacts.

Vineyard Mid-Atlantic is expected to provide steady, well-paying jobs that will have direct positive and stabilizing impacts on the workforce within the Onshore Development Area and will result in significant growth in sectors servicing the offshore wind industry. The Proponent is committed to working cooperatively with educational institutions and others to further develop training and educational opportunities for students and residents of the Onshore Development Area. Vineyard Mid-Atlantic intends to prioritize host communities and environmental justice communities for recruitment, training and hiring. As the development progresses, additional commitments are expected, and this section will be updated as needed.

5.1.2.2 Housing

The anticipated increase in employment opportunities during construction may result in an increased demand for temporary housing for workers and their families. As a result, the demand for temporary housing units may increase, potentially resulting in a decrease in vacancy rates and an increase in housing costs within the Onshore Development Area. Based on housing data presented in Section 5.1.1.2, the anticipated increase of workers relocating into the area is unlikely to be greater than the available number of housing units.

5.1.2.3 Procurement of Materials and Services

Construction and O&M activities are expected to result in the increased purchasing of construction and other materials, goods, and services in the Onshore Development Area, including the purchasing of domestic goods and services by the Vineyard Mid-Atlantic workforce. Where feasible, construction and other materials, including vessel provisioning and servicing, will be sourced from within the Onshore Development Area. Impacts associated with the sourcing of materials and services are anticipated to have a stimulating effect on the Onshore Development Area's economy. The procurement of materials and services is anticipated to have location-specific effects, largely dependent on the magnitude of changes relative to existing local conditions.

5.1.2.4 Port Utilization

As described further in Sections 3.10 and 4.4 of COP Volume I, the Proponent has identified a wide range of potential construction ports due to the uncertainty in Vineyard Mid-Atlantic's construction schedule and the expected demand for ports by other offshore wind developers in the coming years. Only a subset of the ports described in Table 3.10-1 of COP Volume I would ultimately be used. The combination of ports used during construction will depend on the final construction schedule, the availability and capability of each port to support construction activities, and the component suppliers that are ultimately selected for Vineyard Mid-Atlantic.

The Proponent expects to use one or more onshore O&M facilities to support the operation of Vineyard Mid-Atlantic's offshore facilities. The O&M facilities, which could be located at or near any of the ports identified in Table 4.4-1 of COP Volume I, are expected to include dock space for service operation vessels, service accommodation and transfer vessels, crew transfer vessels, and/or other support vessels (see Section 4.4.2 of COP Volume I). The O&M facility would likely be used for dispatching technicians and crew exchange, bunkering, and loading supplies and spare parts onto vessels. The O&M facilities may also include offices, a control room, training space for technicians, employee parking, and/or warehouse space for parts and tools.

5.1.2.5 Summary of Avoidance, Minimization, and Mitigation Measures

Vineyard Mid-Atlantic will result in significant long-term economic benefits and high-quality jobs. Accordingly, impacts associated with Vineyard Mid-Atlantic will largely be beneficial to the Onshore Development Area. The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to demographics, employment, and economics during Vineyard Mid-Atlantic are summarized below:

- Vineyard Mid-Atlantic is expected to support approximately 8,363 direct, indirect, and induced FTE job-years during pre-construction and construction. Construction of Vineyard Mid-Atlantic is estimated to generate approximately $866 million in total labor income, approximately $1.3 billion in value added, and approximately $2.49 billion in total economic output, including approximately $292 million in federal, state, county, and municipal taxes. The operation of Vineyard Mid-Atlantic is projected to generate approximately 9,459 FTE job-years assuming a 30-year operational life (equivalent to 315 direct, indirect, and induced FTEs annually), as well as approximately $670 million in total labor income, approximately $1.8 billion in value added, approximately $2.89 billion in total output., and approximately $478 million in taxes.[57]

- The Proponent is committed to working cooperatively with educational institutions and others to further develop training and educational opportunities for students and residents of the Onshore Development Area.

- The Proponent anticipates sourcing many goods and services throughout the multi-decade O&M period from local and regional providers.

- The Proponent recognizes the importance of early engagement with local municipalities and leaders to gain their input with respect to local workforce development and other opportunities. The Proponent will continue to coordinate closely with federal, state, local authorities, and other stakeholders in advance of construction to ensure that the benefits of Vineyard Mid-Atlantic are maximized within the Onshore Development Area.

- Monitoring, outreach, and communication plans for Vineyard Mid-Atlantic are expected to be implemented, as necessary.

5.2 Environmental Justice

This section addresses the potential impacts and benefits of Vineyard Mid-Atlantic on Environmental Justice (EJ) communities surrounding the Offshore Development Area and Onshore Development Area. An overview of the affected environment and the characteristics of EJ communities is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to EJ communities during the construction, operation, and decommissioning of Vineyard Mid-

[57] Estimated economic benefits are based on an assessment of the expected minimum economic impacts associated with the buildout of Vineyard Mid-Atlantic and do not capture additional benefits associated with the various supply chain localization and facility investments that would likely be included in future Vineyard Mid-Atlantic offtake awards.

Atlantic. This section also evaluates whether EJ communities will bear any disproportionately high or adverse impacts, as well as whether EJ communities will receive disproportionately low benefits from Vineyard Mid-Atlantic.

Executive Order (EO) No. 12898,[58] *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued in 1994, requires federal agencies to identify and address any potential disproportionately high and adverse health or environmental effects of federal actions (such as projects requiring federal permits) on population groups of potential concern, including minority populations, low-income populations, and Native American tribes. EO No. 12898 has come to be known as Environmental Justice. EJ is defined by the Environmental Protection Agency (EPA) as:

> *The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or policies.*

EO No. 14096[59], *Revitalizing Our Nation's Commitment to Environmental Justice for All,* which was signed in April 2023, supplements EO No. 12898. The EO affirms the need for all federal agencies to better protect EJ communities and strengthen engagement with these communities. This includes promoting the latest science and research, expanding interagency coordination, and creating a new Office of Environmental Justice within the White House Council on Environmental Quality (CEQ).

In February 2022, the Bureau of Ocean Energy Management (BOEM) issued interim guidelines for identifying and characterizing EJ communities for offshore wind projects in the Atlantic (BOEM 2022). The EJ assessment presented below follows these guidelines, including how the geographical analysis area is defined and how the EJ communities are identified. Based on BOEM's guidelines, this EJ assessment considers the following EJ populations: low-income populations, minority populations, and Native American tribes. These terms are defined further in Sections 5.2.1.1 and 5.2.1.2.

[58] 59 FR 7629; February 16, 1994

[59] 88 FR 25251; April 21, 2023

5.2.1 Description of Affected Environment

As specified in BOEM's EJ guidelines, the affected environment includes all EJ communities in the counties that encompass the Offshore Development Area and Onshore Development Area. This includes EJ communities that may be affected by views of Vineyard Mid-Atlantic's offshore facilities and onshore facilities.

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs)[60], and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities. With respect to EJ, the Onshore Development Area includes the communities surrounding Vineyard Mid-Atlantic's onshore facilities, operations and maintenance (O&M) facilities, onshore construction staging areas, and/or potential port facilities. As discussed in more detail in Sections 3.10 and 4.4 of COP Volume I, the Proponent has identified several ports in New York, New Jersey, Connecticut, Rhode Island, Massachusetts, Maryland, and South Carolina that may be used to stage offshore components during construction, that may be the site of a manufacturing facility, and/or that may be used to support O&M.

EJ communities within the Preliminary Area of Potential Effects (PAPE) for direct visual effects are also considered in this assessment. The PAPE for direct visual effects includes areas from which Vineyard Mid-Atlantic would, with some certainty, be visible and recognizable under a reasonable range of meteorological conditions. For Vineyard Mid-Atlantic's offshore facilities, the PAPE for direct visual effects includes portions of the south shore of Long Island (i.e., portions of Suffolk County, Nassau County, Queens County, and Kings County) as well as portions of coastal New Jersey (i.e., portions of Monmouth County and Ocean County). For Vineyard Mid-Atlantic's onshore facilities, the PAPE for direct visual effects is related to the onshore substations and onshore RCSs (if used), as the onshore cables will be underground. The delineation of the PAPE for direct visual effects is further described in Section 6.2.3 and Appendix II-K.

Table 5.2-1 lists all counties with EJ communities that may be affected by Vineyard Mid-Atlantic (see Figure 5.2-1 for the overall geographic analysis area).

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[60] If high voltage alternating current (HVAC) cables are used, depending upon numerous technical considerations, an onshore RCS may be located along each onshore export cable route to manage the export cables' reactive power (unusable electricity), increase the transmission system's operational efficiency, reduce conduction losses, and minimize excess heating.

Table 5.2-1 Vineyard Mid-Atlantic Affected Environment for Environmental Justice

County	Presence of Onshore and/or Offshore Facilities[1]	Port Usage and/or O&M Facilities	Visibility of the Onshore and/or Offshore Facilities
New York			
Albany	N/A	Port of Albany-Rensselaer, Port of Coeymans Marine Terminal	No
Rensselaer	N/A	New York State (NYS) Offshore Wind Port	No
Rockland	N/A	Port of Tomkins Cove	No
Richmond	N/A	Arthur Kill Terminal, Homeport Pier, Staten Island Marine Terminal, Rossville Municipal Site, Atlantic Salt Terminal	No
Kings	N/A	South Brooklyn Marine Terminal (SBMT), GMD Shipyard, Red Hook Container Terminal	No
Suffolk	Onshore cable routes; Onshore Substation Site Envelope D[2]/ Onshore reactive compensation station (RCS) (if used);[3] Ruland Road Point of Interconnection (POI)	Shoreham, Port Jefferson Harbor, Greenport Harbor	Yes (onshore and offshore facilities)
Queens	Offshore export cables; Rockaway Beach Landfall Site; onshore cable routes; Eastern Queens Substation POI	Ravenswood Generating Station	Yes (onshore and offshore facilities)
Nassau	Offshore export cables; Atlantic Beach and Jones Beach Landfall Sites; onshore cable routes; Onshore Substation Site Envelopes A, B, C, and D[2]/Onshore RCS (if used);[3] East Garden City Substation POI	N/A	Yes (onshore and offshore facilities)
New Jersey			
Gloucester	N/A	Paulsboro Marine Terminal	No
Salem	N/A	New Jersey Wind Port	No
Essex	N/A	Port Newark Container Terminal and Other Areas in Newark Bay	No
Monmouth	N/A	N/A	Yes (offshore facilities)
Ocean	N/A	N/A	Yes (offshore facilities)

Table 5.2-1 Vineyard Mid-Atlantic Affected Environment for Environmental Justice (Continued)

County	Presence of Onshore and/or Offshore Facilities[1]	Port Usage and/or O&M Facilities	Visibility of the Onshore and/or Offshore Facilities
Connecticut			
Fairfield	N/A	Port of Bridgeport	No
New London	N/A	New London State Pier	No
Rhode Island			
Washington	N/A	Port of Davisville	No
Providence	N/A	Port of Providence, South Quay Terminal	No
Massachusetts			
Bristol	N/A	Brayton Point Commerce Center, New Bedford Marine Commerce Terminal and Other Areas in New Bedford	No
Essex	N/A	Salem Harbor	No
Maryland			
Baltimore	N/A	Sparrows Point	No
South Carolina			
Charleston	N/A	Union Pier Terminal, Columbus Street Terminal, Hugh K. Leatherman Terminal, Wando Welch Terminal	No
Berkeley	N/A	Goose Creek	No

Notes:

1. Onshore construction staging areas (i.e., equipment laydown and storage areas) would be proximate to the onshore cable routes. Communities that may be affected by the onshore cable routes may also be affected by onshore construction staging areas.
2. [redacted]
3. The onshore substation site envelopes could also be used for an RCS, however both an RCS and onshore substation site would not be located in the same onshore substation site envelope.

[redacted]

Since EO 12898 was issued, a number of state and federal guidance documents have been published to identify EJ populations and address EJ concerns. The EJ assessment presented herein was conducted in accordance with the following:

- BOEM's interim EJ guidance, Summary Environmental Justice Section of the Annotated Environmental Impact Statement Outline Interim Process for Community Identification for Offshore Wind in the Atlantic (BOEM 2022)
- EPA's EJScreen: Environmental Justice Screening and Mapping Tool (EPA 2023a; EPA 2023b)
- EPA's Technical Guidance for Assessing Environmental Justice in Regulatory Analysis (EPA 2016)
- CEQ's Environmental Justice: Guidance Under the National Environmental Policy Act (CEQ 1997)
- National Environmental Policy Act (NEPA) Committee and the Federal EJ Interagency Working Group's (EJ IWG) Promising Practices for EJ Methodologies in NEPA Reviews (NEPA Committee and EJ IWG 2016)
- The New York State Department of Environmental Conservation (NYSDEC) Commissioner Policy CP-29: Environmental Justice and Permitting (NYSDEC 2003)
- New York State Climate Justice Working Group (NYSCJWG) Draft Disadvantaged Communities Criteria and List Technical Documentation (NYSCJWG 2022)
- New Jersey Environmental Justice Law, N.J.S.A. 13:1D-157 (NJDEP 2020)
- New Jersey Department of Environmental Protection's Environmental Justice Mapping, Assessment, and Protection (EJMAP): Technical Guidance (NJDEP 2022)
- The Connecticut Public Act 20-6 An Act Concerning Enhancements to the State's Environmental Justice Law (Section 22a-20a of the Connecticut General Statutes [CGS])
- Connecticut Department of Energy and Environmental Protection (CT DEEP) Environmental Equity Policy (CT DEEP 1993)
- The Rhode Island Department of Environmental Management's (RIDEM's) Draft Environmental Justice Policy (RIDEM 2022)
- The Commonwealth of Massachusetts' Environmental Justice Policy (EJ Policy) (Executive Office of Energy and Environmental Affairs [EEA] 2021)
- Maryland Department of the Environment (MDE) Environmental Justice Policy and Implementation Plan (MDE 2022a)

- MDE's Environmental Justice Screening Tool (MDE 2022b)

The federal and state criteria for identifying EJ communities included in these guidance documents are summarized in Table 5.2-2 and described in detail in Sections 5.2.1.1 and 5.2.1.2. This EJ assessment considers all populations identified as EJ communities based on both the federal and state criteria. Other communities that may not be fully captured by the federal and state EJ criteria, such as Native American tribes and low-income and minority workers who rely on commercial and recreational fishing, are discussed in Section 5.2.1.3. Section 5.2.1.4 summarizes all EJ communities that may be affected by Vineyard Mid-Atlantic.

Table 5.2-2 Environmental Justice Community Identification Criteria

Geography/Indicator	Indicator Definition	Threshold for EJ Community
Federal		
Low-income population	A household whose annual income is less than twice the federal poverty level, as set by the United States (US) Census Bureau.[1]	If the low-income population exceeds 50% of the total population or is meaningfully greater[2] than the general population.[3]
Minority population	American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; Hispanic.	If the minority population exceeds 50% of the total population or is meaningfully greater[2] than the general population.
New York[4]		
Low-income population	A population having an annual income that is less than the federal poverty level.	A low-income population equal to or greater than 22.82% of the total population.[5]
Minority population	Hispanic; African American or Black; Asian and Pacific Islander; or American Indian.	Having a minority population equal to or greater than 52.42% of the total population in an urban area and 26.28% of the total population in a rural area.[5]
Disadvantaged Communities (DACs)	Identified based on 45 indicators related to environmental burden, climate change risk, population characteristics, and health vulnerabilities. DACs include census tracts where individual members are considered by the Census Bureau to be part of an American Indian and Alaska Native population or where at least 5% of the land is federally designated reservation territory or State-recognized Nation-owned Land.	Census tracts are ranked in terms of both "Environmental and Climate Change Burdens and Risks" and "Population Characteristics and Health Vulnerabilities." DACs have either: (a) high-to-moderate scores on both components, or (b) a high score on one component, and moderate score on the other component.
New Jersey[6]		
Low-income household	A household that is at or below twice the poverty threshold as determined by the US Census Bureau.	At least 35% of the households are low-income.

Table 5.2-2 Environmental Justice Community Identification Criteria (Continued)

Geography/Indicator	Indicator Definition	Threshold for EJ Community
New Jersey[6] (Continued)		
Minority population	A population who does not identify as a single race white and non-Hispanic. Minority populations include: Black, Hispanic, Asian-American, American Indian or Alaskan Native.	At least 40% of the residents identify as minority or a member of a state-recognized tribal community.
Limited English proficiency	A household without an adult that speaks English "very well" as determined by the US Census Bureau.	At least 40% of the households have limited English proficiency.
Connecticut		
Low-income population	Census block where the population is living below 200% of the federal poverty level.	30% or more of the population consists of low-income persons.
Minority population	Not considered in EJ definition.	
Distressed Municipality	Score based on fiscal and economic indicators such as the tax base, resident's income, and the resident's need for public services.	Towns are ranked based on several criteria (e.g., per capita income, percent of poverty, unemployment). The top 25 towns with highest total scores are designated as Distressed Municipalities. Distressed Municipalities also include municipalities that no longer meet the threshold requirements but are still in a five-year grace period.
Rhode Island		
Low-income population	Based on annual median household income in the state.	Annual median household income is not more than 65% of the statewide annual median household income.
Minority population	Hispanic; African American or Black; Asian and Pacific Islander; or American Indian.	Minority population is equal to or greater than 40% of the population.
English proficiency	English proficiency.	25% or more of the households lack English language proficiency.
Combined (low-income and minority)	Same as above.	Minorities comprise 25% or more of the population and the annual median household income of the municipality does not exceed 150% of the statewide annual median household income.
Massachusetts		
Low-income population	Based on annual median household income in the state.	The annual median household income is not more than 65% of the statewide annual median household income.
Minority population	Latino/Hispanic, Black/African American, Asian, Indigenous people, and people who otherwise identify as non-white.	Minorities comprise 40% or more of the population.

Table 5.2-2 Environmental Justice Community Identification Criteria (Continued)

Geography/Indicator	Indicator Definition	Threshold for EJ Community
Massachusetts (Continued)		
English isolation	English proficiency in no one over 14 years old in the household.	25% or more of households lack English proficiency.
Combined (low-income and minority)	Same as above.	Minorities comprise 25% or more of the population and the annual median household income of the municipality does not exceed 150% of the statewide annual median household income.
Maryland[7]		
Low-income population	Below the federal poverty level as defined by the US Census Bureau.	At least 25% of the residents qualify as low-income.
Minority population	A resident who identifies as non-white.	At least 50% of residents are minorities.
Limited English proficiency	A limited English proficiency household as defined by the Census Bureau as "one in which no member 14 years old and over: (1) speaks only English or (2) speaks a non-English language and speaks English "very well." In other words, all members 14 years old and over have at least some difficulty with English."	At least 15% of the residents have limited English proficiency.
Overburdened Community	Identified based on 21 environmental health indicators that include: pollution burden exposure and environmental effects, health vulnerabilities, and socioeconomic/demographic indicators.	Census tracts with EJ Score in which three or more of the 21 environmental health indicators are above the 75th percentile statewide.
South Carolina[8]		
Low-income population	No specific EJ criteria	N/A
Minority population	No specific EJ criteria	N/A

Notes:

1. Definition from EJScreen technical documentation (EPA 2023b).
2. The 80th percentile is used as the threshold for "meaningfully greater." That is, a community is identified as minority or low-income if it is in the 80th or higher percentile for minority or low-income status as compared to the state population.
3. Threshold as defined by BOEM's interim EJ guidance (BOEM 2022).
4. New York City has slightly different criteria than New York State; the State criteria are listed and used in the EJ analysis.
5. These criteria define the Potential EJ Areas (see NYSDEC 2020).
6. EJ communities in New Jersey are termed "Overburdened Communities" and are identified using the criteria outlined in the table for low-income household, minority population, and limited English proficiency.
7. EJ Communities in Maryland are termed "Underserved Communities" and are identified using the criteria outlined in the table for low-income population, minority population, and limited English proficiency.
8. South Carolina does not have official definitions for EJ communities; therefore, the federal definitions were used.

EJ assessments are based on statistics primarily obtained from United States (US) Census Bureau datasets. These datasets include the last full-count Census (currently dated 2020), which is re-done every decade, the rolling five-year American Community Survey (ACS) estimates from smaller annual survey samplings (utilized by EPA in EJScreen), or one-year smaller survey estimates.

5.2.1.1 Federal EJ Criteria

The federal EJ criteria for a minority population group are defined by CEQ's (1997) *Environmental Justice Guidance Under the National Environmental Policy Act*. CEQ defines a minority as "individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic." CEQ identifies a minority EJ population (or community) as one where either: (1) the minority population of the affected area exceeds 50%, or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. CEQ defines low-income populations based on the annual statistical poverty thresholds from the US Census Bureau's Current Population Reports Series P-60 on Income and Poverty but does not provide a threshold level for identifying a low-income population or community.

Therefore, for the purposes of this EJ assessment, criteria from BOEM's interim EJ guidance (BOEM 2022) and data from EJScreen were used to identify an EJ community at the federal level. EJScreen data is from ACS version (v) 2022, which includes ACS five-year summary data from 2016–2020 based upon 2020 Census block group boundaries. Communities were identified as EJ communities if the minority or low-income population in the block group is greater than 50% or if the block group is in the 80th percentile or greater compared to all other block groups in the state.

5.2.1.2 State-Specific EJ Policies

The EJ community criteria specific to the states that may be affected by Vineyard Mid-Atlantic activities are summarized above in Table 5.2-2 and described in the following sections.

New York

NYSDEC's policy related to EJ, Commissioner Policy CP-29: *Environmental Justice and Permitting*, "provides guidance for incorporating environmental justice concerns into the NYSDEC environmental permit review process and the NYSDEC application of the State Environmental Quality Review Act. The policy also incorporates environmental justice concerns into some aspects of the NYSDEC's enforcement program, grants program and public participation provisions" (NYSDEC 2003).

NYSDEC (2020) identifies "Potential EJ Areas" as US Census block groups that meet or exceed at least one of the following statistical thresholds:

- At least 52.42% of the population in an urban area reported themselves to be members of minority groups;
- At least 26.28% of the population in a rural area reported themselves to be members of minority groups; or
- At least 22.82% of the population in an urban or rural area had household incomes below the federal poverty level.

The federal poverty level and urban/rural designations for census block groups are established by the US Census Bureau. The thresholds are based on statistical analysis of the 2014–2018 ACS data, which was the most recent data available at the time of the analysis in 2020.

New York City has slightly different thresholds for EJ populations than New York State. For low-income communities, New York City defines EJ populations as those where 23.59% or more of the total population is below the federal poverty level. New York City defines minority communities as those where the minority population is greater than or equal to 51.1% of the total population. For the purposes of this EJ assessment, New York State thresholds were used.

In addition to defining Potential EJ Areas, the New York State Climate Justice Working Group finalized criteria for defining "Disadvantaged Communities" (DACs). The Working Group's goal is to advance the implementation of the Climate Leadership and Community Protection Act ("Climate Act"). Under the Climate Act, DACs are defined as "communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low- and moderate- income households." DACs are identified based on a set of 45 indicators that include environmental burden, climate change risk, population characteristics, and health vulnerabilities (NYSCJWG 2022). Census tracts must rank relatively high in terms of both "Environmental and Climate Change Burdens and Risks" and "Population Characteristics and Health Vulnerabilities" (or very high in one of these categories) to be identified as a DAC. DACs also include census tracts where individual members are considered by the Census Bureau to be part of an American Indian and Alaska Native population or where at least 5% of the land is federally designated reservation territory or State-recognized Nation-owned Land, regardless of indicator scores. The DAC criteria will be used to prioritize these communities with regard to reducing air pollution and greenhouse gas emissions, as well as in regulatory impact statements and in the allocation of investments in clean energy and energy efficiency.

New Jersey

In 2020, New Jersey published its Environmental Justice Law requiring "the New Jersey Department of Environmental Protection to "evaluate environmental and public health impacts of certain facilities on overburdened communities when reviewing certain permit applications" (NJDEP 2020).

The law defines an "Overburdened Community" (equivalent to an EJ community) as a census block group where:

- At least 35% of the households qualify as low-income households (at or below twice the federal poverty level);
- At least 40% of the residents identify as minority or members of a state-recognized tribal community; or
- At least 40% of the households have limited English proficiency (a household without an adult that speaks English "very well," as determined by the US Census Bureau).

In addition, New Jersey identifies "adjacent block groups" as a "block group identified by the US Census Bureau with a population of zero that are also immediately next to one or more statutorily defined overburdened communities." (NJDEP 2022)

The most recently updated EJ Map for New Jersey uses data from the five-year ACS for 2017–2021.

Connecticut

It is the policy of CT DEEP that, "no segment of the population should, because of its racial or economic makeup, bear a disproportionate share of the risks and consequences of environmental pollution or be denied equal access to environmental benefits. The Department is committed to incorporating environmental equity into its program development and implementation, its policy making and its regulatory activities" (CT DEEP 1993).

Connecticut's state-level criteria for an "Environmental Justice Community" uses the following definitions:

- A US census block group, as determined in accordance with the most recent US census, for which 30% or more of the population consists of low-income persons who are not institutionalized and have an income below 200% of the federal poverty level; or
- A "Distressed Municipality," as discussed below.

The Connecticut Environmental Justice Maps were last updated in January 2023 and are based on data from the 2017–2021 ACS five-year estimates (Onat et al. 2023). Distressed Municipalities are scored based on fiscal and economic indicators including the tax base, personal income of residents, and the residents' need for public services; the top 25 towns with the highest total scores are designated as Distressed Municipalities (CT DECD 2023). Additionally, Distressed Municipalities include municipalities that no longer meet the threshold requirements but are still in a five-year grace period. The Department of Economic and Community Development (DECD) maintains a list of Distressed Municipalities, which are used by state agencies to target funding for housing, insurance, open space, brownfield remediation, and economic development programs (CT DECD 2023).

Rhode Island

RIDEM has published a Draft *Environmental Justice Policy*, which "represents RIDEM's ongoing commitment and dedication to the State of Rhode Island and the people who live within its communities who are often disproportionately impacted by environmental issues and lack of access to natural resource opportunities" (RIDEM 2022).

As specified in the draft EJ Policy, Rhode Island has identified "Environmental Justice Focus Areas," which are the same as EJ communities, as census tracts that meet one or more of the following criteria:

- Annual median household income is not more than 65% of the statewide annual median household income;
- Minority population is equal to or greater than 40% of the population;
- 25% or more of the households lack English language proficiency; or
- Minorities comprise 25% or more of the population and the annual median household income of the municipality does not exceed 150% of the statewide annual median household income.

There are some areas of Rhode Island that are not EJ communities but may be considered EJ communities using the above criteria because of the inclusion of prisons in the area or seasonal student populations that might be counted as non-white populations with low or no income.

This is a limitation of how the US Census Bureau compiles demographic statistics at the census block level. For example, the Quonset Point and the Newport Naval Base areas of Narragansett are comprised of primarily seasonal homes that are used by University of Rhode Island students during the school year. This means that this assessment is likely overcounting the EJ communities in some areas of Rhode Island.

Massachusetts

EJ populations are the focus of the state's EJ Policy, which establishes EJ as a key consideration in all EEA programs when applicable and allowable by law (EEA 2021). Specifically, as stated in the state's EJ Policy (EEA 2021):

> *It is the policy of the Executive Office of Energy and Environmental Affairs that environmental justice principles shall be an integral consideration, to the extent applicable and allowable by law, in making any policy, making any determination or other action related to a project review, in undertaking any project…. including but not limited to, the grant of financial resources or technical assistance, the promulgation, implementation and enforcement of laws, regulations, and policies, the provision of access to both active and passive open space, and the diversification of energy sources, including energy efficiency and renewable energy generation.*

- In Massachusetts, an EJ population is defined as a neighborhood (census block group) that meets one or more of the following criteria: The annual median household income is not more than 65% of the statewide annual median household income;
- Minorities comprise 40% or more of the population;
- 25% or more of households lack English language proficiency; or
- Minorities comprise 25% or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150% of the statewide annual median household income.

The Massachusetts Environmental Justice Maps were last updated in 2022; this update included EJ communities based on 2020 Census block groups and data from 2016–2020 ACS five-year estimates.

Maryland

The Maryland Department of the Environment (MDE) issued an Environmental Justice Policy and Implementation Plan in 2022 (MDE 2022a). This plan outlines how MDE will implement environmental laws and programs to protect and restore the environment and address any inequities for EJ communities. MDE considers both underserved and overburdened communities in order to identify communities with EJ concerns.

As noted in the plan, MDE defines "Underserved Communities" (equivalent to EJ communities) as any census tract with the following characteristics based on the latest US Census Bureau data:

- at least 25% of the residents qualify as low-income;

- at least 50% of the residents identify as non-white; or
- at least 15% of the residents have limited English proficiency.

In addition, MDE defines "Overburdened Communities" using an EJ screening score based on 21 environmental health indicators that include pollution burden exposure and environmental effects, health vulnerabilities, and socioeconomic/demographic indicators. Overburdened Communities are any census tract in which three or more of the 21 environmental health indicators are above the 75th percentile statewide. MDE has created a mapping/Geographic Information System (GIS) tool to help identify EJ communities in Maryland (MDE 2022b). This tool was used to identify both Underserved Communities and Overburdened Communities.

South Carolina

The South Carolina Department of Health and Environmental Control (DHEC) uses the EJ definition established by EPA: "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." In 2022, DHEC issued its 2022-2024 Bridge Strategic Plan to further the goals of the agency including "promoting and protecting the health of the public and the environment" (DHEC 2023). As South Carolina is still in the process of planning for how the state will address EJ, the Proponent found no EJ definitions or tools similar to those used in other states. Therefore, the federal definitions were used to identify EJ communities in South Carolina.

5.2.1.3 Other Communities

This EJ assessment considers Native American tribes as well as low-income and minority workers who are employed in commercial fishing, for-hire recreational fishing, and supporting industries (e.g., seafood processing and distribution, vessel and port maintenance) or who rely on recreational fisheries as a food source and may be impacted by Vineyard Mid-Atlantic activities.

EPA's EJ policies recognize the need to consider Native American tribes that may not be included in the definition of minority (EPA 2016). Any communities with federally or state-recognized Native American tribes that may not fall under the federal or state definition of minority were identified using US Census Bureau GIS data (US Census Bureau 2022).[61] The GIS data were obtained from the ACS and include "American Indian and Alaska Native legal and

[61] The GIS datafile is named "TIGER/Line Shapefile, 2022, Nation, U.S., American Indian/Alaska Native/Native Hawaiian Areas (AIANNH)" and is available at https://www.census.gov/cgi-bin/geo/shapefiles/index.php.

statistical areas," such as federally recognized American Indian reservations and off-reservation trust land areas, state-recognized American Indian reservations, tribal designated statistical areas, and state-designated tribal statistical areas (US Census Bureau 2022).

As further described in Sections 5.3 and 5.4, Vineyard Mid-Atlantic activities may impact commercial and recreational fisheries, which may, in turn, affect EJ communities who rely on these industries. National Oceanic and Atmospheric Administration (NOAA) Fisheries' Community Social Vulnerability Indicators were used to evaluate potential EJ populations in the geographic analysis area that also have a high level of "fishing engagement" or "fishing reliance" (NOAA Fisheries 2019). Fishing engagement indicates that there is a relatively large amount of commercial or recreational fishing activity in the area (e.g., based on permits, fish dealers, etc.), whereas fishing reliance is a measure of the amount of commercial or recreational fishing in relation to the population size of a community. While subsistence fishing may be affected by Vineyard Mid-Atlantic activities, there is a lack of subsistence fishing reliance indicators; therefore, recreational fishing reliance is used as a proxy for subsistence fishing reliance. The results of this evaluation are summarized for each state in Section 5.2.1.4.

5.2.1.4 Environmental Justice Populations

Table 5.2-1 above lists all counties with EJ communities that may be affected by Vineyard Mid-Atlantic activities. Table 5.2-3 shows the number of EJ communities in each of these counties, as defined by federal and state criteria, as well as the counties with any tribal areas or high fishing engagement (no EJ areas overlap with areas of high fishing reliance). These EJ communities are illustrated in Figures 5.2-2 through 5.2-20. A summary of the EJ communities in each state is provided below.

Table 5.2-3 Environmental Justice Communities Within the Study Area

Location (County)	Figure	Number of EJ Communities		Tribal Areas[2]	NOAA High Fishing Engagement[3]
		Federal	State[1]		
New York					
Albany	5.2-2	62	56 EJ Areas & 23 DACs	0	No
Rensselaer	5.2-2	27	31 EJ Areas & 0 DACs	0	No
Rockland	5.2-3	90	73 EJ Areas & 18 DACs	0	No
Richmond	5.2-4 and 5.2-8	110	99 EJ Areas & 36 DACs	0	Yes (recreational)
Kings	5.2-4 and 5.2-8	1,470	1,432 EJ Areas & 308 DACs	0	Yes (recreational)
Suffolk	5.2-5, 5.2-7 and 5.2-8	198	217 EJ Areas & 43 DACs	2	Yes (commercial and recreational)
Queens	5.2-6, 5.2-7 and 5.2-8	1,342	1,270 EJ Areas & 211 DACs	0	Yes (recreational)
Nassau	5.2-6, 5.2-7, and 5.2-8	347	314 EJ Areas & 44 DACs	0	No

Table 5.2-3 Environmental Justice Communities Within the Study Area (Continued)

Location (County)	Figure	Number of EJ Communities		Tribal Areas[2]	NOAA High Fishing Engagement[3]
		Federal	State[1]		
New Jersey					
Gloucester	5.2-9	31	53	0	No
Salem	5.2-9	13	13	0	No
Essex	5.2-10	460	503	0	No
Monmouth	5.2-11	74	109	0	N/A[4]
Ocean	5.2-11	73	85	0	N/A[4]
Connecticut[5]					
Fairfield	5.2-12 and 5.2-14	228	174 EJ Areas & 2 Distressed Municipalities	1	No
New London	5.2-13 and 5.2-14	47	57 EJ Areas & 10 Distressed Municipalities	5	Yes (recreational)
Rhode Island					
Washington	5.2-15	7	0	1	Yes (commercial and recreational)
Providence	5.2-15	207	87	0	No
Massachusetts					
Bristol	5.2-16 and 5.2-18	130	183	1	Yes (commercial)
Essex	5.2-17 and 5.2-18	165	267	0	Yes (commercial and recreational)
Maryland					
Baltimore	5.2-19	233	106 Underserved & 51 Overburdened Communities	0	No
South Carolina					
Charleston	5.2-20	28	N/A	0	Yes (recreational)
Berkeley	5.2-20	15	N/A	1	Yes (recreational)

Notes:

1. Some states define populations with EJ concerns based on demographic characteristics (e.g., low-income, minority, and limited English proficiency) as well as by other environmental or health indicators (e.g., DACs in New York or Distressed Municipalities in Connecticut).
2. Tribal areas were identified using "American Indian and Alaska Native legal and statistical areas" from the US Census Bureau, which do not necessarily take into account non-"statistical areas" that may be of cultural or historical significance to a particular Native American tribe.
3. NOAA Fisheries' Community Social Vulnerability Indicators were used to evaluate potential EJ populations in the geographic analysis area that also have a high level of "fishing engagement" or "fishing reliance" (NOAA Fisheries 2019). Fishing engagement indicates that there is a relatively large amount of commercial or recreational fishing activity in the area (e.g., based on permits, fish dealers, etc.), whereas fishing reliance is a measure of the amount of commercial or recreational fishing in relation to the population size of a community.
4. Since Monmouth and Ocean Counties in New Jersey may only experience direct visual effects from Vineyard Mid-Atlantic's offshore facilities and do not contain onshore facilities or port facilities, areas of high fishing engagement or reliance were not assessed.
5. The Distressed Municipalities in Connecticut include those in the 5-year grace period.

New York

As shown in Table 5.2-3, there are a number of federal and state EJ communities in the counties of Albany, Rensselaer, Rockland, Richmond, Kings, Suffolk, Queens, and Nassau that may potentially be impacted by Vineyard Mid-Atlantic activities. Figure 5.2-2 shows the EJ communities and tribal areas in Albany and Rensselaer Counties where potential construction ports are located. EJ areas are concentrated primarily near the city of Albany. Figure 5.2-3 shows EJ areas in Rockland County where another potential construction port is located, although the port is not in an EJ area. Figure 5.2-4 shows EJ areas in the counties of Richmond and Kings where several potential construction and O&M ports are located. EJ areas in Suffolk County are shown in Figure 5.2-5 and can be found near the onshore facilities and potential O&M ports. Figure 5.2-6 shows the EJ areas in Queens and Nassau County where the OECC (the state waters portion) and onshore facilities are proposed. As shown in Figure 5.2-7, a relatively small number of EJ communities along the southern coast of Long Island in Queens, Nassau, and Suffolk Counties are within the PAPE for direct visual effects from the offshore facilities. In addition, EJ communities are within the PAPE for direct visual effects from the onshore facilities (specifically Onshore Substation Site Envelopes A, B, and C; no EJ communities are within the visual PAPE for Onshore Substation Site Envelope D).

EJ areas overlap with areas of high recreational fishing engagement in Brooklyn (Kings County) and near Port Jefferson Harbor (Suffolk County), and with areas of high recreational and commercial fishing engagement in Montauk and Hampton Bays (Suffolk County) and near the Rockaway Beach Landfall Site and OECC in Queens County (see Figure 5.2-8). No EJ areas overlapped with any areas with high commercial or recreational fishing reliance.

New Jersey

Table 5.2-3 and Figures 5.2-9 and 5.2-10 summarize the EJ communities in the counties of Gloucester/Salem and Essex, respectively, which contain potential ports that may be used for Vineyard Mid-Atlantic. These ports are not located in EJ areas. No EJ areas in Gloucester, Salem, and Essex Counties overlap with areas with high engagement or reliance on commercial or recreational fishing. EJ communities along the coast of northern New Jersey in Monmouth and Ocean Counties (see Figure 5.2-11) are within the PAPE for direct visual effects from the offshore facilities. Most of these EJ communities are around Long Branch City and Asbury Park City in Monmouth County. EJ communities in Point Pleasant Beach and Seaside Heights in Ocean County also overlap with the PAPE for direct visual effects from the offshore facilities.

Connecticut

In Connecticut, there are EJ communities in the counties of Fairfield and New London, which contain construction and O&M ports that may be used for Vineyard Mid-Atlantic (see Table 5.2-3). In Fairfield County, there are EJ areas and Distressed Municipalities near the Port of

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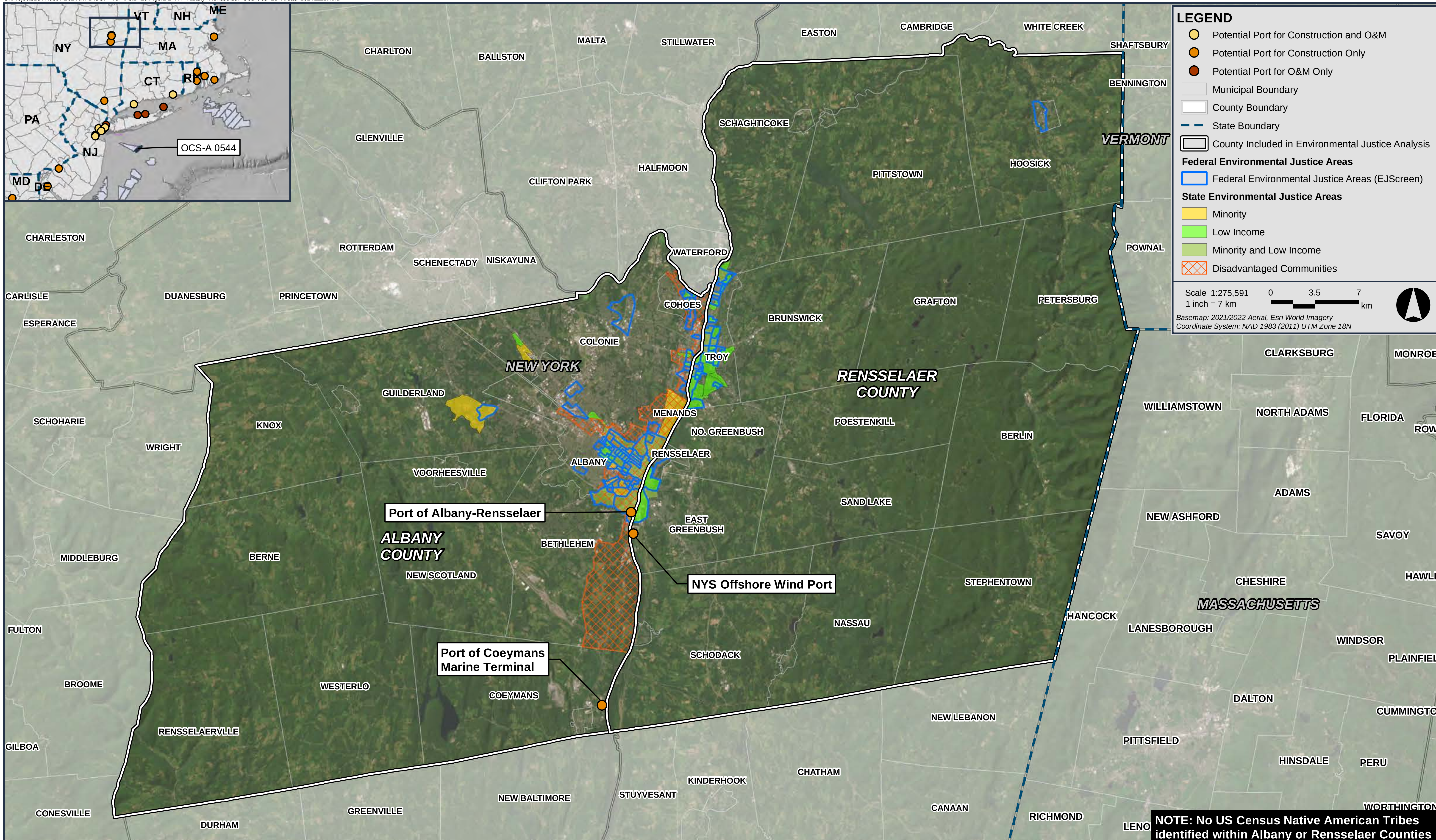

Figure 5.2-2
Albany and Rensselaer Counties, New York
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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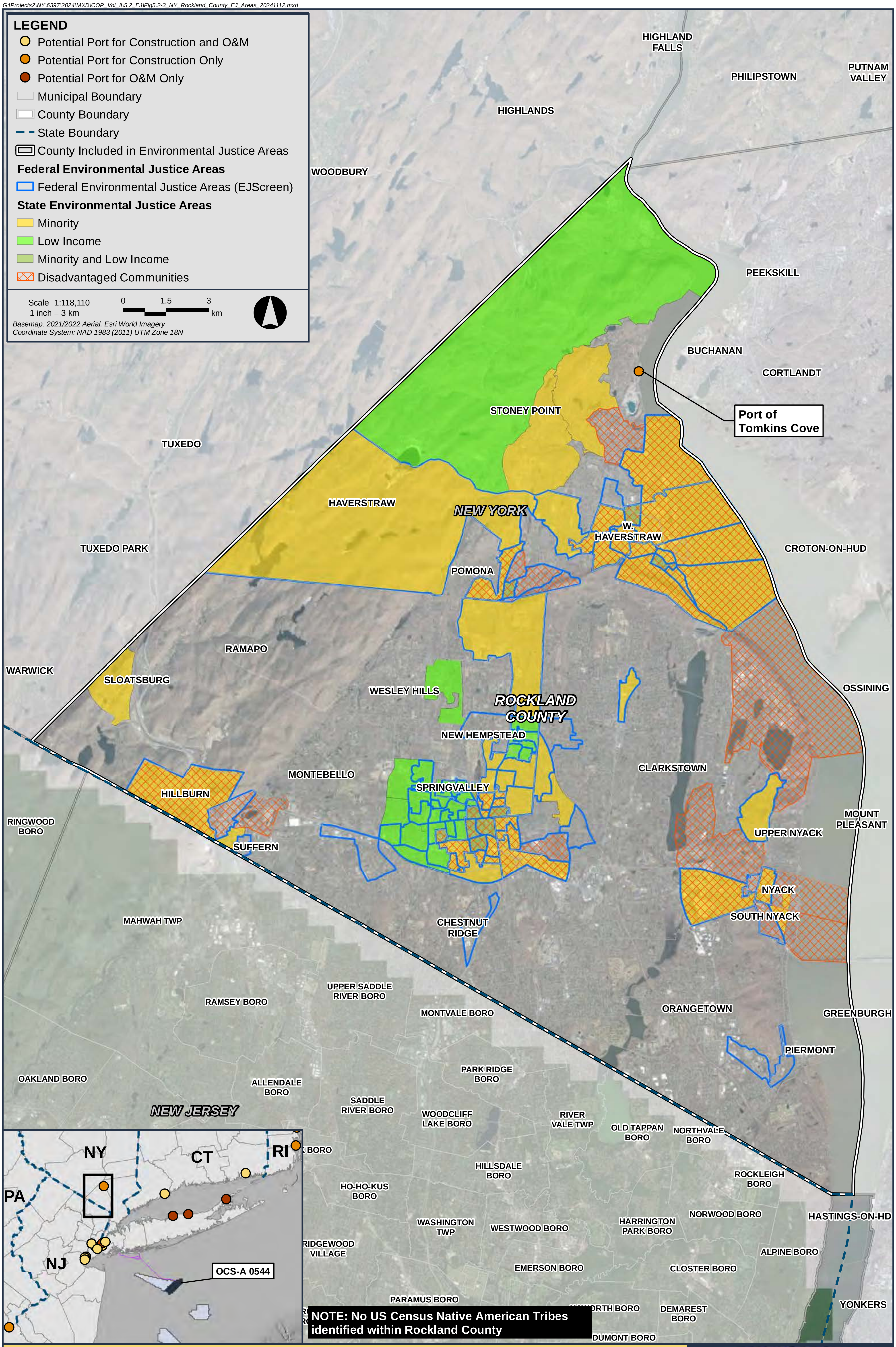

NOTE: No US Census Native American Tribes identified within Rockland County

Figure 5.2-3
Rockland County, New York
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

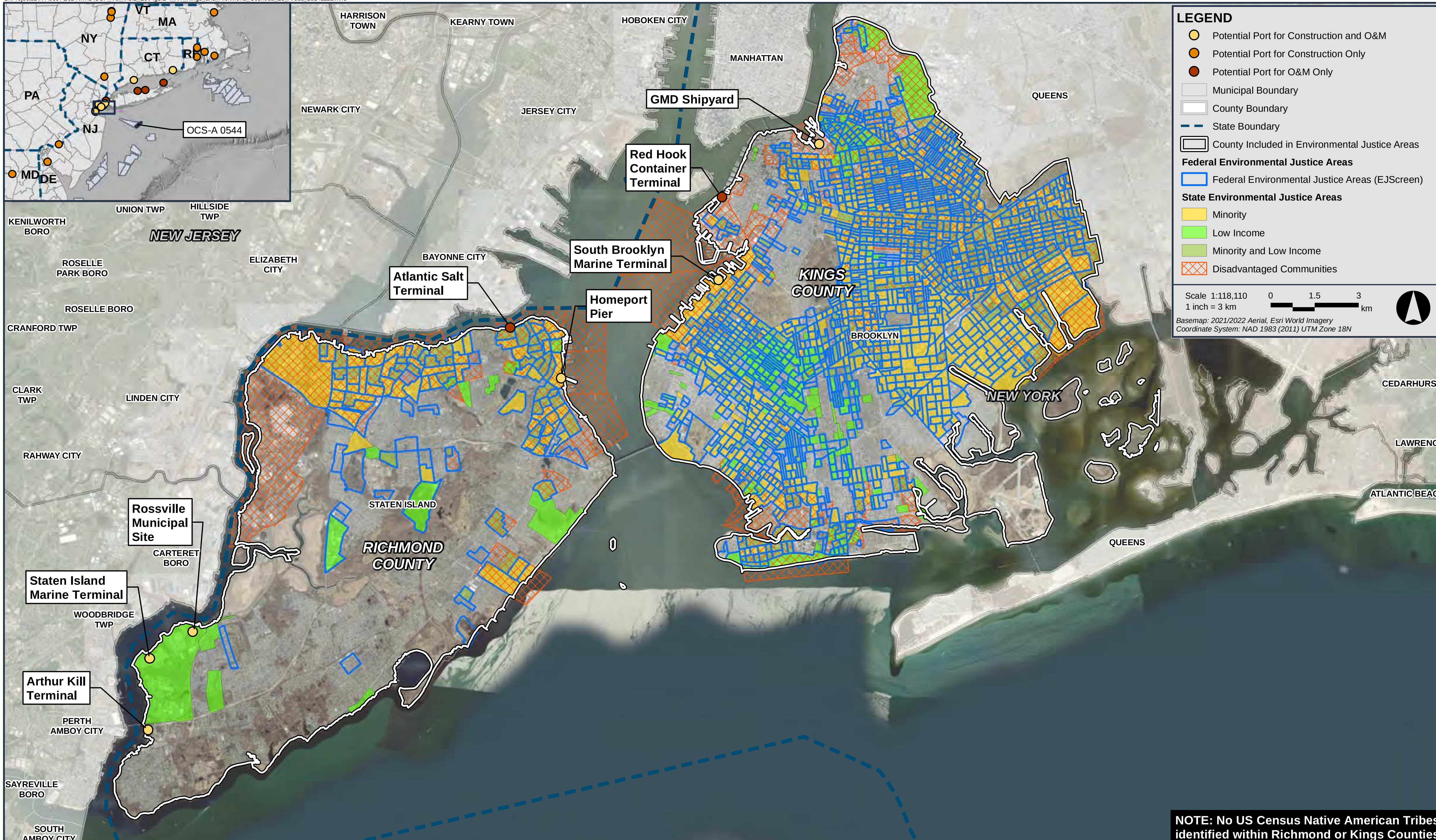

Figure 5.2-4
Richmond and Kings Counties, New York
Environmental Justice Communities and Native American Tribes

[redacted]

[redacted]

[redacted]

[redacted]

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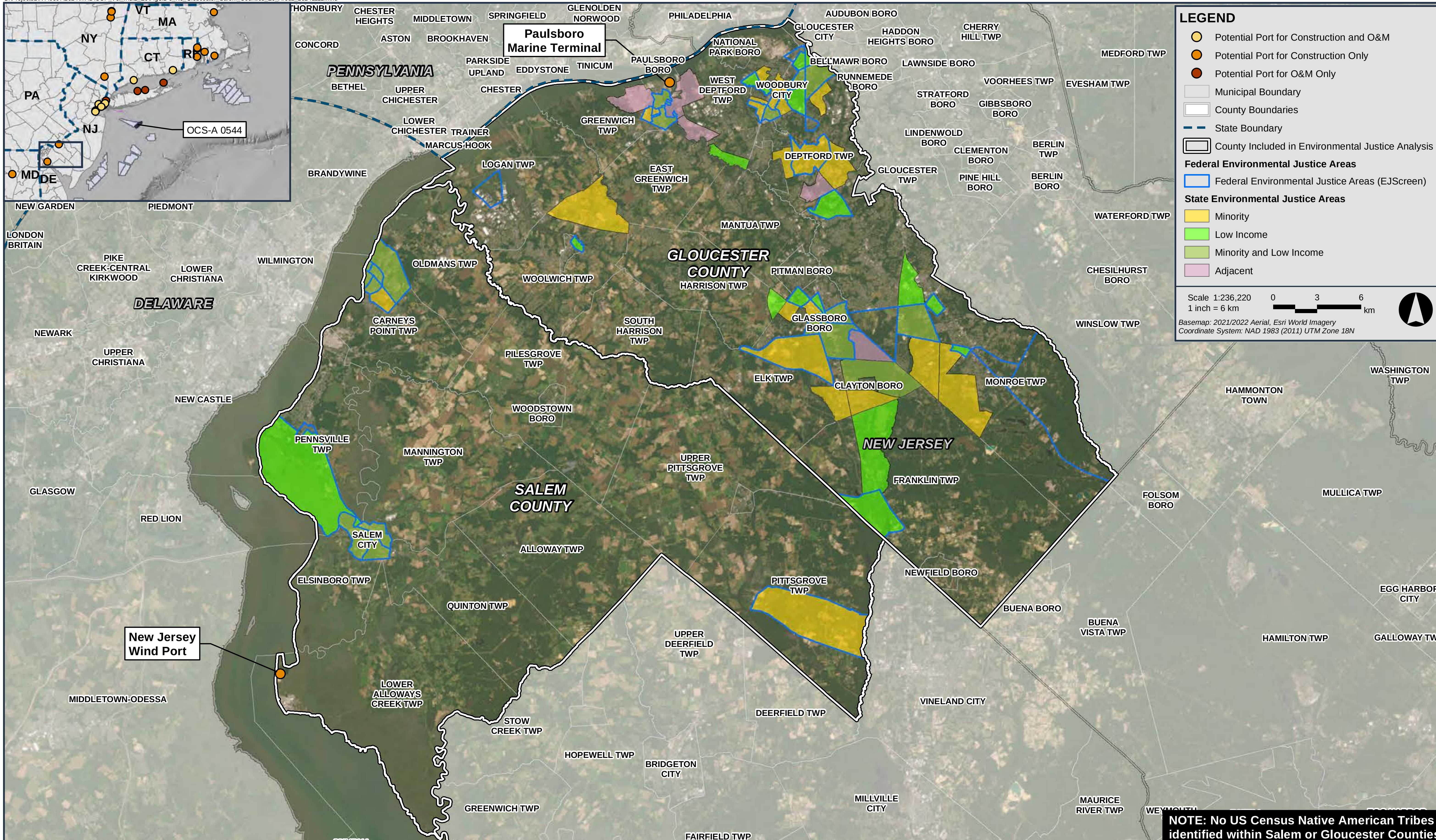

Figure 5.2-9
Gloucester and Salem Counties, New Jersey
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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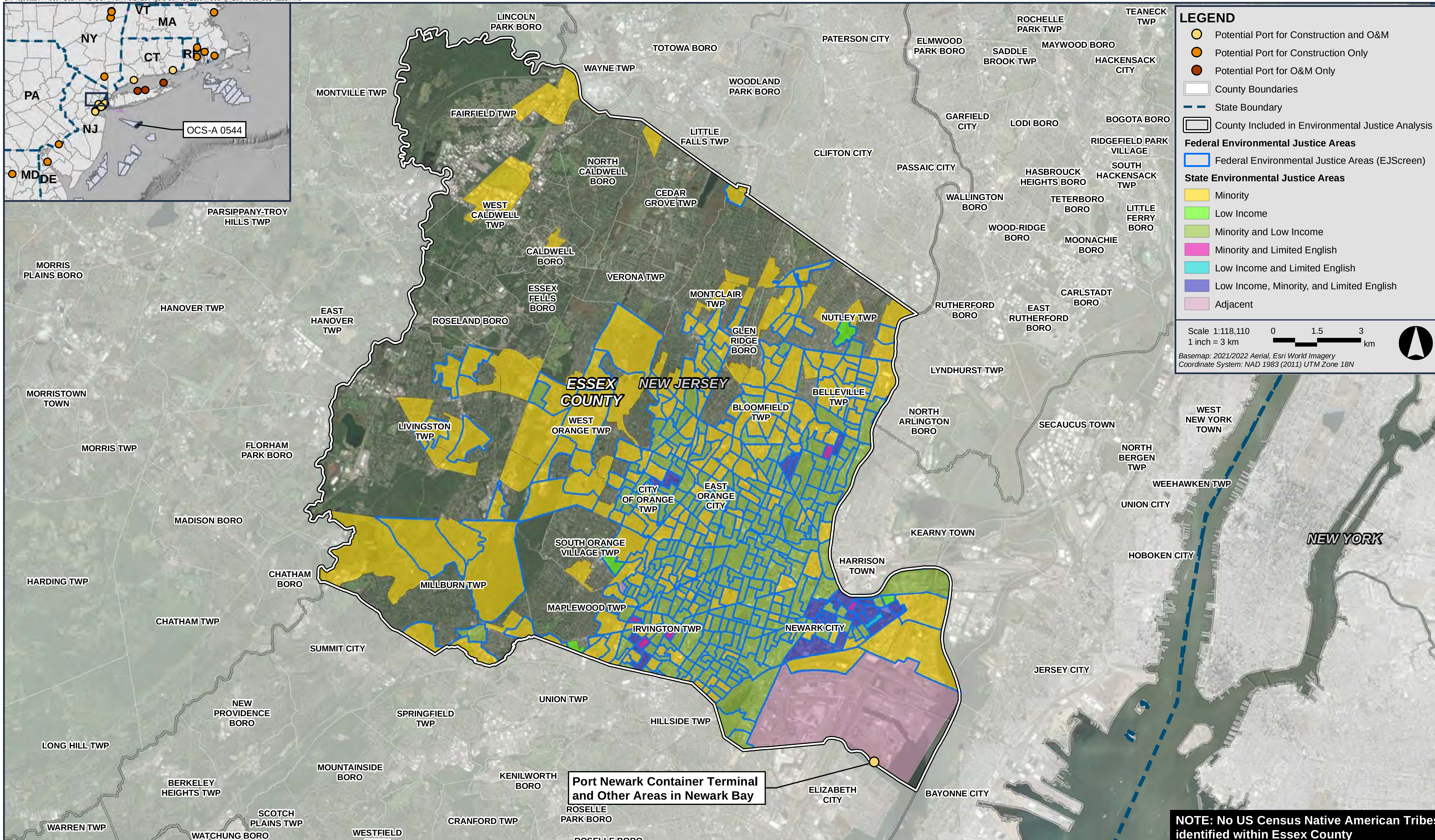

Figure 5.2-10
Essex County, New Jersey
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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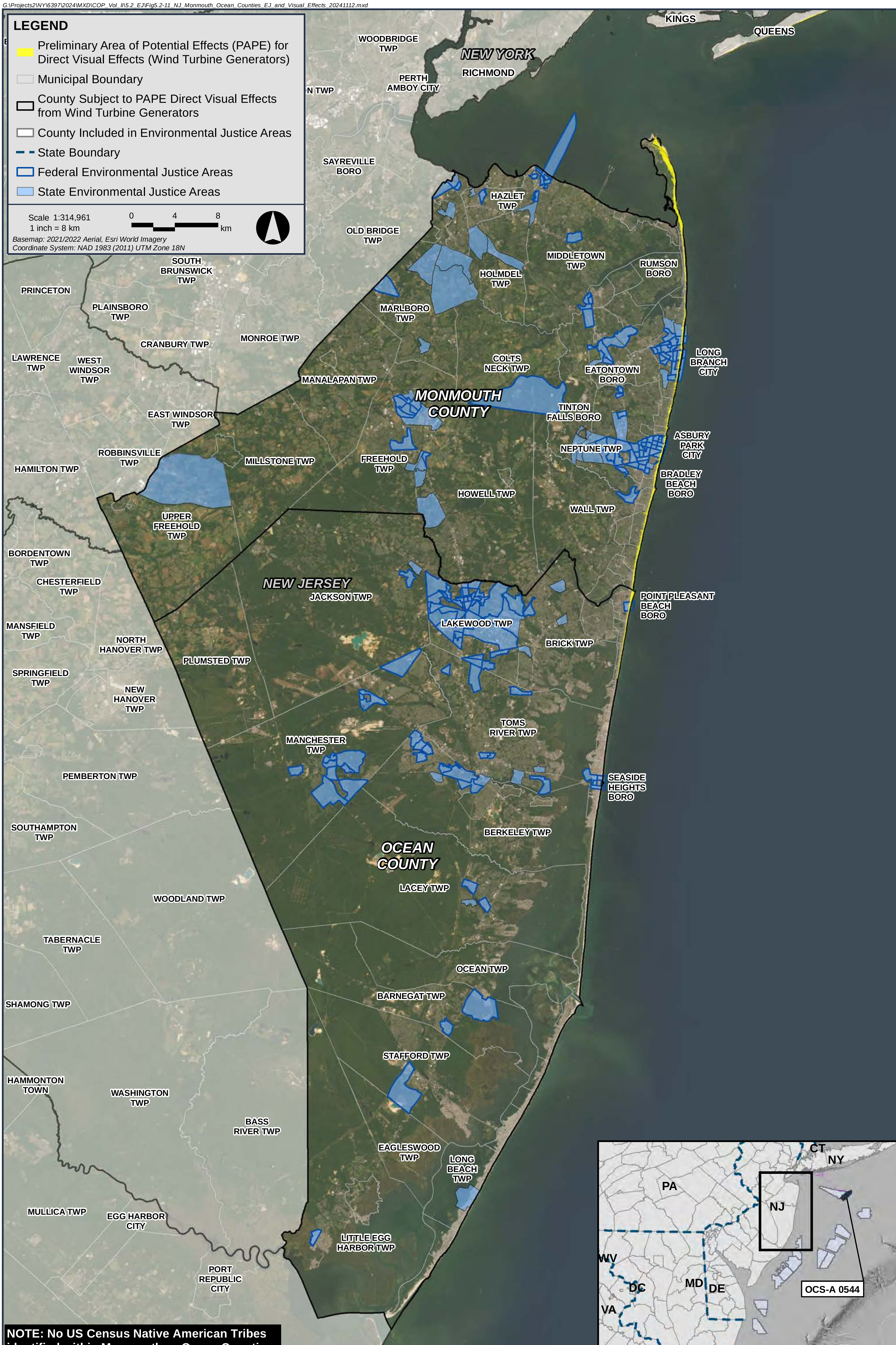

Figure 5.2-11
Monmouth and Ocean Counties, New Jersey
Preliminary Area of Potential Effects for Direct Visual Effects (Wind Turbine Generators)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

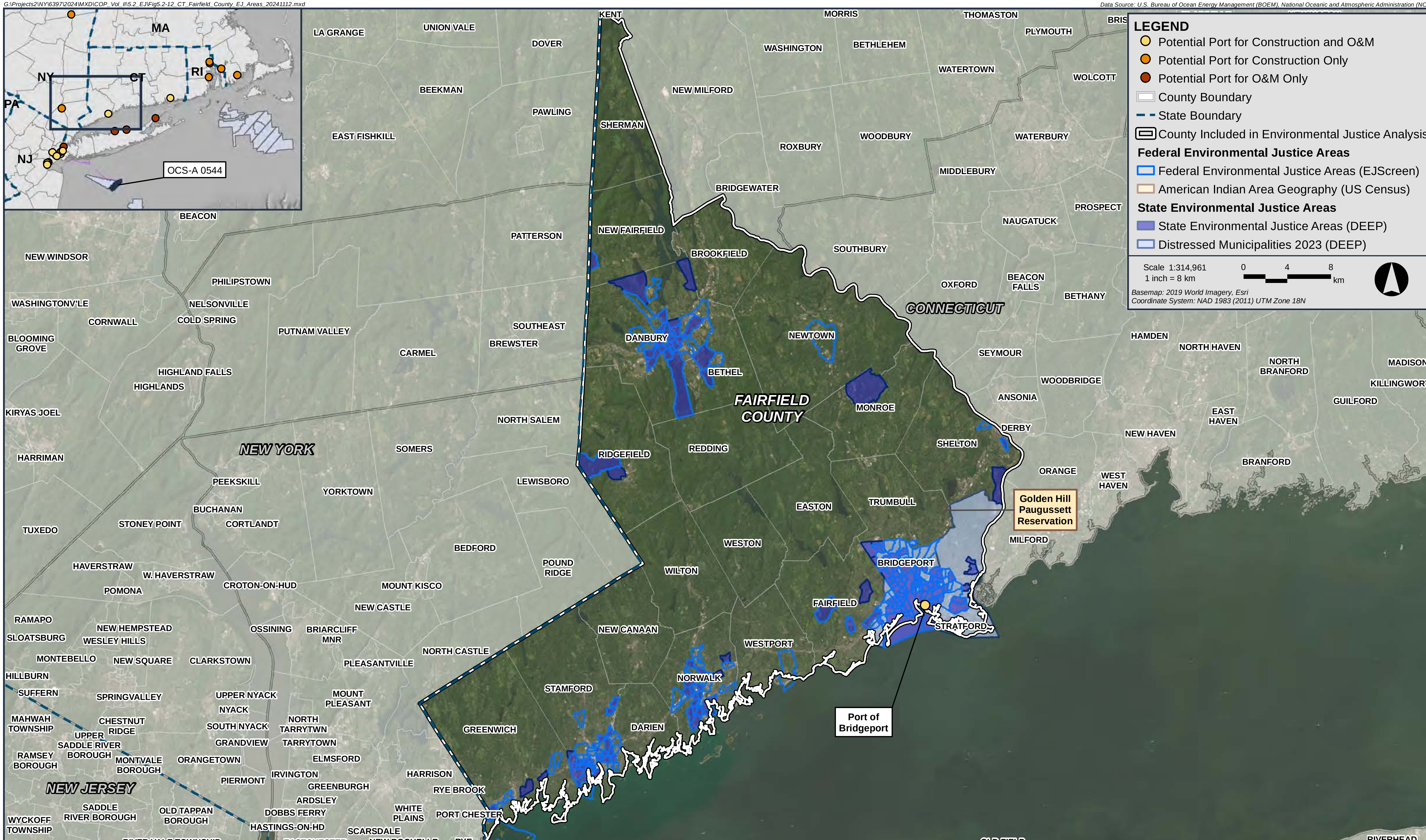

Figure 5.2-12
Fairfield County, Connecticut
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

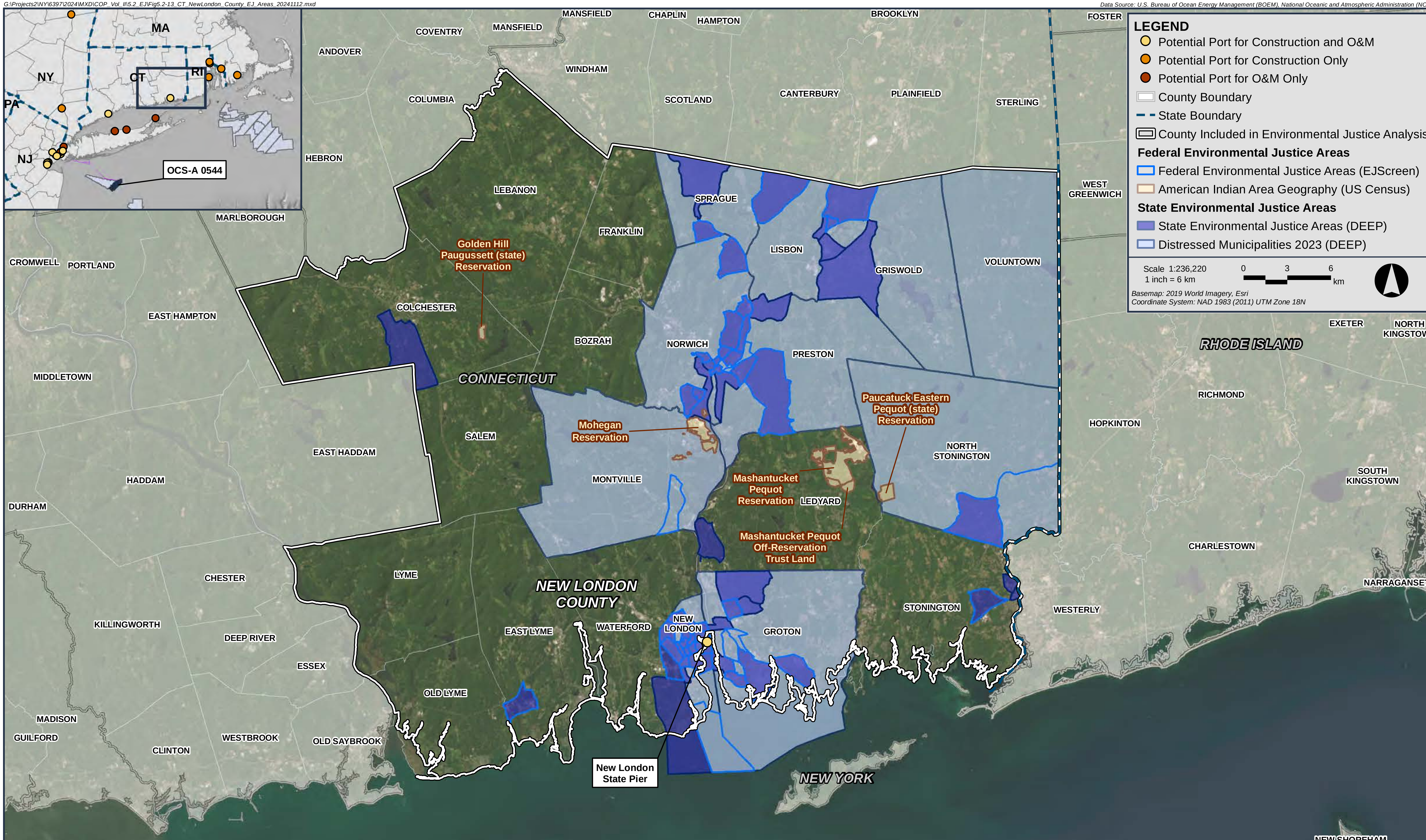

Figure 5.2-13
New London County, Connecticut
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Bridgeport (see Figure 5.2-12). In New London County, there are EJ areas and Distressed Municipalities near the New London State Pier (see Figure 5.2-13). A few EJ areas (two block groups) overlap with areas of high recreational fishing engagement in Waterford (New London County), as shown on Figure 5.2-14. No EJ areas overlapped with any areas with high commercial or recreational fishing reliance.

Rhode Island

Vineyard Mid-Atlantic activities may occur in construction ports in Providence County and/or Washington County. The EJ communities and Native American tribes in these counties are summarized in Table 5.2-3. As shown in Figure 5.2-15, EJ communities are mostly located around Providence, with others scattered throughout the counties. There are a few EJ communities (by the federal definition) in North Kingstown and Narragansett (Washington County) that have high commercial fishing engagement (see Figure 5.2-15). Some EJ communities in Narragansett and North Kingstown also have high recreational fishing engagement. One tribal area in Charlestown (Washington County) overlapped with an area of high recreational fishing engagement. No EJ areas overlapped with any areas with high reliance on commercial or recreational fishing.

Massachusetts

As shown in Table 5.2-3, there are a number of federal and state EJ communities in the counties of Bristol and Essex. Figure 5.2-16 shows the EJ communities and tribal areas in Bristol County near potential construction ports. Most of the EJ block groups in Bristol County that could be impacted by Vineyard Mid-Atlantic activities are located around the larger cities of New Bedford and Fall River. In Essex County, there are EJ communities around Salem Harbor, a potential construction port (see Figure 5.2-17).

As shown on Figure 5.2-18, there are EJ areas with high commercial fishing engagement in New Bedford and Fairhaven (Bristol County). In Gloucester and Newburyport (Essex County), there are areas of high commercial and recreational fishing engagement that overlap with a few EJ communities. No EJ areas overlapped with any areas with high reliance on commercial or recreational fishing.

Maryland

In Baltimore County, the potential construction port, Sparrows Point, is located in an EJ community (see Table 5.2-3 and Figure 5.2-19). There are no areas of high commercial and recreational fishing engagement or reliance that overlap with EJ communities.

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

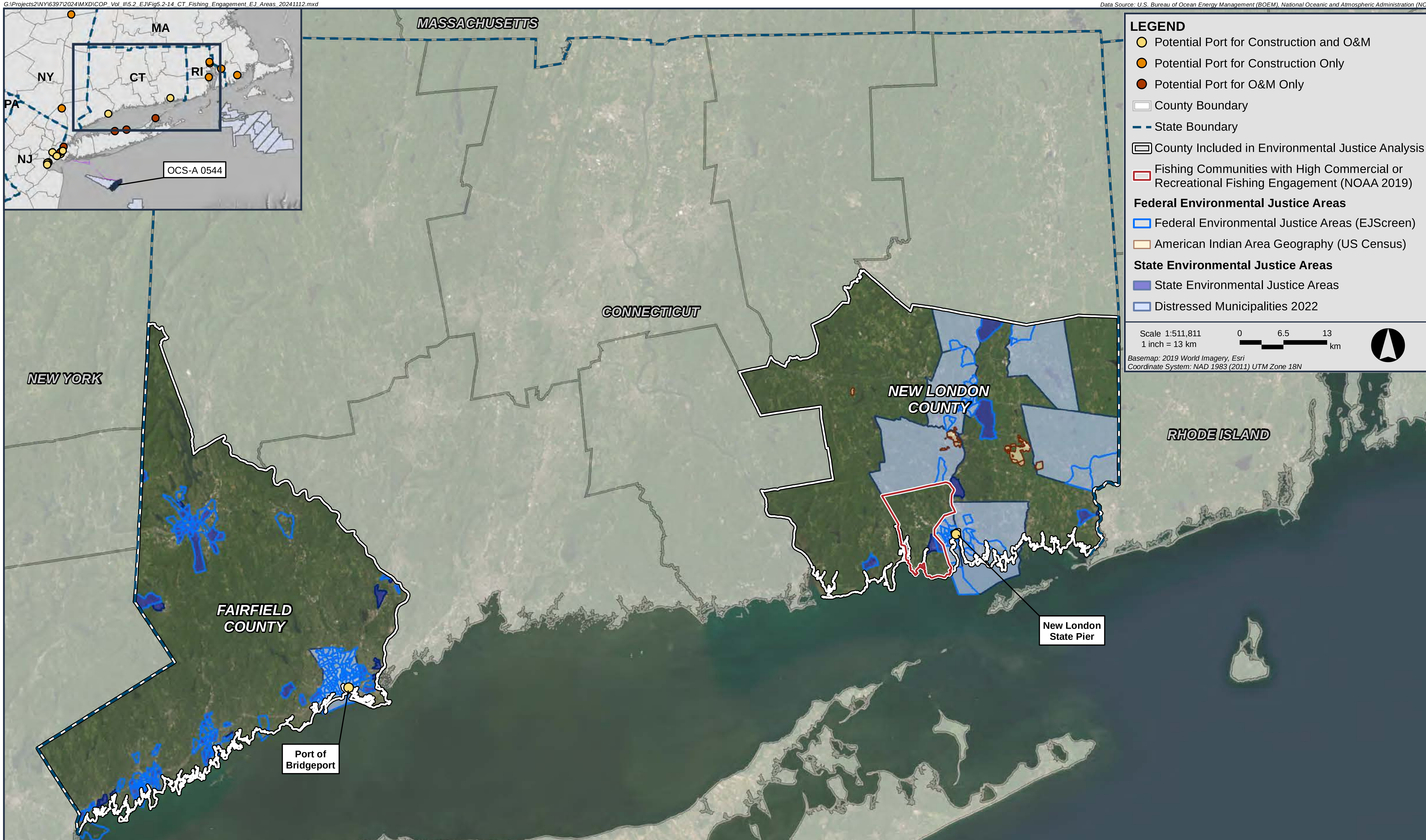

Figure 5.2-14
Connecticut High Fishing Engagement Communities
within the Geographic Analysis Area

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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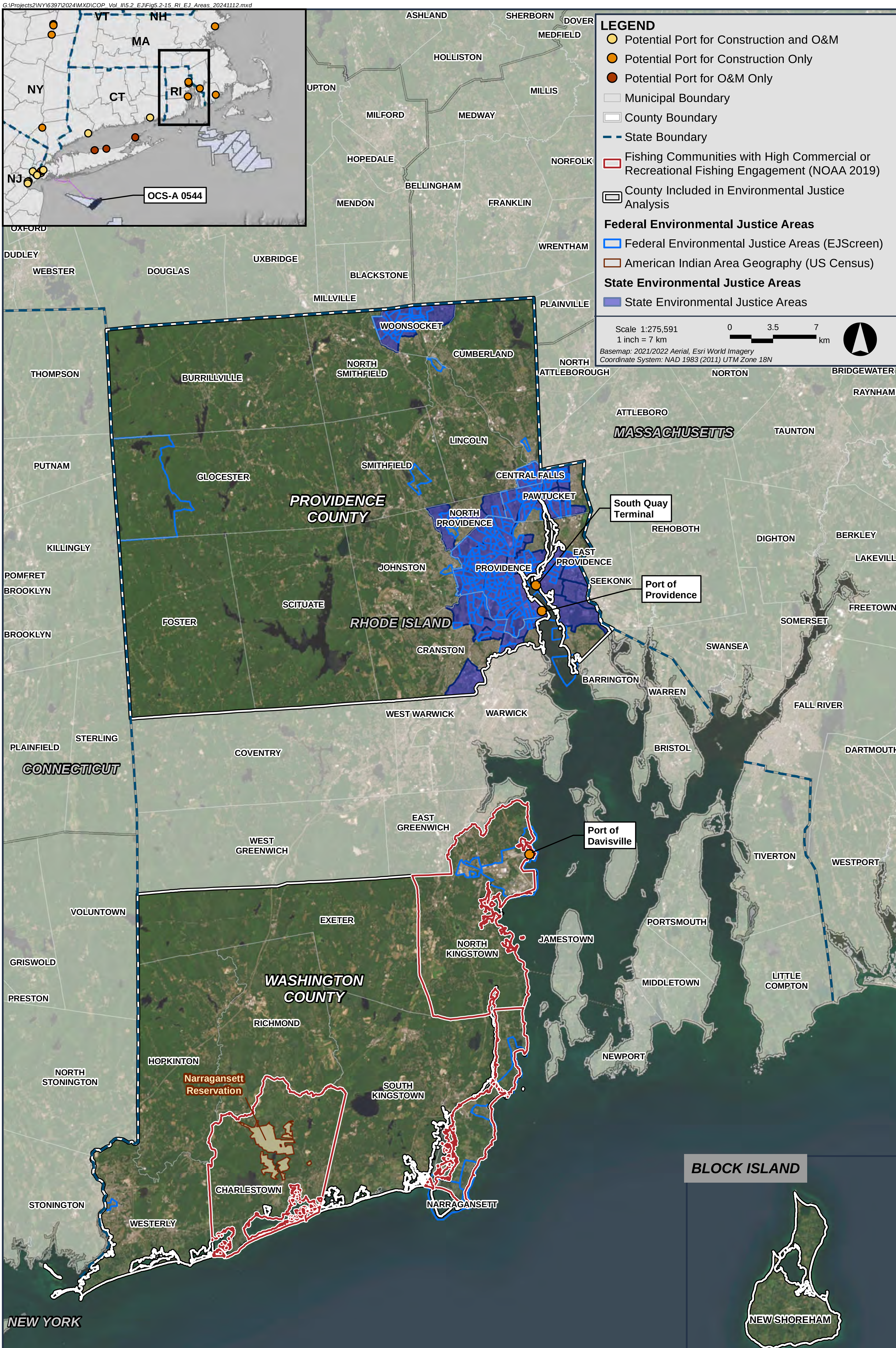

Figure 5.2-15
Providence and Washington Counties, Rhode Island Environmental Justice Communities, Native American Tribes, and High Fishing Engagement Communities

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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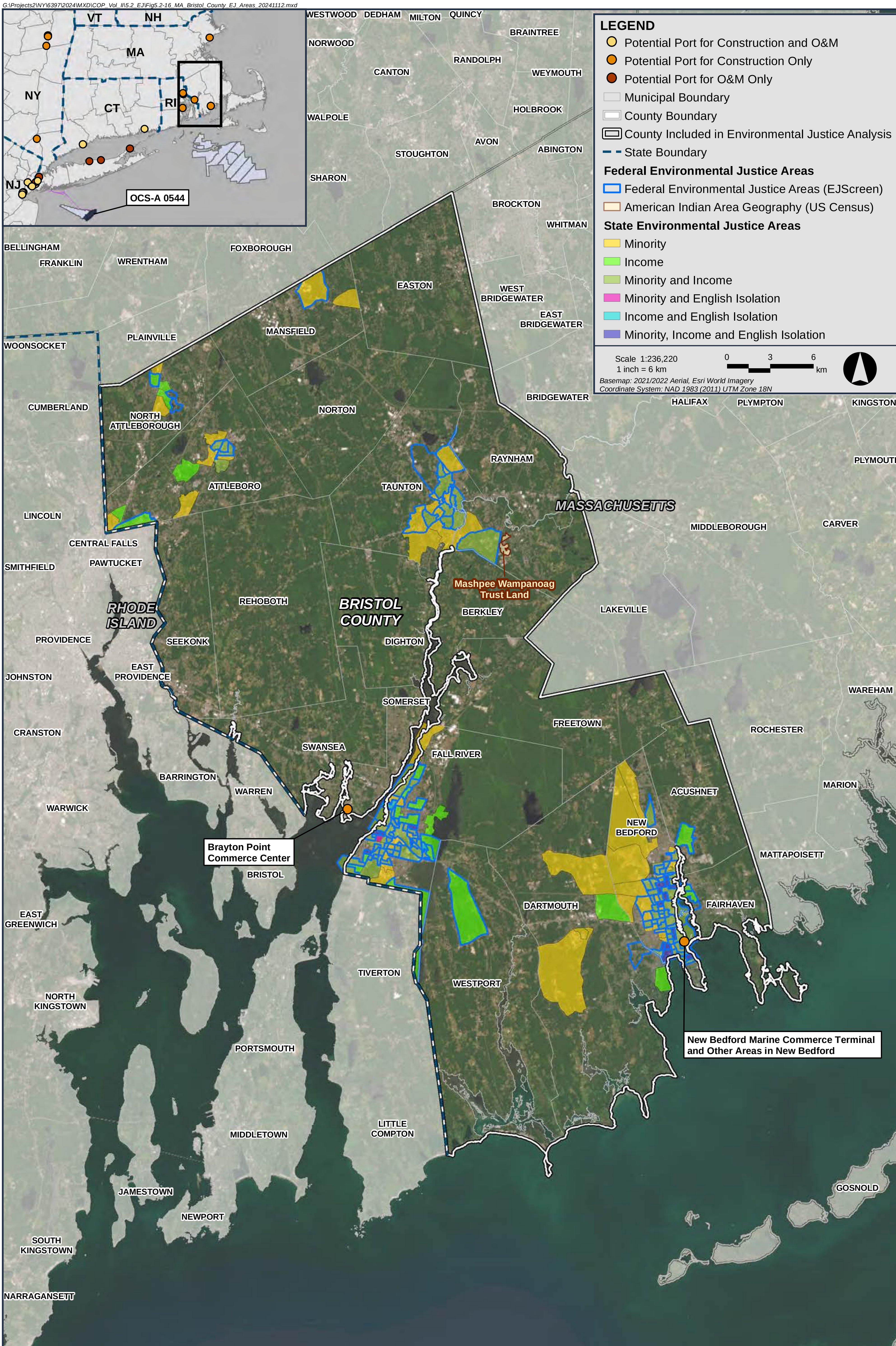

Figure 5.2-16
Bristol County, Massachusetts
Environmental Justice Communities and Native American Tribes

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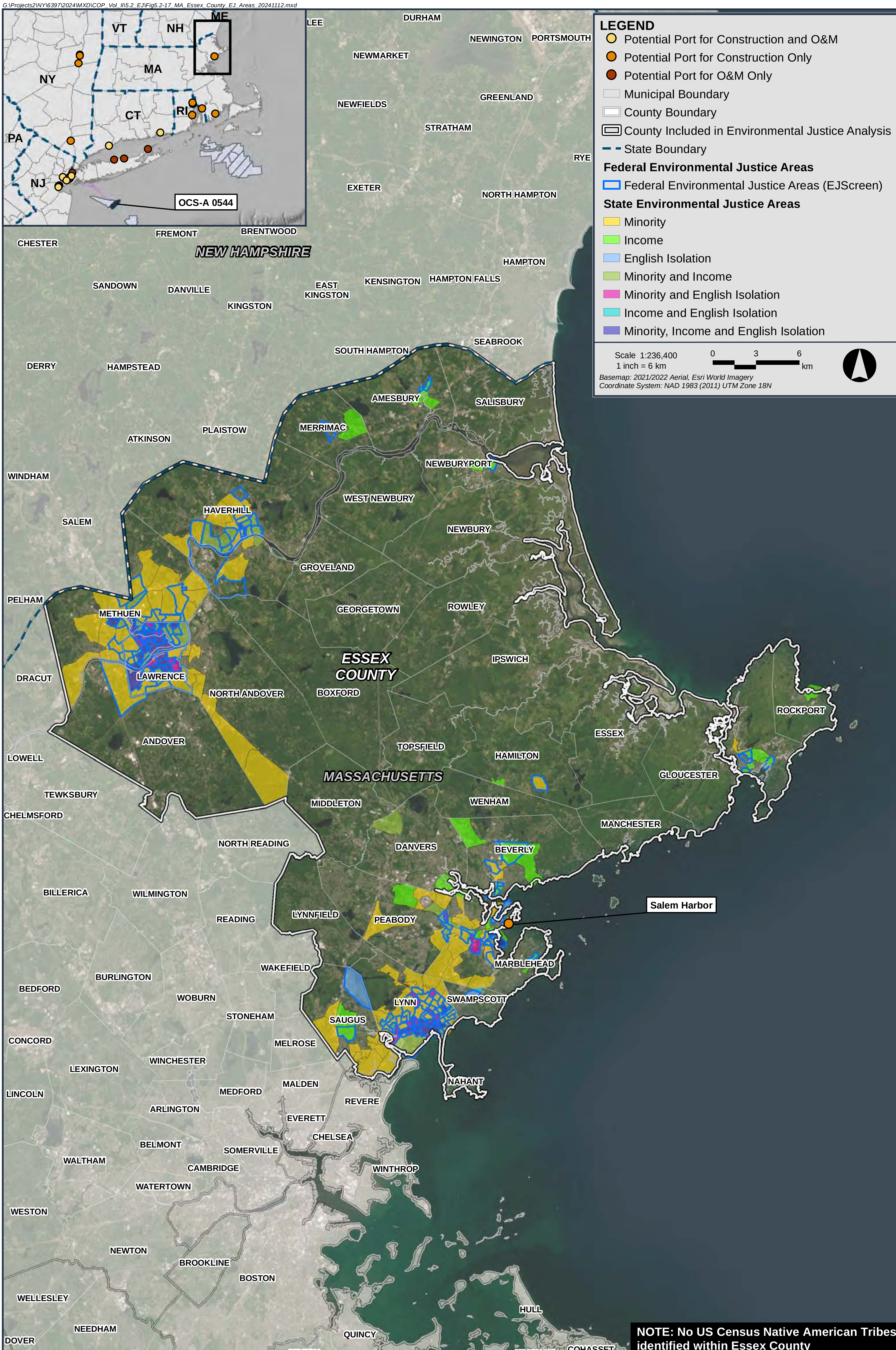

Figure 5.2-17
Essex County, Massachusetts
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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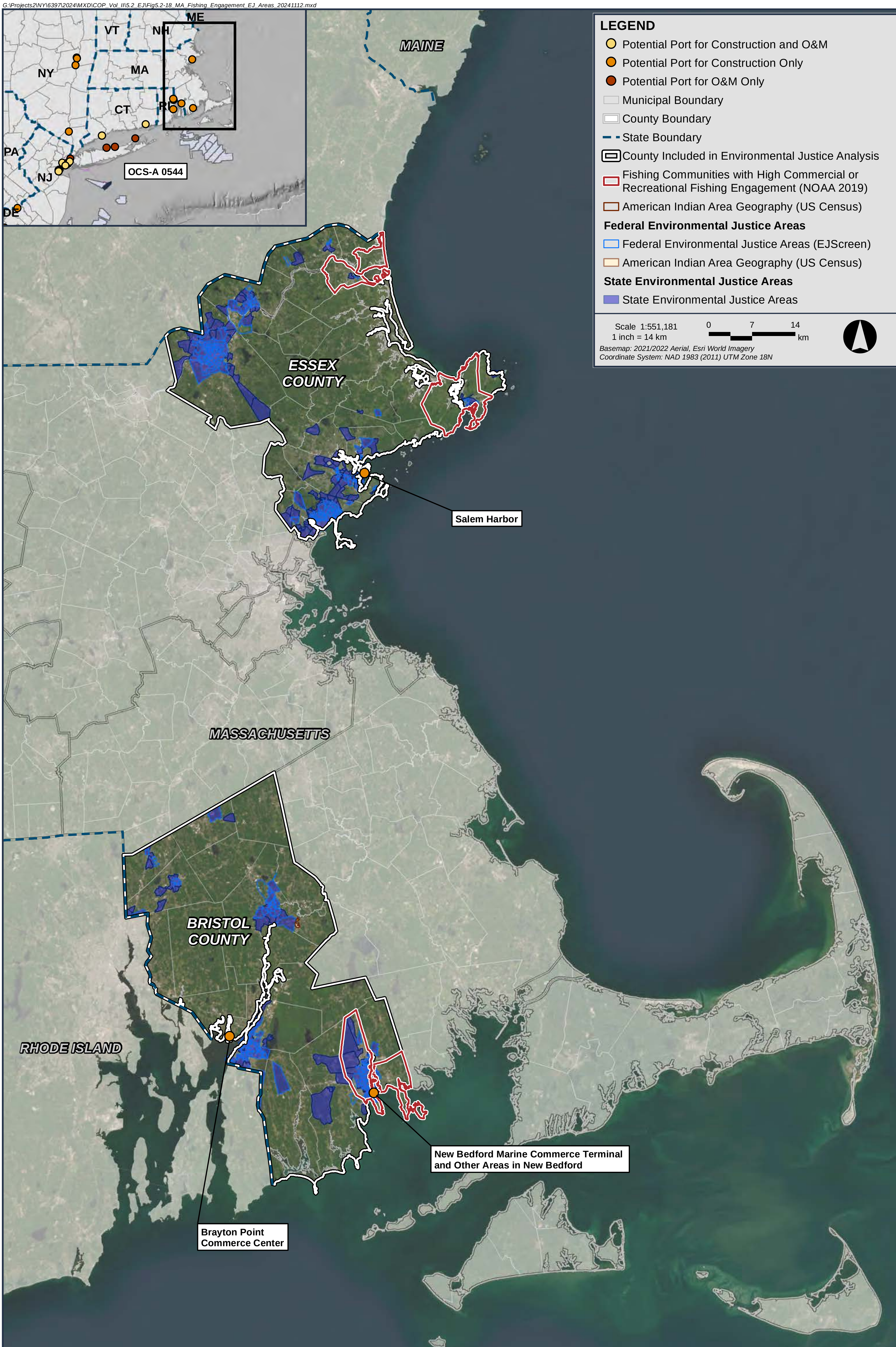

Figure 5.2-18
Massachusetts High Fishing Engagement Communities within the Geographic Analysis Area

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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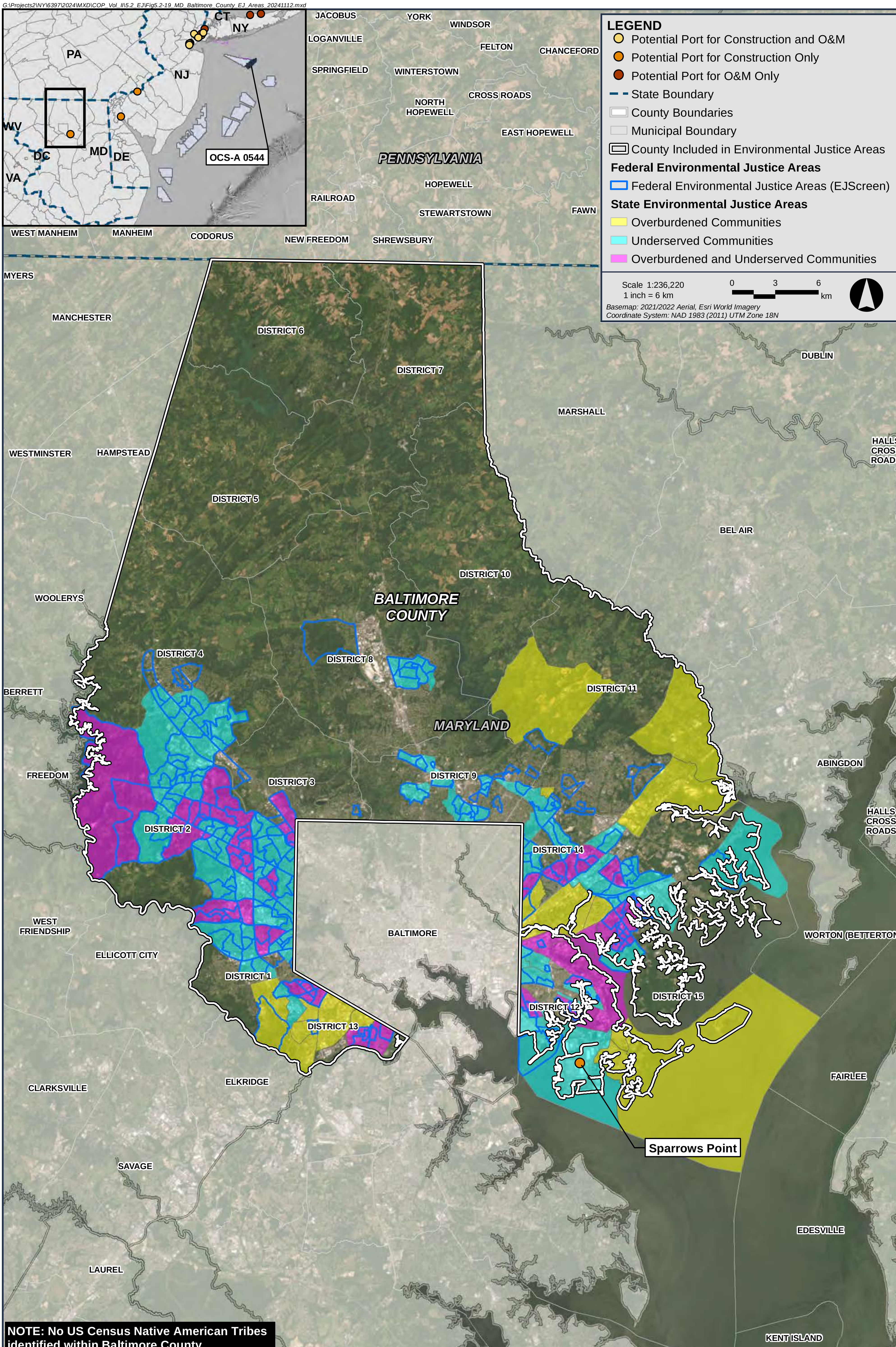

Figure 5.2-19
Baltimore County, Maryland
Environmental Justice Communities and Native American Tribes

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

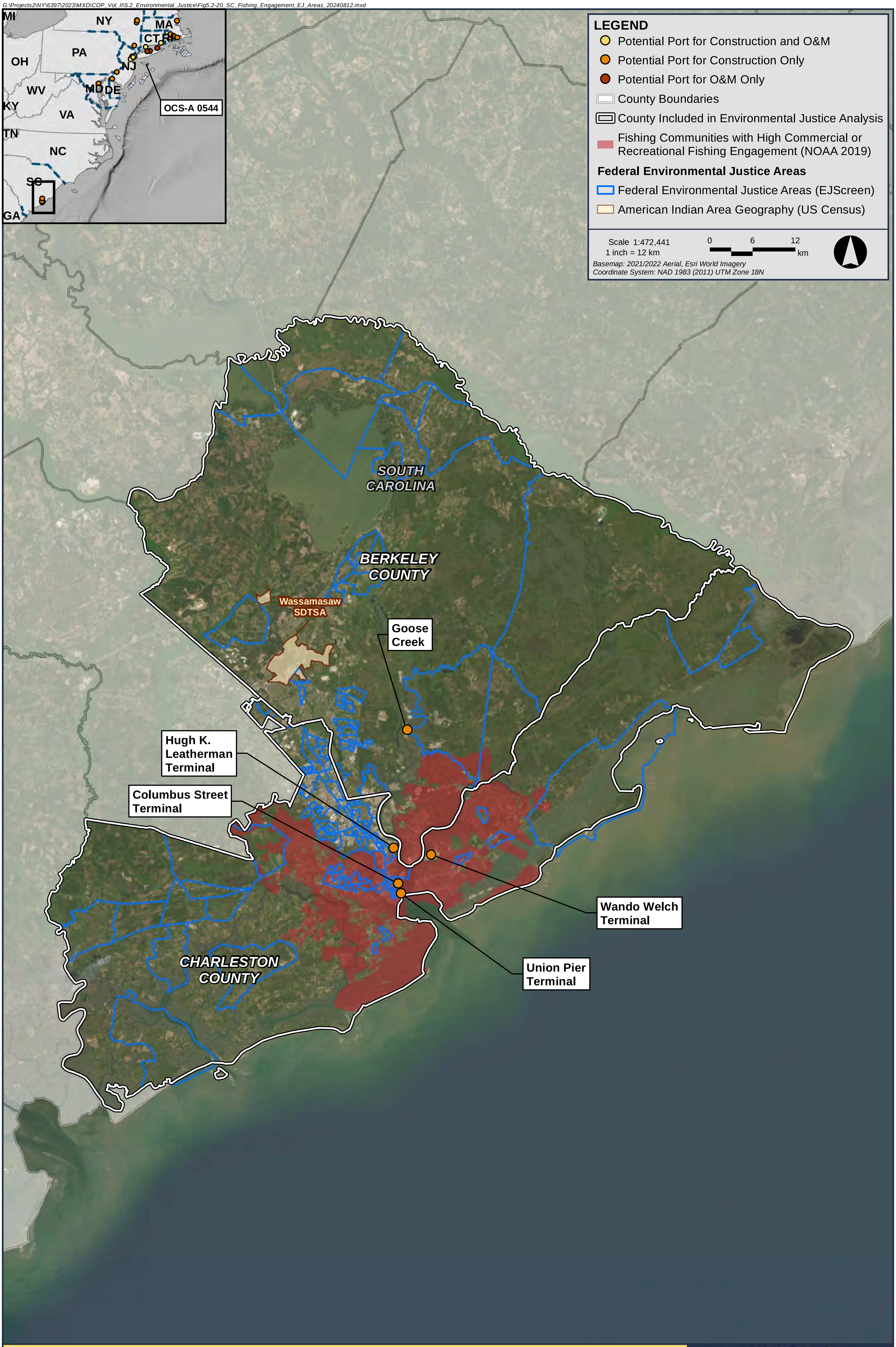

Figure 5.2-20
Berkeley and Charleston Counties, South Carolina Environmental Justice Communities, Native American Tribes, and High Fishing Engagement Communities

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

South Carolina

There are EJ areas in the counties of Berkeley and Charlston (see Table 5.2-3 and Figure 5.2-20), where potential construction ports are located. There are also a limited number of EJ areas that overlap with areas of high recreational fishing engagement in Charleston and Berkeley Counties, as shown in Figure 5.2-20.

5.2.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect EJ communities during the construction, O&M, and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.2-4.

Table 5.2-4 Impact Producing Factors for Environmental Justice Communities

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Workforce Initiatives and Economic Activity	•	•	•
Port Utilization	•	•	•
Onshore Construction and Maintenance Activities	•	•	•
Noise	•		•
Housing	•		•
Presence of Structures	•	•	•

Potential effects to EJ communities were assessed using the maximum design scenario for Vineyard Mid-Atlantic as described in Section 1.5.

5.2.2.1 Workforce Initiatives and Economic Activity

Vineyard Mid-Atlantic is expected to result in significant long-term economic benefits, including considerable new employment opportunities. The Proponent anticipates hiring a diverse workforce across a range of professions during development, construction, O&M, and decommissioning. Potential jobs are related to fabrication, component assembly, other construction and installation tasks, and maintenance of the offshore facilities. The expected number of jobs created during construction and throughout the operational life of Vineyard Mid-Atlantic are significant and are further detailed in Section 5.1.

The Proponent is committed to ensuring that EJ communities receive appropriate economic benefits from Vineyard Mid-Atlantic. The Proponent will make reasonable efforts to hire from within host communities (i.e., the communities in which onshore facilities are located) and adjacent EJ communities. The Proponent also anticipates that it will develop workforce initiatives, including initiatives specifically targeting EJ communities, that are designed to educate, recruit, mentor, and train residents for careers in the offshore wind industry. To support these goals, the Proponent expects to implement a collaborative, flexible, and community-led workforce development framework that: (1) advances workforce and training initiatives that are aligned with Vineyard Mid-Atlantic's workforce needs and timelines; (2) is tailored to the communities it aims to benefit; and (3) is implemented by the Proponent and local partners. This framework is expected to include a hiring plan and youth education initiatives that will raise awareness, enable hiring and training directly from local host communities and EJ populations, and provide a pathway for the next generation to access careers in offshore wind. The hiring plan will describe Vineyard Mid-Atlantic's workforce needs, along with associated education, training, and certification requirements, identify partnerships with existing programs and organizations to train the necessary workforce, and outline how the Proponent will prioritize hiring and training directly from host communities and adjacent EJ communities. The youth education initiatives and programming will provide opportunities that allow youth to meaningfully connect with and learn about the offshore wind industry. The Proponent is committed to working cooperatively with educational institutions and others to further develop training and educational opportunities for students and residents of the Onshore Development Area. The Proponent also expects to host and participate in workforce events and career fairs to inform residents about job opportunities during the development, construction, and O&M of Vineyard Mid-Atlantic.

Additionally, the Proponent anticipates that it will pursue contracts with local suppliers, including minority-owned businesses. The Proponent will also continue to identify opportunities to increase participation of businesses located in EJ communities, Women-Owned Business Enterprises, and Service-Disabled Veteran-Owned Businesses in the offshore wind supply chain. The increase in job opportunities and related economic growth for local businesses that serve the expanding offshore wind industry are expected to benefit EJ communities that are in the vicinity of the Onshore Development Area.

To inform stakeholders of the potential opportunities and impacts from Vineyard Mid-Atlantic, the Proponent has and will continue to engage with the public, including potential EJ population groups, in meaningful ways. The Proponent's approach to tribal and stakeholder outreach for Vineyard Mid-Atlantic is described in Section 8 of COP Volume I. As discussed in Section 8.5 of COP Volume I, the Proponent recognizes that local communities and stakeholders have different needs when it comes to receiving information and participating in the offshore wind development process. For that reason, the Proponent employs an array of methods to disseminate information and engage with interested community stakeholders while also evaluating and adapting approaches to ensure the effectiveness of community outreach efforts. The Proponent's outreach efforts are expected to include holding information sessions in a public space as well as sponsoring and staffing information tables at community, environmental, and fisheries-related events. These events will be advertised on the

Proponent's dedicated community webpage,[62] via social media, press releases, and other media, and through in-person outreach. The Proponent's public engagement efforts suggest that stakeholders, particularly EJ communities, generally support clean energy projects as necessary to address climate change and local pollution burdens. For EJ communities, the creation of new jobs is a primary benefit of offshore wind projects that is of interest to them. As such, they want developers to provide clear, concise information on the types of jobs, when jobs will be available, and the training or skills needed for those jobs. Additional information regarding economic development and supply chain opportunities is also of interest to EJ communities.

Additional community and environmental benefits from Vineyard Mid-Atlantic that are also expected to benefit local EJ communities are described in Section 2. As the development of Vineyard Mid-Atlantic progresses, additional commitments are expected, and this section will be updated as needed.

5.2.2.2 Port Utilization

As described further in Sections 3.10 and 4.4 of COP Volume I, Vineyard Mid-Atlantic has identified several existing and planned ports that may be used for construction and/or O&M. Each port under consideration for Vineyard Mid-Atlantic is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction or O&M proceeds. The Proponent has identified a wide range of potential ports due to the uncertainty in Vineyard Mid-Atlantic's construction schedule and the expected demand for ports by other offshore wind developers in the coming years. Only a subset of the potential ports identified would ultimately be used. The combination of ports used during construction and O&M will depend on the final construction and maintenance schedules, the availability and capability of each port to support a given activity, and the component suppliers that are ultimately selected for Vineyard Mid-Atlantic.

Vineyard Mid-Atlantic activities at ports will be typical of marine industrial uses and may result in temporary increases in traffic, noise, and air emissions from support vehicles and vessels. The activities at these ports are not anticipated to disproportionally affect EJ communities. Further, port utilization may result in additional employment opportunities in EJ communities as described in Section 5.2.2.1.

5.2.2.3 Onshore Construction and Maintenance Activities

Onshore construction and maintenance activities related to Vineyard Mid-Atlantic's onshore facilities on Long Island, New York may temporarily result in increased traffic, noise, dust, and/or air emissions (noise is discussed further in Section 5.2.2.4). Onshore construction equipment is expected to be similar to that used during typical public works projects (e.g.,

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[62] See https://www.vineyardoffshore.com/communities.

road resurfacing, storm sewer installation, transmission line construction). Onshore construction activities may temporarily impact residents, tourists, and businesses near these activities, including EJ and non-EJ populations (see Figures 5.2-5 and 5.2-6).

The Proponent anticipates that it will develop a Construction Management Plan (CMP) that will list construction best management practices to minimize the potential impacts of onshore construction. The Proponent will use the CMP to guide contractors during construction. The Proponent will also work with municipalities to develop the onshore construction schedule and hours in accordance with local ordinances. The timing of onshore construction activities will be coordinated with state and local agencies to avoid seasons or times of peak usage, and to align with planned public works projects, where feasible, to minimize traffic disruption. Onshore construction at the landfall sites is planned to occur outside of the period from Memorial Day to Labor Day.

During construction and decommissioning, the Proponent anticipates an increase in construction and support vehicle traffic in portions of the Onshore Development Area. To avoid and minimize traffic impacts during onshore construction activities, the Proponent will develop a Traffic Management Plan (TMP) and will coordinate the timing of activities with state and local agencies. Signage, lane restrictions, police details, and other appropriate traffic management measures will be used to maintain traffic flow, and traffic management will always be coordinated with municipal officials. The Proponent anticipates utilizing various methods of public outreach prior to and during all phases of Vineyard Mid-Atlantic to keep residents, business owners, and officials updated on the construction schedule, vehicular access, lane closures, detours, and other traffic management information.

Overall, it is expected that any disruptions from onshore construction and maintenance activities will be temporary and localized to the immediate work area. Areas and/or infrastructure disturbed by installation activities will be restored following completion. EJ populations are not anticipated to be disproportionally impacted by these short-term activities.

5.2.2.4 Noise

Similar to construction activities for typical public works projects, Vineyard Mid-Atlantic's onshore construction activities may generate temporary and intermittent increases in noise levels within the Onshore Development Area. Noise may also be generated from activities at ports but is not expected to differ significantly from noise that is already generated by these ports. Some noise may also be generated at the onshore substations and onshore RCSs (if used), and sound attenuation walls may be installed to mitigate potential noise impacts, if needed.

The Proponent is committed to minimizing noise-related impacts to communities in the Onshore Development Area, including EJ communities. Construction hours will be developed in accordance with local noise ordinances. Construction equipment will be operated such that construction-related noise levels will comply with applicable local, state, and federal requirements. Mitigation measures to limit noise from construction equipment (e.g., using quieter equipment, assuring the functionality of equipment, adding mufflers or noise-reducing features, using temporary noise barriers) will be utilized as needed. Potential impacts to EJ and non-EJ communities are not anticipated to differ and would be intermittent and short term.

5.2.2.5 Housing

No adverse housing effects on EJ communities are anticipated from Vineyard Mid-Atlantic construction, O&M, and decommissioning. Any housing needs are anticipated to be met by the local housing markets. More details are presented in Section 5.1.

5.2.2.6 Presence of Structures

As discussed further in Sections 5.3 and 5.4, the presence of Vineyard Mid-Atlantic's wind turbine generators (WTGs) and electrical service platform(s) (ESP[s]) may affect commercial and recreational fishing, which may, in turn, affect low-income and minority workers and Native American tribes who rely on these industries. During O&M of Vineyard Mid-Atlantic, the Lease Area and OECC will be open to marine traffic, and no permanent vessel restrictions are proposed. The proposed layout is expected to facilitate safe navigation through the Lease Area by providing two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512and creating north-south and northwest-southeast corridors that would accommodate all of the existing Automatic Identification System (AIS)-equipped fishing fleet[63]. However, some fishermen may opt to reroute transits around the Lease Area, resulting in a slight increase in vessel transit time (see Section 5.4). Depending on the activity, the Proponent may request that mariners give a wide berth to active work sites or construction and maintenance vessel(s) through the issuance of Offshore Wind Mariner Updates. Additionally, the Proponent may request that the US Coast Guard (USCG) establish temporary safety zones, per 33 CFR Part 147, that extend 500 meters (m) (1,640 feet [ft]) around each WTG and ESP during construction and certain maintenance activities. The presence of these safety zones would temporarily preclude fishing activities in the immediate vicinity of the WTGs and ESP(s) and may cause fishermen to slightly alter their navigation routes to avoid the active work sites. However, the safety zones would be limited in size and duration and would not affect the entire Lease Area at any given time.

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[63] AIS equipment is not required for vessels less than 20 m (65 ft) in length, so non-AIS equipped vessels are smaller vessels that would also be accommodated by the north-south and northwest-southeast corridors.

As described in Section 5.4, a limited portion of the offshore cables may require cable protection. Cable protection will be designed and installed to minimize interfering with bottom fishing gear to the maximum extent practicable and fishermen will be informed of areas where cable protection exists. Nevertheless, there will remain a possibility that bottom fishing gear may snag on cable protection resulting in gear damage, lost fishing time, and associated economic losses.

If these potential impacts result in a decrease in revenue, employment, and income for low-income and minority workers in marine-based industries or affect those who rely on subsistence fishing, the EJ communities described in Section 5.2.1.3 may be affected. However, it is not expected that EJ communities will bear disproportionately high or adverse impacts, especially when considering the measures that the Proponent will implement to avoid, minimize, and mitigate potential impacts to recreational and commercial fishing, which are described in Sections 5.3 and 5.4. In addition, Vineyard Mid-Atlantic's foundations, scour protection, and cable protection (if used) may attract fish species to new structured habitat, resulting in increases in biodiversity and abundance of fish (see Section 4.6 and Section 5.3). The expected fish aggregation and artificial reef effects of the structures could result in an increase in certain types of recreational fishing in the Lease Area, which may provide future business opportunities (e.g., for recreational fishing).

As described in Section 5.2.1.4, the PAPE for direct visual effects from the offshore facilities overlaps with a limited number of EJ communities along the southern shore of Long Island, New York and along the coast of northern New Jersey (see Figures 5.2-7 and 5.2-11). The direct visual effects from the offshore facilities will primarily be associated with the presence of the WTGs, as the maximum height of the ESP(s) is much less than the WTGs and all offshore cables will be underwater and not visible. The sheer distance of Vineyard Mid-Atlantic from the nearest coastal vantage point—greater than 38 km (24 mi) from the closest WTG—serves to minimize visibility of the offshore facilities from EJ communities. The potential visual impacts from Vineyard Mid-Atlantic generally affect both EJ and non-EJ communities equally and therefore do not constitute a disproportionate impact. Vineyard Mid-Atlantic is also applying important mitigation techniques, such as using colors that are compatible with the marine landscape and using an Aircraft Detection Lighting System (ADLS) or similar system to control aviation obstruction lights, to minimize visual impacts to the maximum extent practicable (see Section 6.1 for a description of proposed measures to reduce visual impacts). In addition, the presence of structures in the Lease Area may provide additional recreational opportunities by creating sightseeing interest (see Section 5.3).

The PAPE for direct visual effects from the onshore facilities is related to the two new onshore substations and up to two onshore RCSs in Nassau County and/or Suffolk County, New York. Onshore substation and onshore RCS construction may require clearing and grading of the site, but the periphery of the site (outside the security fencing) will be restored and revegetated (if required). To minimize visual effects, vegetative buffers for visual screening may be installed, if needed. The Proponent will ensure that the outdoor lighting scheme complies with local requirements. Outdoor lighting will typically be equipped with light shields to prevent light from encroaching into adjacent areas.

5.2.2.7 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to EJ communities during Vineyard Mid-Atlantic are summarized below:

- The Proponent is committed to ensuring that EJ communities receive economic benefits from Vineyard Mid-Atlantic and intends to develop hiring plans and workforce initiatives that target EJ communities.

- The Proponent plans to engage with the public, including potential EJ populations, in meaningful ways, such as holding information sessions and sponsoring/staffing information tables at public events. The Proponent will consider accessibility when scheduling and hosting events to ensure that EJ populations have the opportunity to meaningfully participate.

- The Proponent anticipates that it will develop a CMP that will list construction best management practices to minimize the potential impacts of onshore construction.

- Construction equipment will be operated such that construction-related noise levels will comply with applicable local, state, and federal requirements. Mitigation measures to limit noise will be utilized as needed, such as sound attenuation walls at the onshore substation sites and onshore RCSs.

- The Proponent will work with municipalities to develop the onshore construction schedule and hours in accordance with local ordinances. The timing of onshore construction activities will be coordinated with state and local agencies to avoid seasons or times of peak usage and to align with planned public works projects, where feasible, to minimize disruption.

- The Proponent will develop a TMP prior to construction and will coordinate the timing of activities with state and local agencies.

- The Proponent anticipates utilizing various methods of public outreach prior to and during all phases of Vineyard Mid-Atlantic to keep residents, business owners, and officials updated on the construction schedule and traffic management information.

- The proposed layout provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512 and creates north-south and northwest-southeast corridors that would accommodate all of the existing AIS-equipped fishing fleet.

- The amount of cable protection will be limited. Cable protection will be designed and installed to minimize interfering with bottom fishing gear to the maximum extent practicable and fishermen will be informed of areas where cable protection exists.

- The Proponent will use an ADLS or similar system that automatically turns on and off aviation obstruction lights in response to the detection of aircraft, which substantially minimizes the effect of nighttime lighting.

- To minimize visual effects from the onshore substation sites and onshore RCSs (if used), vegetative buffers for visual screening may be installed, if needed.

Considering these and other measures described in Sections 5.1, 5.3, 5.4, 6.1, and 6.2, it is not expected that EJ communities will bear disproportionately high or adverse impacts or receive disproportionately low benefits from Vineyard Mid-Atlantic.

Furthermore, as described in Section 3.1.2.2, Vineyard Mid-Atlantic will generate clean, renewable energy that will significantly reduce air emissions from the regional electric grid by displacing electricity produced by fossil fuel power plants. Recent studies on redlined communities[64] have shown that fossil fuel power plants are disproportionately sited in these communities, resulting in poor air quality and impacting land use patterns (e.g., causing lower housing values). Levy (2023) notes that these inequalities lead to multiple environmental and social burdens on these communities. Similarly, Cushing et al. (2023) found that the siting of fossil fuel power plants in EJ communities contributed to disproportionate air pollution exposure burdens. Thus, EJ communities, in particular, will benefit from the reduction in fossil fuel power plant emissions that are expected as a result of Vineyard Mid-Atlantic's clean, renewable energy.

5.3 Recreation and Tourism

This section addresses the potential impacts and benefits of Vineyard Mid-Atlantic on recreation and tourism in the Offshore Development Area and Onshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to recreation and tourism during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

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[64] Redlining is a term used to describe racism related to real estate and is derived from historic government maps that identified (in red) predominantly Black neighborhoods that were considered to be risky investments. These communities, which are largely minority communities, are considered to be EJ communities.

A Seascape, Landscape, and Visual Impact Assessment (SLVIA) is provided in Appendix II-J and is summarized in Section 6.1. Commercial fisheries and for-hire recreational fishing impacts are assessed in Section 5.4.

5.3.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities. For the purpose of assessing the effects to recreation and tourism, the Offshore Development Area includes the waters in which Vineyard Mid-Atlantic-related vessels and equipment may operate.

The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities. Onshore export cables will connect up to two of the three potential landfall sites to two new onshore substations in Nassau County and/or Suffolk County, New York. Grid interconnection cables will connect the new onshore substations to the existing East Garden City Substation (Uniondale) POI in Uniondale, New York, the Ruland Road Substation POI in Melville, New York, or the proposed Eastern Queens Substation POI in Queens, New York.

The Onshore Development Area also includes areas where port usage may occur. Each port facility being considered for construction or operations and maintenance (O&M) is either located within an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction proceeds. As a result, use of ports is not expected to impact recreation and tourism and is not discussed further in this section. Port utilization is discussed further in Sections 3.10 and 4.4 of COP Volume I.

The following analysis relies upon recreation and tourism data and analyses compiled by state and municipal economic authorities in New York. United States (US) Census Bureau Economic Census data are also used to quantify recreation and tourism in the Onshore Development Area. National Oceanic and Atmospheric Administration (NOAA) Fisheries and agencies in New York provide data about recreational fishing and boat-based wildlife viewing in New York Bight waters.

5.3.1.1 Offshore Development Area

Recreational boating, fishing, swimming, diving, surfing, and wildlife viewing are seasonally important recreational activities within the Offshore Development Area. According to the 2012 Northeast Recreational Boater Survey and the 2017 New York State Offshore Wind Master Plan: Marine Recreational Uses Study, recreational boating activity, including fishing and wildlife viewing (e.g., migratory bird watching or whale watching), varies seasonally with peak boating season occurring between May and September (Starbuck and Lipsky 2013; NYSERDA 2017).

Starbuck and Lipsky (2013) estimated that approximately 350,000 boating trips on ocean and coastal waters by vessels registered in New York during 2012. Data from the 2012 Northeast Boater Survey identifying recreational boating routes and recreational boating density are presented in Figure 5.3-1. Most recreational boating in the Offshore Development Area occurs within 5.5 kilometers (km) (3 miles [mi]) of shore and within state waters (Starbuck and Lipsky 2013), however, recreational boaters may transit the Lease Area. As noted by Starbuck and Lipsky (2013), the majority of recreational activities such as canoeing, kayaking, surfing, and paddle-boarding occur in more sheltered waters and predominantly within 1.6 km (1 mi) of the coastline. Nearshore recreational boating (e.g., canoeing and kayaking) is most likely to occur in areas close to the landfall sites and less likely to occur farther offshore and within the Lease Area. Surface based recreation such as swimming, surfing, diving, and snorkeling are also popular closer to shore and most activity occurs in the summer months (NYSERDA 2017; Diamond 2019). Diving and snorkeling occur year-round but are most popular between May and October, with near-shore diving extending into November (NYSERDA 2017). Recreational diving reefs can be found within a 5.6 km (3.5 mi) boundary off the coast of New York and New Jersey. Surfing in particular is popular along Long Beach, and the western edge of Jones Beach Island (NYSERDA 2017).

Recreational fishing is a popular activity in the waters of the Offshore Development Area. Survey results presented in Starbuck and Lipsky (2013) indicate that approximately 42% of recreational boating trips originating from New York were associated with recreational fishing. Recreational boating trips increase substantially in the warmer weather months of June, July, and August (Starbuck and Lipsky 2013) and recreational fishing effort data available from NOAA Fisheries (NOAA Fisheries 2024) indicates that those months correspond with the highest number of angler trips in New York Bight waters. The timing of migratory species' "run" through the Offshore Development Area, however, likely also influences the timing of recreational fishing effort, particularly for shore-based fishing. From 2019 to 2023, there have been approximately 15.6 million recreational angler trips (i.e., party and charter boats, rental/private boats, and shore-based) in New York ocean waters (NOAA Fisheries 2024). Of those recreational angler trips, approximately 14.8 million or 95%, are from rental/private boats and shore-based trips. Based on feedback from Fisheries Representatives, there are a few recreational fishing tournaments that occur in state waters near the OECC, including Hooks for Heroes Scotty's Shark Tournament and Hooks for Heroes Summer Fluke Slam in Point Lookout, New York; and Freeport Tuna Club Fluke Shootout and Freeport Hudson Anglers Annual Shark Tournament in Hempstead, New York. There are no offshore recreational fishing tournaments that occur nearby or directly overlap with the Lease Area. The closest two offshore recreational fishing tournaments are east of the Lease Area and OECC and include the Montauk Canyon Challenge and Montauk Mercury Grand Slam. Additional information about for-hire recreational fishing is provided in Section 5.4.1.3.

NOAA Fisheries (NOAA Fisheries 2024) identified key recreational species and/or species groups in New York Bight waters. Those species include tunas and mackerels, scup, summer flounder, black sea bass, tautog, and striped bass. Vineyard Offshore's feedback from New York Bight recreational fisherman indicate that target species also include bluefish, Atlantic cod, scup, dolphin, and yellowfin tuna in federal waters.

The New York State Department of Environmental Conservation (NYSDEC) has established 16 artificial reef sites, including nine along the south shore of Long Island (NYSDEC 2023). No reefs are located within the Lease Area or within OECC, however, recreational vessels accessing these reefs may transit through Offshore Development Area. The New York Department of State, in collaboration with state, regional, and federal partners, gathered detailed data about the characteristics and locations of recreational fishing in New York waters. Those data, along with the location of the NYSDEC artificial reefs, are shown on Figure 5.3-1.

Boat-based wildlife viewing, including bird watching (for pelagic and shorebirds) and whale watching, occur within and in the vicinity of the Offshore Development Area (Figure 5.3-2). Bird watching is typically paired with fishing on charter or recreation boats. It is primarily based along the beaches and shoreline of Long Island, however, pelagic bird watching trips may occur from Jones Inlet out to Hudson Canyon. Bird watching charters generally occur during the seasonal migration, which starts in the spring and ends in the fall (NYSERDA 2017). Shore-based recreational bird watching areas extend from Jones Beach to the Fire Island National Seashore, as well as across the Gateway National Recreation Area. During winter months, the peninsula in Sandy Hook is used to observe species offshore (White 2016; NYSERDA 2017). July and August are the peak months for whale watching in the Northeast US and trips occur most days during the week. The general use area of whale watching cruises may occur from New York Harbor and overlaps with nearshore portions of the OECC (specifically the Rockaway Beach Approach and Atlantic Beach Approach) (Figure 5.3-2). The dominant use area, which is typically used later in the season if whale sightings offshore of New Jersey decline, parallels a short stretch of the western Long Island coast (Figure 5.3-2). Typical commercial whale watching vessels are greater than 20 meters (m) (65 feet [ft]) long and can hold 300 or more passengers (NYSERDA 2017).

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), SeaPlan 2012 Northeast Recreational Boater Survey

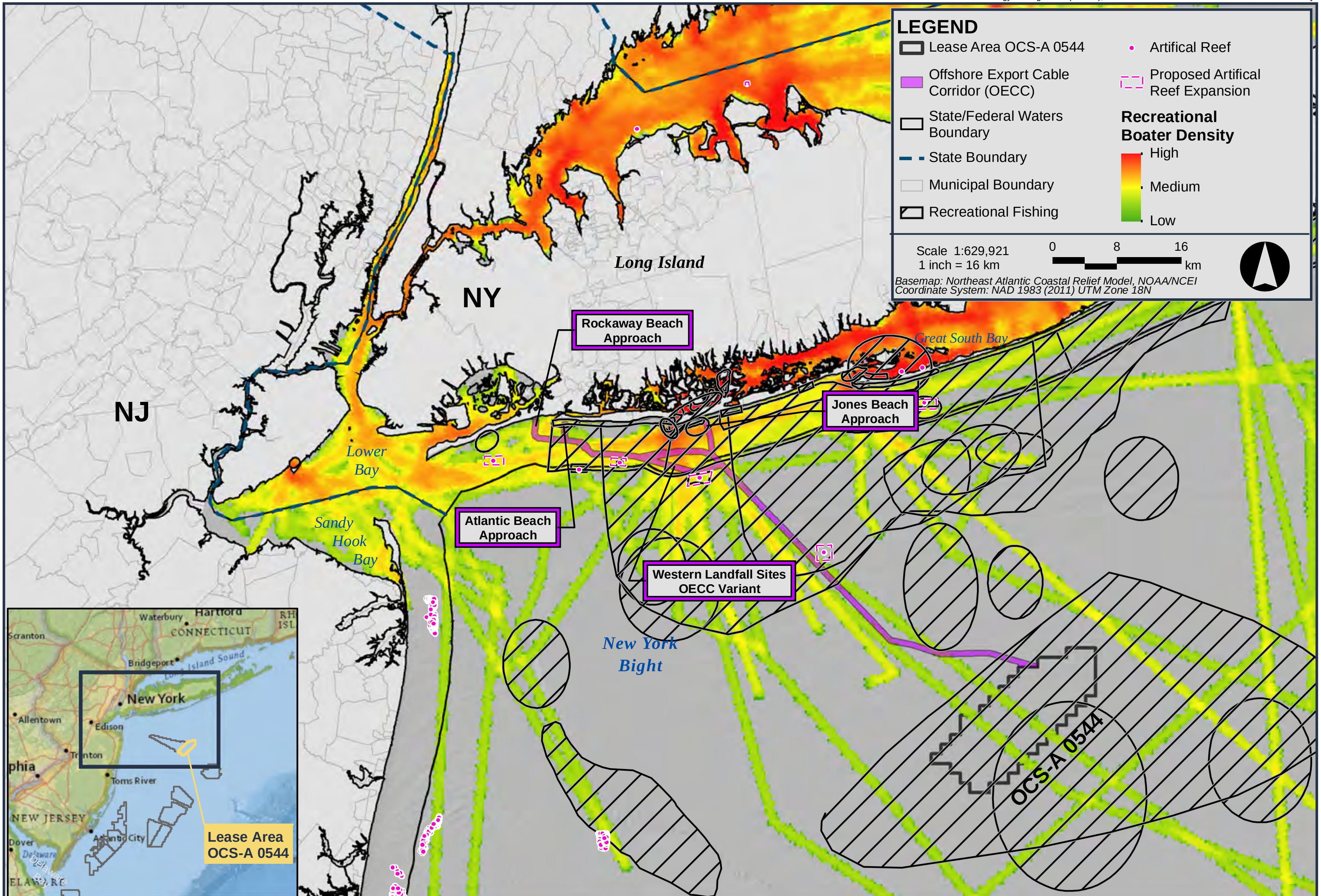

Figure 5.3-1
New York Recreational Boating Density, Recreational Fishing, and Artificial Reefs

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), SeaPlan 2012 Northeast Recreational Boater Survey

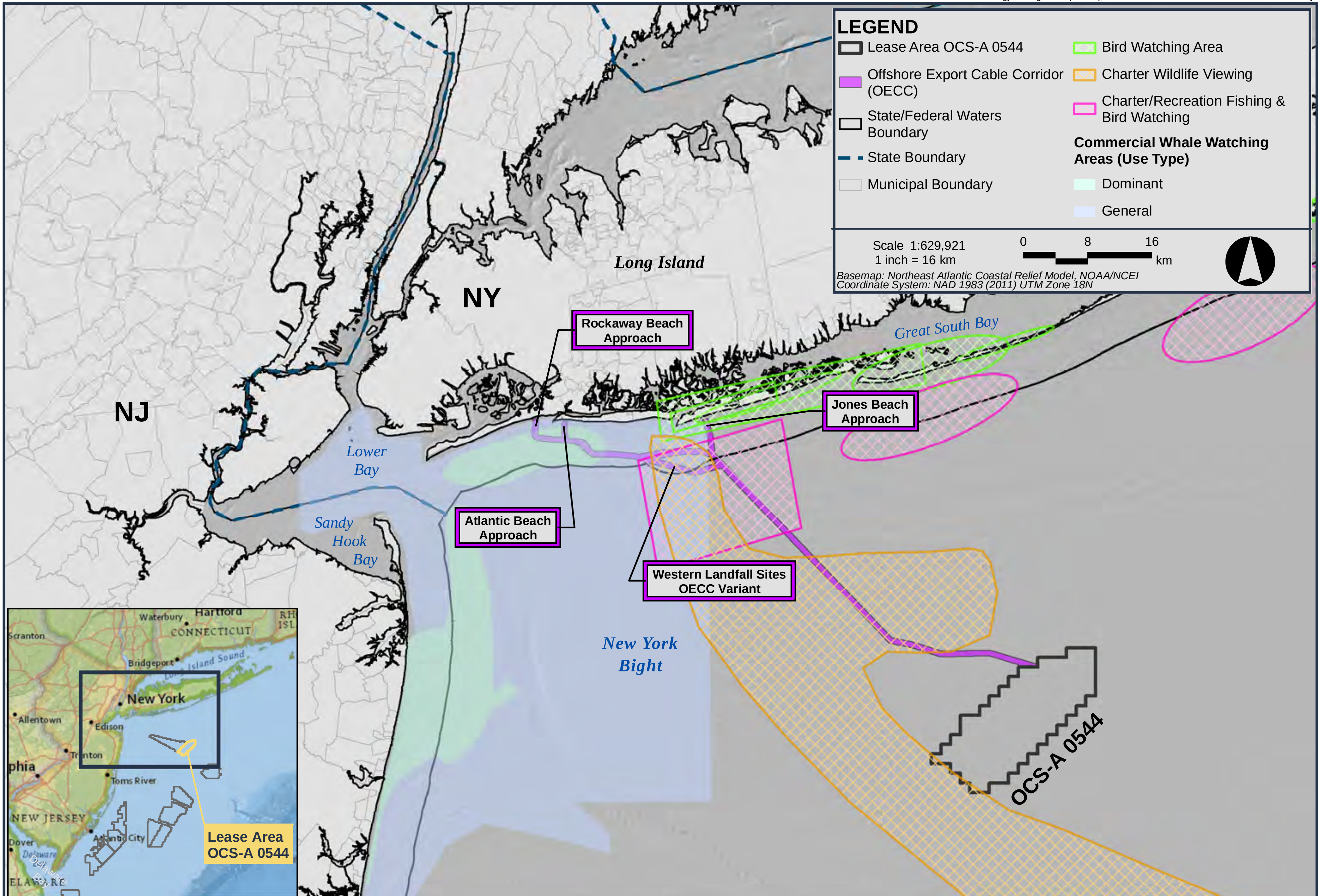

Figure 5.3-2
Wildlife Viewing Areas

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

5.3.1.2 Onshore Development Area

The Onshore Development Area (which consists of the landfall sites, onshore cable routes, onshore substation sites, and potentially onshore RCSs) is located on Long Island, New York in the Borough of Queens, which is co-extensive with Queens County, the Town of Hempstead, and the Town of Oyster Bay, which are in Nassau County, and the Town of Huntington, which is in Suffolk County (see Figure 5.3-3). The onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas). [65] Detailed descriptions of Queens, Nassau, and Suffolk counties can be found in Section 5.1.

5.3.1.2.1 Queens County

Queens County encompasses approximately 282 square kilometers (km^2) (109 square miles [mi^2]) of western Long Island and comprises the Borough of Queens. In 2017, Queens County's recreation and tourism sectors were supported by an estimated 138 facilities offering short-term accommodations, collectively these facilities generated approximately $450.6 million in annual revenue and employed 2,995 individuals. Queens County had approximately 5,358 food and drink establishments generating approximately $4.1 billion in annual sales and employing 52,808 individuals (US Census Bureau 2017). There were 552 arts, entertainment, and recreation establishments in Queens County, generating approximately $1.5 billion in revenue (US Census Bureau 2017). In 2021, traveler spending in Queens County totaled approximately $5.8 billion which supported approximately 73,400 jobs and resulted in approximately $561.9 million in local tax receipts (Tourism Economics 2022).

Offshore export cables installed within the OECC will transition onshore at up to two of the three potential landfall sites. The Rockaway Beach Landfall Site (see Figure 5.3-3) is located in a portion of a previously disturbed area adjacent to Rockaway Beach in Queens, New York. The landfall site, which is located between the Beach 52nd Street and Beach 54th Street boardwalk access points, is bound to the south by the Rockaway Beach Boardwalk and to the north by Edgemere Avenue, the Rockaway Freeway, and train tracks. Surrounding land uses include public open space, including Rockaway Beach and Boardwalk and its access points, and commercial properties, and residential high-rises. Rockaway Beach and Boardwalk are operated by the New York City Department of Parks and Recreation.

5.3.1.2.2 Nassau County

Nassau County encompasses approximately 738 km^2 (285 mi^2) of western Long Island and comprises two cities, Glen Cove and Long Beach, and three towns, Hempstead, North Hempstead, and Oyster Bay. In 2017, Nassau County's recreation and tourism sectors were supported by an estimated 90 facilities offering short-term accommodations, collectively these

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[65] In limited areas, the onshore cable routes may follow utility rights-of-way (ROWs) or depart from public roadway layouts, particularly at complex crossings (e.g., crossings of busy roadways, railroads, wetlands, and waterbodies).

facilities generated approximately $368.3 million in annual revenue and employed 2,748 individuals. Nassau County had approximately 3,718 food and drink establishments generating approximately $3.7 billion in annual sales and employing 51,649 individuals (US Census Bureau 2017). There were 867 arts, entertainment, and recreation establishments in Nassau County, generating approximately $1.5 billion in revenue (US Census Bureau 2017). In 2019, domestic visitors to Nassau County spent approximately $2.9 billion which supported approximately 37,000 jobs and resulted in approximately $186.7 million in local tax receipts (Tourism Economics 2020).

Two potential landfall sites are in Nassau County (see Figure 5.3-3).

- **Atlantic Beach Landfall Site:** The Atlantic Beach Landfall Site is located in a paved parking area near the intersection of The Plaza and Ocean Boulevard in the incorporated village of Atlantic Beach in the Town of Hempstead, New York. The town-owned parking lot is bordered to the south by the Atlantic Beach Boardwalk. Nearby land uses include private beach clubs and private residences. Atlantic Beach is accessible only to residents of Atlantic Beach; however, non-residents may access the boardwalk.

- **Jones Beach Landfall Site:** The Jones Beach Landfall Site is located in a paved parking area (Field 1) near the intersection of the Meadowbrook State Parkway and Ocean Parkway within Jones Beach State Park. Surrounding land uses include the boardwalk, beach, bike path, and open space.

  Jones Beach State Park, managed by the New York State (NYS) Office of Parks, Recreation, and Historic Preservation (NYSOPRHP), is a 17 km^2 (2,400 acres) park on the south shore of Long Island in Hempstead, New York (NYSOPRHP 2022). The park includes a nature center, bathhouses, bike path, boardwalk, ball fields/courts, pools, and outdoor performance centers, among many other amenities. The area is most heavily used during the summer season. Each year from 2018 to 2022, approximately 8.3 million people visited Jones Beach State Park (NYSOPRHP 2022).

The four potential onshore substation site envelopes are also located wholly or partially in Nassau County (see Figure 5.3-3).

- **Onshore Substation Site Envelope A:** [redacted]

- **Onshore Substation Site Envelope B:** [redacted]

[redacted]

- **Onshore Substation Site Envelope C:** [redacted]

- **Onshore Substation Site Envelope D:** [redacted]

5.3.1.2.3 Suffolk County

In 2017, Suffolk County's recreation and tourism sectors were supported by an estimated 177 facilities offering short-term accommodations, and collectively these facilities generated approximately $444.7 million in annual revenue and employed 3,195 individuals. Suffolk County had approximately 3,733 food and drink establishments generating approximately $3.5 billion in annual sales and employing 51,816 individuals (US Census Bureau 2017). There were 917 arts, entertainment, and recreation establishments in Suffolk County, generating approximately $1.1 billion in revenue (US Census Bureau 2017). In 2019, domestic visitors to Suffolk County spent approximately $3.4 billion which supported approximately 42,000 jobs and resulted in approximately $226.9 million in local tax receipts (Tourism Economics 2020).

No landfall sites are anticipated to be located in Suffolk County. A portion of the onshore cable routes and the Ruland Road Substation POI are located in Suffolk County (See Figure 5.3-3).

5.3.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect recreation and tourism during the construction, O&M, and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.3-1.

Table 5.3-1 Impact Producing Factors for Recreation and Tourism

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Vessel Activity	•	•	•
Presence of Structures		•	
Onshore Construction and Maintenance Activities	•	•	•
Noise	•	•	•

[redacted]

Potential effects to recreation and tourism were assessed using the maximum design scenario for Vineyard Mid-Atlantic's onshore and offshore facilities as described in Section 1.5.

5.3.2.1 Vessel Activity

Construction and support vessels will be present within the Lease Area and along the OECC during pre-installation, installation, maintenance, and decommissioning activities. Vessel traffic associated with Vineyard Mid-Atlantic is not anticipated to represent a significant increase over the current levels of vessel traffic within the Offshore Development Area. Navigation and vessel traffic are further discussed in Section 5.6 and Appendix II-G.

The Proponent will work to inform recreational boaters and recreational fishermen of planned vessel activities during construction, maintenance, and decommissioning. The Proponent provides Offshore Wind Mariner Updates and coordinates with the US Coast Guard (USCG) to issue Notices to Mariners (NTMs) advising other vessel operators of planned offshore activities. The Vineyard Mid-Atlantic website will be regularly updated to provide information about activities occurring in the Offshore Development Area.

Depending on the activity, the Proponent may request that mariners give a wide berth to active work sites or construction and maintenance vessel(s) through the issuance of Offshore Wind Mariner Updates. Additionally, the Proponent may request that the USCG establish temporary safety zones, per 33 CFR Part 147, that extend 500 m (1,640 ft) around each wind turbine generator (WTG) and electrical service platform (ESP) during construction and certain maintenance activities (see Section 8.4 of COP Volume I for additional details). The presence of these safety zones would temporarily preclude recreational boating and fishing activities in the immediate vicinity of the structures and may cause boaters and recreational fishermen to slightly alter their navigation routes to avoid the active work sites. However, the safety zones would be limited in size and duration and would not affect the entire Lease Area at any given time.

5.3.2.2 Presence of Structures

The onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas).[66] The onshore cables may be installed within a duct bank or installed within directly buried conduit(s). Onshore cables typically require splices approximately every 152–457 m (500–1,500 ft) or more. At each splice location, one or more underground splice vaults will be installed. Onshore cables will be continuously remotely monitored, inspected at regular intervals, and repairs or maintenance will be conducted promptly. If onshore cable repairs are required, the cables would typically be accessed through manholes installed at the splice vaults and transition vaults. The Proponent also

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[66] In limited areas, the onshore cable routes may follow utility ROWs or depart from public roadway layouts, particularly at complex crossings.

intends to prioritize industrial/commercial onshore substation sites that have been previously disturbed to minimize effects to the surrounding area. If needed, any repair work at the onshore substations or onshore RCSs would occur within the fenced perimeter of the sites. Onshore maintenance and repair activities are expected to require minimal use of worker vehicles and construction equipment. Following construction, the presence of this onshore infrastructure is not anticipated to interfere with recreation and tourism.

The presence of structures in the Lease Area may provide additional recreational opportunities by creating sightseeing interest. A study of Delaware beachgoers found that 45% of respondents would likely take a tour boat to see an offshore wind facility (Lilley et al. 2010). A 2019 study examined potential impacts from the Block Island Wind Farm on the vacation rental market in Block Island, Rhode Island. The study observed that Block Island vacation rental rates increased in the summer relative to other Southern New England tourist destinations and concluded that offshore wind farms may attract tourists (Carr-Harris and Lang 2019). Visual impacts are assessed in the SLVIA (Appendix II-J).

During O&M of Vineyard Mid-Atlantic, the Lease Area and OECC will be open to marine traffic, and no permanent vessel restrictions are proposed. As described in Section 2.3 of COP Volume I, WTG and ESP positions within the Lease Area will be arranged in a uniform grid pattern with west-northwest to east-southeast rows, north to south columns, and 0.68 nautical mile (NM) (1.3 km) spacing between positions. This 0.68 x 0.68 NM WTG/ESP layout provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512, in accordance with the stipulations in Lease OCS-A 0544. Although most recreational vessel traffic occurs closer to shore, the proposed spacing will facilitate safe navigation through the Lease Area. If maintenance activities are required, the Proponent may request that mariners give a wide berth to active work sites or maintenance vessel(s) through the issuance of Offshore Wind Mariner Updates and may request that the USCG establish temporary safety zones that extend 500 m (1,640 ft) around each WTG and ESP, as described in Section 5.3.2.1. However, it is expected that certain maintenance activities in the Lease Area will not require in-water work but will instead be based from the structures themselves. A detailed Navigation Safety Risk Assessment (NSRA) for Vineyard Mid-Atlantic is included as Appendix II-G and additional discussion of navigational impacts and the presence of structures in the Offshore Development Area is provided in Section 5.6.

As described in Section 5.6, to aid marine navigation, the WTGs, ESP(s), and their foundations will be equipped with marine navigation lighting, marking, and signaling in accordance with USCG and Bureau of Ocean Energy Management (BOEM) guidance. Each WTG and ESP will be maintained as a Private Aid to Navigation (PATON). Based on current USCG guidance, the Proponent expects the lighting, marking, and signaling scheme of the offshore facilities during the operational period as described in Section 4.1.5 of COP Volume I. Further information on marine navigation lighting and marking can be found in the NSRA (see Appendix II-G). The Proponent will coordinate with USCG and NOAA to ensure that the WTGs and ESP(s) are identified on nautical charts.

It is anticipated that foundations may function as fish aggregating devices by providing additional structure for species that prefer structured habitat, thereby improving the recreational fishing experience within the Lease Area (BOEM 2012). Feedback from New York Bight recreational fishermen was that WTGs would also attract migratory species such as tuna, dolphin, and cobia in the summer months. The addition of foundations, scour protection, and cable protection (if used) may attract fish species to new structured habitat, resulting in increases in biodiversity and abundance of fish (Riefolo et al. 2016; Raoux et al. 2017; The Nature Conservancy and INSPIRE Environmental 2021). Degraer et al. (2020) also noted that the addition of WTGs in this type of environment may provide shelter and food for some finfish species (e.g., Atlantic cod and black sea bass) that have demonstrated, in studies of other offshore wind installations, spending some part of their lifecycle closely associated with WTGs. There is also evidence that WTG reef habitats and the resources they provide increase the growth and condition of juvenile Atlantic cod and whiting-pout (Reubens et al. 2013), which is consistent with observations near deep-water offshore wind farms (Løkkeborg et al. 2002; Hille Ris Lambers and ter Hofstede 2009). Degraer et al. (2020) also noted that species production may increase as a result of new habitat that enhances settlement, survival, and/or growth or may save energy (Schwartzback et al 2020).

Feedback from New York Bight recreational fishermen indicates recreational fishermen are interested in seeing scour protection around WTG foundations because it provides additional structured habitat for fish such as tautog, black sea bass, summer flounder, and other species. As proposed, scour protection in the Project Design Envelope allows for an approximate maximum diameter of 96-121 m (315-397 ft)[67] for monopiles (see Tables 3.3-1 and 3.4-4 of COP Volume I). The need for scour protection is specific to the final design of the selected foundation concept(s) and will be further assessed upon detailed engineering of the foundations. The Proponent will also evaluate the feasibility of using nature-inclusive scour protection designs, which refers to options that can be integrated with or added to the design of scour protection to create suitable habitat for native species. In the event WTGs aggregate or increase productivity of recreationally targeted species, based on the intensity of recreational fishing within the Lease Area and its geographic scale, neither congestion effects nor gear conflicts are expected.

5.3.2.3 Onshore Construction and Maintenance Activities

Onshore construction and maintenance activities may result in temporary impacts at the landfall sites, along onshore cable routes, onshore substation sites, and/or at potentially onshore RCSs. The Proponent will work with municipalities to develop the construction schedule and hours in accordance with local ordinances. The timing of onshore construction

[67] A range of the approximate maximum size of scour protection is provided as detailed engineering of the foundations is ongoing.

activities will be coordinated with state and local agencies to avoid seasons or times of peak usage and to align with planned public works projects, where feasible, to minimize disruption. Onshore construction at the landfall sites is planned to occur outside of the period from Memorial Day to Labor Day.

Onshore export cables will transmit power from the landfall sites to the onshore substation sites. The potential onshore cable routes associated with each POI are described in Sections 3.8.1 through 3.8.3 of COP Volume I. The onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas) via open trenching. Trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies). The onshore cables may be installed within a duct bank (i.e., an array of plastic conduits encased in concrete) or within directly buried conduit(s). The onshore cables are expected to be installed in open trenches using conventional construction equipment (e.g., hydraulic excavator, loader, dump trucks, flatbed trucks, crew vehicles, cement delivery trucks, and paving equipment).

During construction and decommissioning, the Proponent anticipates an increase in construction and support vehicle traffic in areas within the Onshore Development Area. The Proponent will work with municipalities to develop a Traffic Management Plan (TMP) prior to construction and will coordinate the timing of activities with state and local agencies. Signage, lane restrictions, police details, and other appropriate traffic management measures will be used to maintain traffic flow, and traffic management will always be coordinated with municipal officials. The Proponent anticipates utilizing various methods of public outreach prior to and during the all phases of Vineyard Mid-Atlantic to keep residents, business owners, and officials updated on the construction schedules, vehicular access, lane closures, detours, and other traffic management information, local parking availability, emergency vehicle access, construction crew movement and parking, laydown areas, staging, and equipment delivery, nighttime or weekend construction, and road repaving. The Proponent will coordinate with the local police and emergency service departments prior to the commencement of any work.

To protect public health and safety during the installation or decommissioning of the onshore cables, short-term access restrictions to parks/conservation areas along the onshore cable routes may be implemented in the area immediately surrounding work activities. Similarly, construction at the landfall sites may temporarily limit pedestrian access to discrete areas of the landfall sites. Additionally, shore-based recreational activities (e.g., swimming) at the landfall sites may be temporarily displaced during construction or decommissioning; however, onshore construction at the landfall sites is planned to occur outside of Memorial Day to Labor Day to avoid or minimize potential impacts.

During O&M, periodic maintenance may be required. If onshore cable repairs are required, the cables would typically be accessed through manholes installed at the splice vaults and transition vaults thereby minimizing impacts to recreation and tourism.

The Proponent anticipates that temporary and minor impacts on ambient air quality from onshore construction vehicles will be limited to areas adjacent to active construction, maintenance, or decommissioning activities. Potential impacts include construction vehicle or equipment emissions and possibly the generation of fugitive dust during construction. Such emissions are expected to be similar to other onshore construction projects.

5.3.2.4 Noise

Onshore cable installation and decommissioning activities (and, to a lesser extent, maintenance activities) may generate temporary noise levels that are periodically audible along the onshore cable routes. Construction equipment may also generate noise at the landfall sites, onshore substations, and potentially onshore RCSs, and staging and maintenance areas. The Proponent anticipates that construction equipment utilized for cable installation activities will be similar to that used during typical public works projects (e.g., road resurfacing, storm sewer installation, transmission line installation). Horizontal directional drilling (HDD) is expected to be used at the landfall sites and may result in temporarily elevated noise levels.

Although intermittent increases in noise levels are expected within the Onshore Development Area, primarily during construction, the Proponent is committed to minimizing these impacts. As noted, onshore construction at the landfall sites is planned to occur outside of the period from Memorial Day to Labor Day, which will minimize the effects of the construction noise (including HDD). Construction hours will be developed in accordance with local noise ordinances. Construction equipment will be operated such that construction-related noise levels will comply with applicable local, state, and federal requirements. Mitigation measures to limit noise (such as using quieter equipment, assuring the functionality of equipment, adding mufflers or noise-reducing features, using temporary noise barriers) will be utilized as needed. The onshore substations will be designed to comply with applicable sound level limits and will include sound level mitigation as needed.

Construction activities may affect recreational fishing activities by impacting recreationally-important species. For example, pile driving and low-intensity noise from increased vessel traffic may cause recreationally targeted species to temporarily avoid the immediate vicinity of the construction activities (Kirkpatrick et al. 2017). However, any species affected by construction and installation activities are anticipated to return to the area soon after construction and installation noises cease (Bergstrom et al. 2014). Potential water quality, noise, and other impacts to species targeted by recreational fishing vessels are described in Section 4.6.

5.3.2.5 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to recreation and tourism during Vineyard Mid-Atlantic are summarized below:

- The Proponent provides Offshore Wind Mariner Updates and coordinates with the USCG to issue NTMs advising other vessel operators of planned offshore activities. Depending on the activity, the Offshore Wind Mariner Update may request that mariners give a wide berth to the work site or construction and maintenance vessel(s). The Vineyard Mid-Atlantic website will be regularly updated to provide information about vessel activities occurring in the Offshore Development Area.

- The Proponent may request that the USCG establish temporary safety zones, per 33 CFR Part 147, that extend 500 m (1,640 ft) around each WTG and ESP during construction and certain maintenance activities. The safety zones would be limited in size and duration and would not affect the entire Lease Area at any given time.

- The WTGs and ESP(s) will be arranged in a uniform grid pattern with west-northwest to east-southeast rows, north to south columns, and 0.68 NM (1.3 km) spacing between positions to accommodate vessel transits, recreational fishing, and other uses of the OCS. This 0.68 x 0.68 NM WTG/ESP layout provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512, in accordance with the stipulations in Lease OCS-A 0544.

- The WTGs, ESP(s), and their foundations will be equipped with marine navigation lighting, marking, and signaling in accordance with USCG and BOEM guidance. Each WTG and ESP will be maintained as a PATON. The Proponent will coordinate with USCG and NOAA to ensure that the WTGs and ESP(s) are identified on nautical charts.

- Construction equipment will be operated such that construction-related noise levels will comply with applicable local, state, and federal requirements and mitigation measures to limit noise will be utilized as needed. The onshore substations and potentially onshore RCSs will be designed to comply with applicable sound level limits and will include sound level mitigation as needed.

- The Proponent will work with municipalities to develop a TMP prior to construction.

5.4 Commercial Fisheries and For-Hire Recreational Fishing

This section addresses the potential impacts of Vineyard Mid-Atlantic on commercial fisheries and for-hire recreational fishing in the Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to commercial fisheries and for-hire recreational fishing during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Information presented in this section is supplemented by Appendix II-F, which provides further analysis of the potential economic exposure of commercial fisheries to Vineyard Mid-Atlantic, and Appendix II-G, which includes the Navigation Safety Risk Assessment (NSRA) and provides further analysis of commercial fishing vessel operations in the Offshore Development Area.

5.4.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities. This section provides an overview of fishing fleets, fishing ports, fishing vessel activity, and the estimated value of commercial landings from within the Offshore Development Area.

To assess and characterize commercial fishing and to develop baseline estimates of the economic value of commercial fishing, this section uses several data sources and reports that provide information on commercial fishing activities within the Offshore Development Area:

- Maps of fishing activity based on vessel monitoring system (VMS)[68] data and vessel trip reports (VTRs)[69] developed for the Northeast Regional Ocean Council (NROC) and the Mid-Atlantic Council on the Ocean (MARCO),

- VTR-based spatial representation of commercial fishing intensity and revenue developed by the Bureau of Ocean Energy Management (BOEM),[70]

- Estimates of the commercial fisheries revenue developed by National Oceanic Atmospheric Administration (NOAA) Fisheries for the Lease Area (NOAA Fisheries 2024a) and for the OECCs (NOAA Fisheries 2024b),[71] and

- Automatic identification system (AIS) data were queried to establish estimates of commercial fishing vessel traffic.

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[68] Concepts and methodology for development of the VMS data are described in Fontenault (2018).

[69] Concepts and methodology for development of the VTR data are described in St. Martin (2008).

[70] Concepts and methodology for development of these data are described in NOAA Tech Memo NE-229 (DePiper 2014).

[71] Data from these sources were processed by NOAA Fisheries following the methods described in Kirkpatrick et al. (2017) and DePiper (2014).

To characterize for-hire recreational fishing activity in the Offshore Development Area, this analysis uses data from the NOAA Fisheries report of socioeconomic impacts of Atlantic offshore wind development (NOAA Fisheries 2024c), NOAA Fisheries Marine Recreational Information Program (MRIP) database (NOAA Fisheries 2024d), and a regional for-hire fisheries assessment (Hutt and Silva 2015).

Based on these data sources, the following sections present estimates of the economic value of commercial fishing activity in the Offshore Development Area. These values represent the economic “exposure” of commercial fishing in the Lease Area and OECC. The estimated economic exposure presented below does not represent the absolute value of income from commercial fishing in the Offshore Development Area because, as shown in Appendix II-F, an economic impact analysis considers many additional factors, including the costs incurred to harvest species.

Because of the large geographic range of many commercially harvested species, commercial fisheries are typically regional in nature and vessels participating in these fisheries may operate from ports located throughout the Atlantic coastline. Based on currently available data, it is understood that vessels operating within the Offshore Development Area do so predominantly from the commercial fishing ports identified in the following sections. Vessels operating from other ports may also have some presence in the Offshore Development Area; however, they are not expected to have meaningful economic exposure to Vineyard Mid-Atlantic. The Proponent anticipates working with federal and state agencies as well as environmental, fisheries, and local community stakeholders to further develop estimates of economic exposure of commercial fisheries and for-hire recreational fisheries within the Offshore Development Area.

Many environmental and regulatory factors contribute to the productivity of commercial fishing areas and, as a result, the locations of commercial fishing efforts are highly variable. Restrictions limiting fishing activity for certain species and changes to the habitat and prey of commercial species can give an incomplete picture of the potential value of fishery resources available in the Offshore Development Area. Fisheries management impacts commercial fisheries through the management of sustainable fish stocks and measures to reduce impacts on important habitat and protected species. Measures to manage the duration of fishing seasons, quotas, and closed areas, can also reduce or increase the size of available landings to commercial fisheries. The following analysis summarizes historic fishing values and effort in the Offshore Development Area and cannot account for ecological change, climate change, commercial fishing pressures, and interannual changes in populations of commercially harvested species. As stated in the NOAA Fisheries Draft Northeast Regional Action Plan to Implement the NOAA Fisheries Climate Science Strategy in 2022–2024, climate change impacts such as warming ocean temperature can manifest changes in species distribution, abundance, productivity, natural mortality, growth rates, and predator-prey interactions of commercially harvested species (NOAA Fisheries 2021). Therefore, estimates of fisheries exposure do not necessarily capture the complete economic value of resources in the Offshore Development Area.

Nonetheless, the Proponent will continue to meet with fishermen to solicit additional information on fishing efforts in the Lease Area and OECC, and to ensure that the most accurate and relevant information regarding each of the fisheries in the Offshore Development Area is incorporated into the planning and design of Vineyard Mid-Atlantic.

5.4.1.1 Lease Area OCS-A 0544

Data summarizing commercial fishing activity, revenue exposure, and landings within the Lease Area are available from NOAA Fisheries (NOAA Fisheries 2024a). These data include annualized landings and revenue by species, gear type, and fishery management plan (FMP) as well as by port and state and were used to identify the primary commercial fisheries, ports, and states potentially affected by development in the Lease Area (NOAA Fisheries 2024a).

The data summarized in Tables 5.4-1 through 5.4-6 are based on NOAA Fisheries' analysis of combined data from VTRs and dealer reports submitted by those issued a federal fishing vessel permit. Values reported in these tables have been deflated to 2022 dollars to aid in comparison across the 15 years of data.

Table 5.4-1 provides the annual landed weight and value of all species harvested within the Lease Area between 2008 and 2022.

Table 5.4-1 Commercial Landings from the Lease Area by Year, 2008–2022

Year	Landings (lbs)	Value (2022 dollars)
2008	793,000	$1,429,000
2009	990,000	$1,119,000
2010	718,000	$1,928,000
2011	491,000	$4,350,000
2012	990,000	$4,905,000
2013	544,000	$2,326,000
2014	449,000	$4,174,000
2015	255,000	$1,989,000
2016	712,000	$1,955,000
2017	362,000	$1,004,000
2018	429,000	$897,000
2019	287,000	$746,000
2020	392,000	$1,460,000
2021	235,000	$371,000
2022	166,000	$603,000
Average annual	520,867	$1,950,400

Notes:

1. NOAA Fisheries 2024a.

2. Values have been deflated to 2022 dollars.

The 15-year average annual weight and value of the 10 most valuable species landed in the Lease Area are shown in Table 5.4-2. These 10 species account for approximately 100% of the average annual value from the Lease Area.

Table 5.4-2 Average Annual Volume and Value of Commercial Landings from the Lease Area by Species, 2008–2022

Species	Average annual Landings (lbs)	Average annual Value (2022 dollars)	Percentage of Average annual Lease Area Value
Sea Scallop	138,467	$1,721,600	88.3%
All Others	73,000	$69,933	3.6%
Monkfish	16,933	$35,800	1.8%
Atlantic Mackerel	92,933	$20,800	1.1%
Atlantic Herring	135,933	$19,867	1.0%
Summer Flounder	5,933	$18,333	0.9%
Longfin Squid	11,667	$16,933	0.9%
Black Sea Bass	3,867	$13,733	0.7%
Scup	10,933	$10,533	0.5%
Surfclam	11,133	$8,867	0.5%
Total of Top Species	500,800	$1,936,400	-

Notes:

1. NOAA Fisheries 2024a.
2. Values have been deflated to 2022 dollars.
3. "All Others" refers collectively to all species with landings data related to fewer than three permits or dealers to protect data confidentiality.

The 15-year average annual weight and value of the 10 most valuable species managed under FMPs in the Lease Area are shown in Table 5.4-3. These FMPs account for approximately 99.8% of the average annual value landed from the Lease Area.

Table 5.4-3 Average Annual Volume and Value of Commercial Landings from the Lease Area by Fishery Management Plan, 2008–2022

Fishery Management Plan	Average Annual Landings (lbs)	Average Annual Value (2022 dollars)	Percentage of Average Annual Lease Area Value
Sea Scallop	138,467	$1,721,600	88.2%
Surfclam, Ocean Quahog	49,067	$54,333	2.8%
Summer Flounder, Scup, Black Sea Bass	20,733	$42,600	2.2%
Mackerel, Squid, and Butterfish	112,867	$38,067	1.9%
Monkfish	16,933	$35,800	1.8%
All Others	29,000	$26,467	1.4%
Atlantic Herring	135,933	$19,867	1.0%

Table 5.4-3 Average Annual Volume and Value of Commercial Landings from the Lease Area by Fishery Management Plan, 2008–2022 (Continued)

Fishery Management Plan	Average Annual Landings (lbs)	Average Annual Value (2022 dollars)	Percentage of Average Annual Lease Area Value
ASMFC FMP	6,267	$5,200	0.3%
No Federal FMP	3,200	$2,400	0.1%
Skates	5,933	$2,267	0.1%
Other FMPs	2,533	$1,900	0.1%
Total	520,933	$1,950,500	-

Notes:

1. NOAA Fisheries 2024a.
2. Values have been deflated to 2022 dollars.
3. "All Others" refers collectively to all FMPs with landings reported for fewer than three permits or dealers to protect data confidentiality.
4. The Atlantic States Marine Fisheries Commission (ASMFC) FMP includes the following species: American lobster, cobia, Atlantic croaker, black drum, red drum, menhaden, NK sea bass, NK seatrout, spot, striped bass, tautog, Jonah crab, and pandalid shrimp.
5. "No Federal FMP" contains a variety of species that are not federally regulated, such as: lobster, Jonah crab, smooth and chain dogfish, whelk, and menhaden (approximately 69 species without federal FMPs are harvested in the Lease Area).

The 15-year average annual weight and value of select gear types in the Lease Area are shown in Table 5.4-4. The first five gear types listed account for approximately 99.6% of average annual value landed from the Lease Area.

Table 5.4-4 Average Annual Volume and Value of Commercial Landings from the Lease Area by Gear Type, 2008–2022

Gear Type	Average Annual Landings (lbs)	Average Annual Value (2022 dollars)	Percentage of Average Annual Lease Area Value
Scallop Dredge	136,133	$1,671,600	85.7%
Bottom Trawl	67,600	$126,533	6.5%
Clam Dredge	78,200	$82,533	4.2%
Midwater Trawl	215,400	$32,067	1.6%
Gillnet (sink)	17,867	$29,800	1.5%
Lobster Pot	1,200	$4,267	0.2%
Other Pot	2,667	$2,133	0.1%
All Others	1,800	$1,133	0.1%
Other Dredge	33	$400	0.02%
Handline	33	$33	0.002%
Total	520,933	$1,950,500	-

Notes:

1. NOAA Fisheries 2024a.
2. Values have been deflated to 2022 dollars.
3. "All Others" refers collectively to gear types with landings reported for fewer than three permits or dealers to protect data confidentiality.

The 15-year average annual weight and value of commercial landings by state within the Lease Area are shown in Table 5.4-5. New Jersey and Massachusetts account for approximately 84% of the average annual value landed from the Lease Area.

Table 5.4-5 Average Annual Volume and Value of Commercial Landings from the Lease Area by State, 2008–2022

State	Average Annual Landings (lbs)	Average Annual Value (2022 dollars)	Percentage of Average Annual Lease Area Value
New Jersey	227,067	$932,000	47.8%
Massachusetts	213,667	$700,400	35.9%
Virginia	16,733	$174,200	8.9%
New York	24,800	$50,800	2.6%
Connecticut	5,133	$45,467	2.3%
Rhode Island	29,333	$41,533	2.1%
North Carolina	1,467	$4,000	0.2%
Maryland	467	$1,200	0.1%
All Others	2,267	$800	0.04%
Total	520,933	$1,950,400	-

Notes:

1. NOAA Fisheries 2024.
2. Values have been deflated to 2022 dollars.
   "All Others" refers collectively to states with landings reported for fewer than three permits or dealers to protect data confidentiality.

The 15-year average annual weight and value of the 10 most exposed ports in the Lease Area are shown in Table 5.4-6. The first five ports listed account for approximately 92.4% of the average annual value landed from the Lease Area.

Table 5.4-6 Average Annual Volume and Value of Commercial Landings from the Lease Area by Port, 2008–2022

Port	Average Annual Landings (lbs)	Average Annual Value (2022dollars)	Percentage of Average Annual Lease Area Value
New Bedford, MA	152,533	$685,000	35.1%
Point Pleasant, NJ	72,800	$340,667	17.5%
Cape May, NJ	90,067	$299,733	15.4%
Barnegat, NJ	29,067	$220,800	11.3%
Newport News, VA	11,000	$119,800	6.1%
City Of Seaford, VA	2,733	$34,800	1.8%
Point Judith, RI	9,467	$28,867	1.5%
Atlantic City, NJ	25,733	$27,867	1.4%

Table 5.4-6 Average Annual Volume and Value of Commercial Landings from the Lease Area by Port, 2008–2022 (Continued)

Port	Average Annual Landings (lbs)	Average Annual Value (2022dollars)	Percentage of Average Annual Lease Area Value
Stonington, CT	2,533	$24,133	1.2%
Point Lookout, NY	3,067	$21,533	1.1%
Total of Top 10 Ports	399,000	$1,803,200	-

Notes:

1. NOAA Fisheries 2024a.
2. Values have been deflated to 2022 dollars.

The VMS- and VTR-based mapping made available by NROC and MARCO qualitatively characterize the density of commercial fishing vessel activity within the multispecies (groundfish), monkfish, sea scallop, surf clam/ocean quahog, mackerel, squid, and herring fisheries, and within the bottom trawl, dredge, gillnet, longline, and pots and traps fisheries. The maps were used to characterize commercial fishing effort in the Lease Area.

Figures 5.4-1 through 5.4-6 depict a standardized density of commercial fishing vessel activity within the VMS dataset, including: multispecies (groundfish), monkfish, scallop, surf clam/ocean quahog, squid, and herring. As noted above, these maps are based on VMS data for the years 2015 to 2016 and use vessel speed data to differentiate between transiting vessels and vessels actively engaged in fishing. A speed threshold of <4 or 5 knots is considered indicative of fishing activity but may also capture vessels transiting (such as within navigation channels) or other non-fishing activities (e.g., processing landings at sea). The VMS-based analysis for the years 2015 to 2016 indicates very little presence of vessels participating in the multispecies (groundfish), monkfish, and surf clam/ocean quahog fisheries, low to medium presence of vessels participating in the squid and herring fisheries, and high presence of vessels participating in the sea scallop fishery in the Lease Area.

Figures 5.4-7 through 5.4-12 are VTR-based maps depicting the bottom trawl, dredge, gillnet, longline, and pots and traps fisheries (excluding lobster). It is important to note that the VMS figures (see Figures 5.4-1 through 5.4-6) depict relative commercial fishing vessel density between 2015 and 2016, while the VTR figures (see Figures 5.4-7 through 5.4-12) depict relative commercial fishing vessel density between 2011 and 2015. The VTR-based analysis indicates very little activity in the Lease Area of vessels participating in bottom trawl, gillnet, longline, and pots and traps fisheries and more activity of vessels participating in the dredge fisheries.

To support the Kirkpatrick et al. (2017) analysis of socioeconomic exposure of commercial fisheries to wind energy development in the United States (US) Atlantic and to improve upon the spatial precision of self-reported VTR fishing locations, BOEM developed a revenue-intensity raster dataset using fishery dependent landings data (BOEM 2020). Revenue intensity

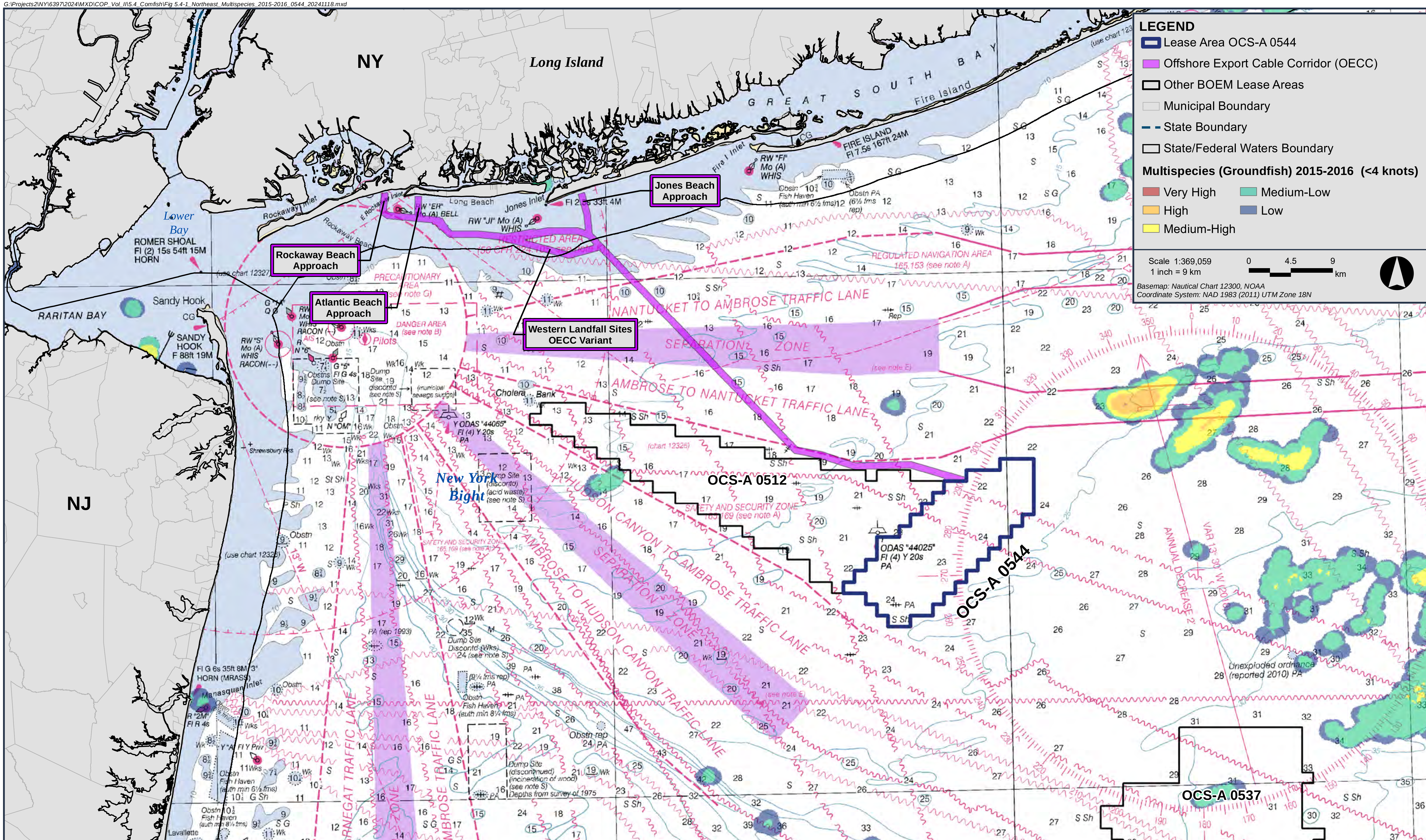

Figure 5.4-1
Northeast Multispecies (Groundfish) Commercial Fishing Density 2015–2016 (<4 knots; VMS data)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

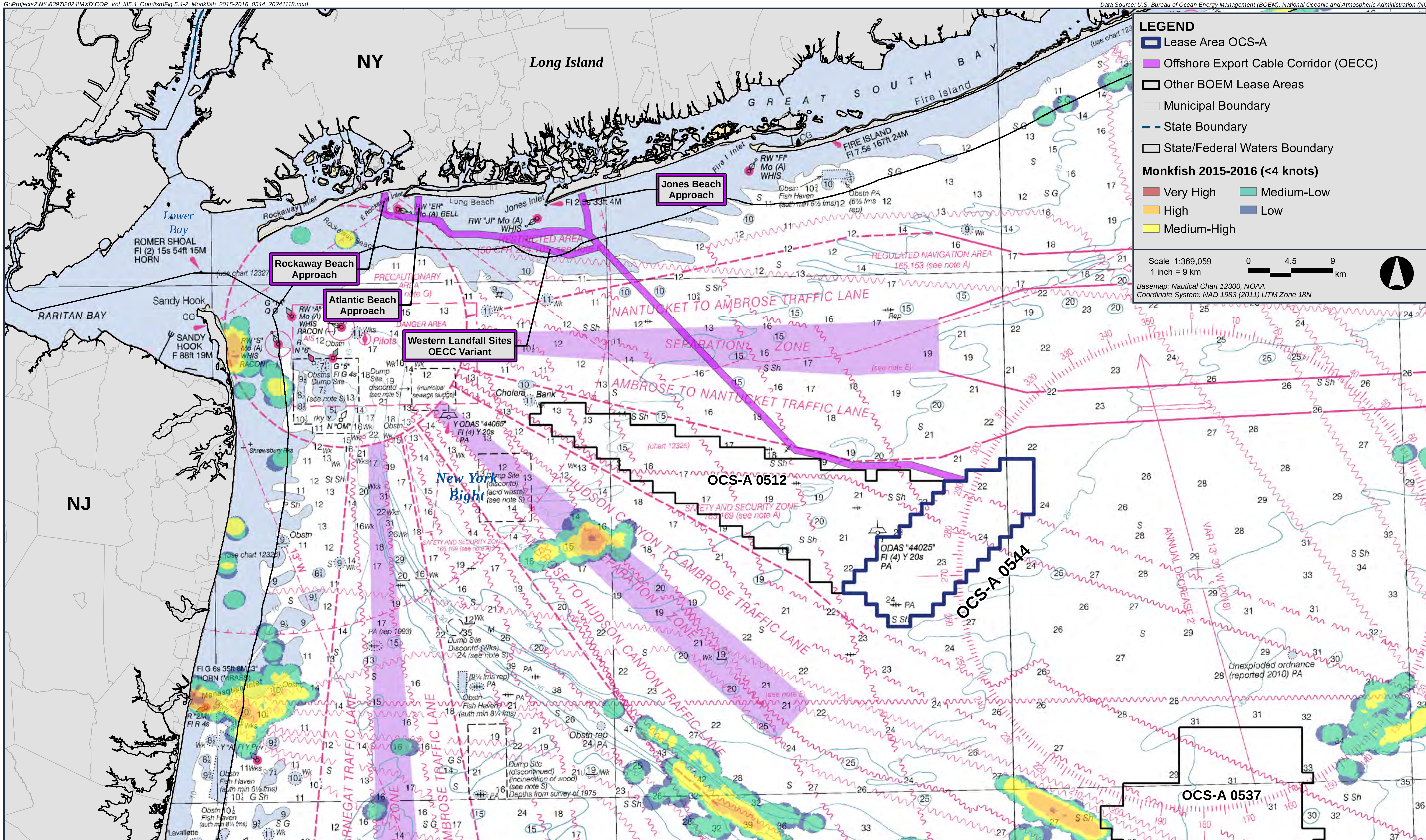

Figure 5.4-2

Monkfish Commercial Fishing Density 2015–2016 (<4 knots; VMS data)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-3_Scallop_2015-2016_0544_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

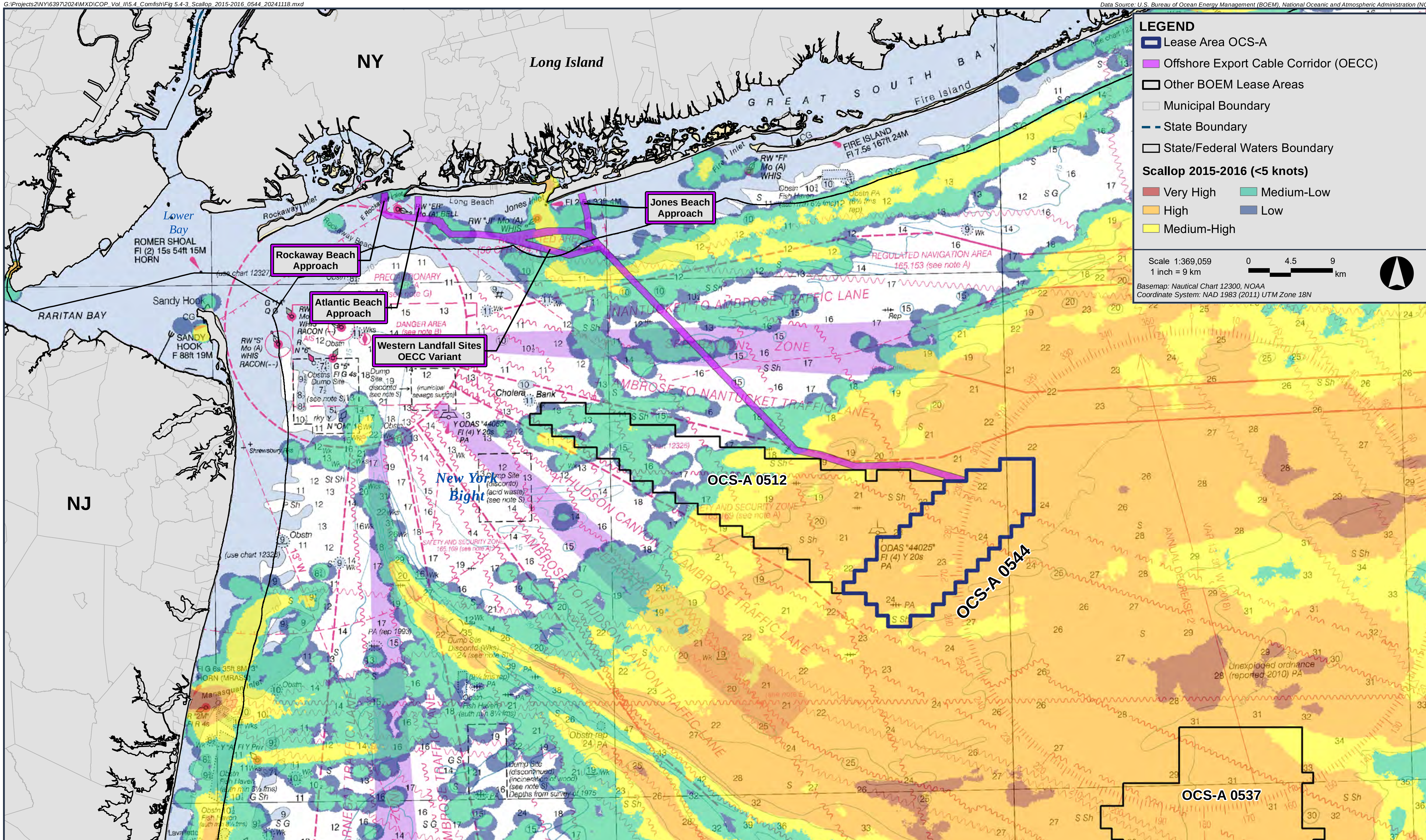

Figure 5.4-3

Scallop Commercial Fishing Density 2015–2016 (<5 knots; VMS data)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-4_Surf_Clam_Quahog_2015-2016_0544_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

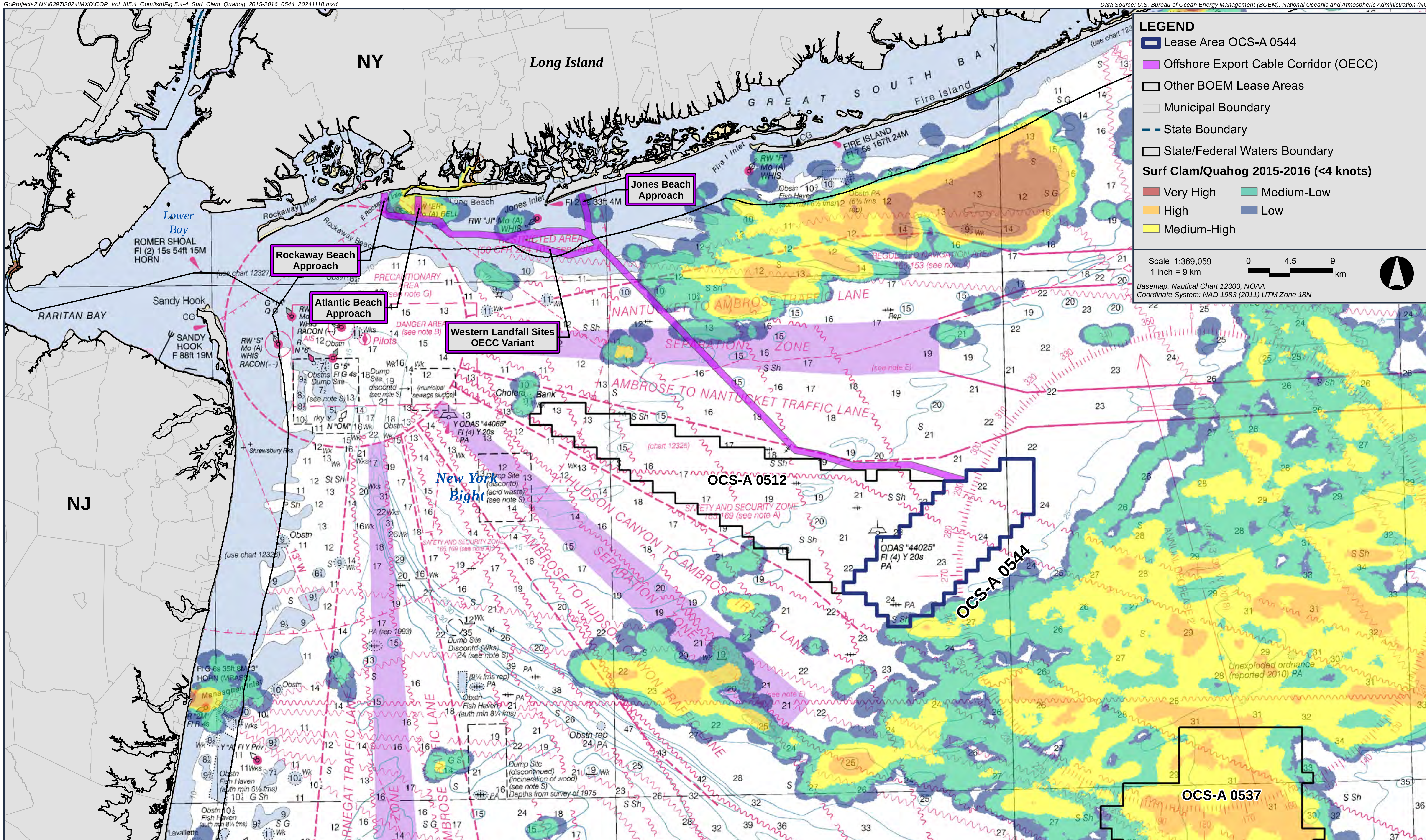

Figure 5.4-4

Surf Clam/Ocean Quahog Commercial Fishing Density 2015–2016 (<4 knots; VMS data)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

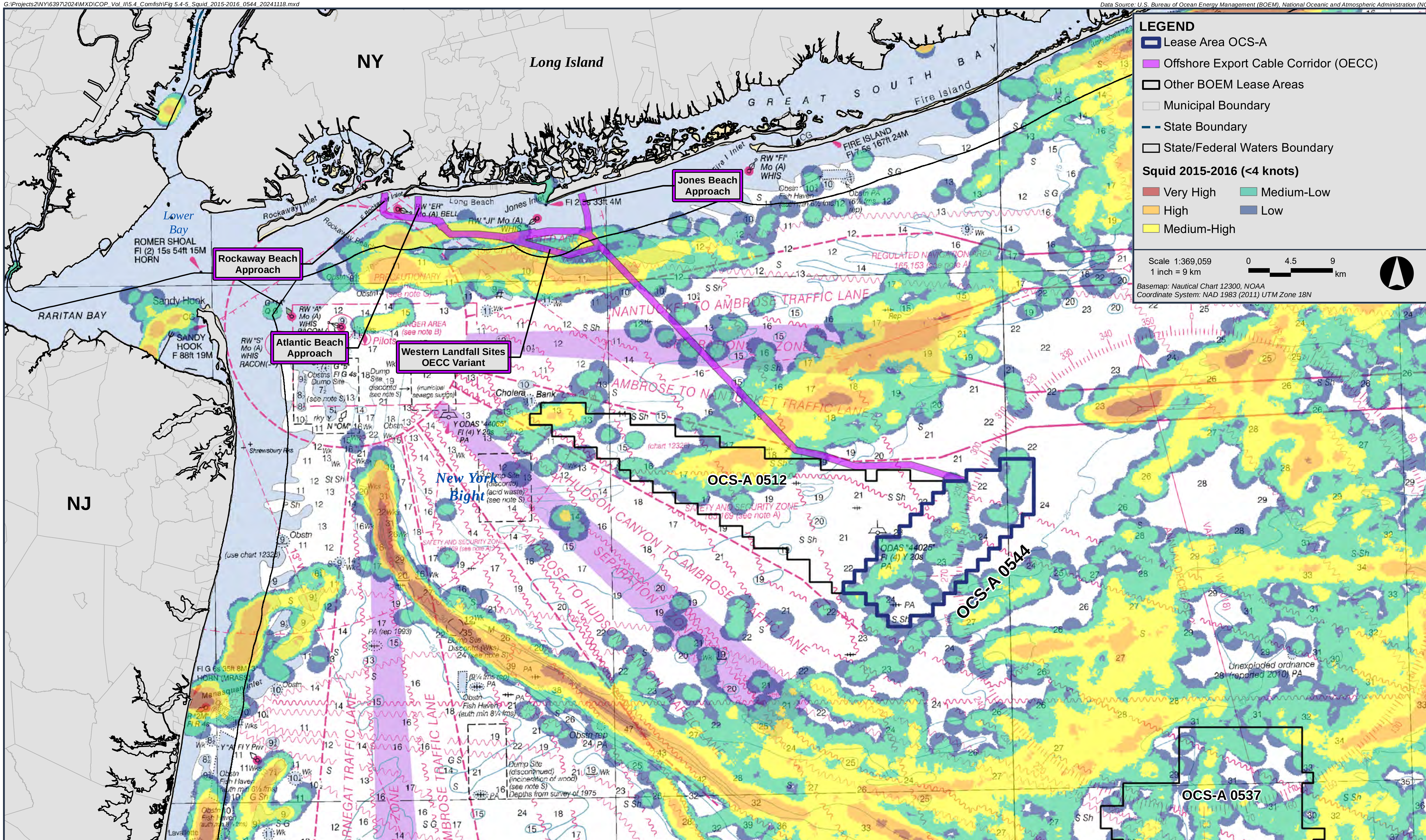

Figure 5.4-5

Squid Commercial Fishing Density 2015–2016 (<4 knots; VMS data)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-6_Herring_2015-2016_0544_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

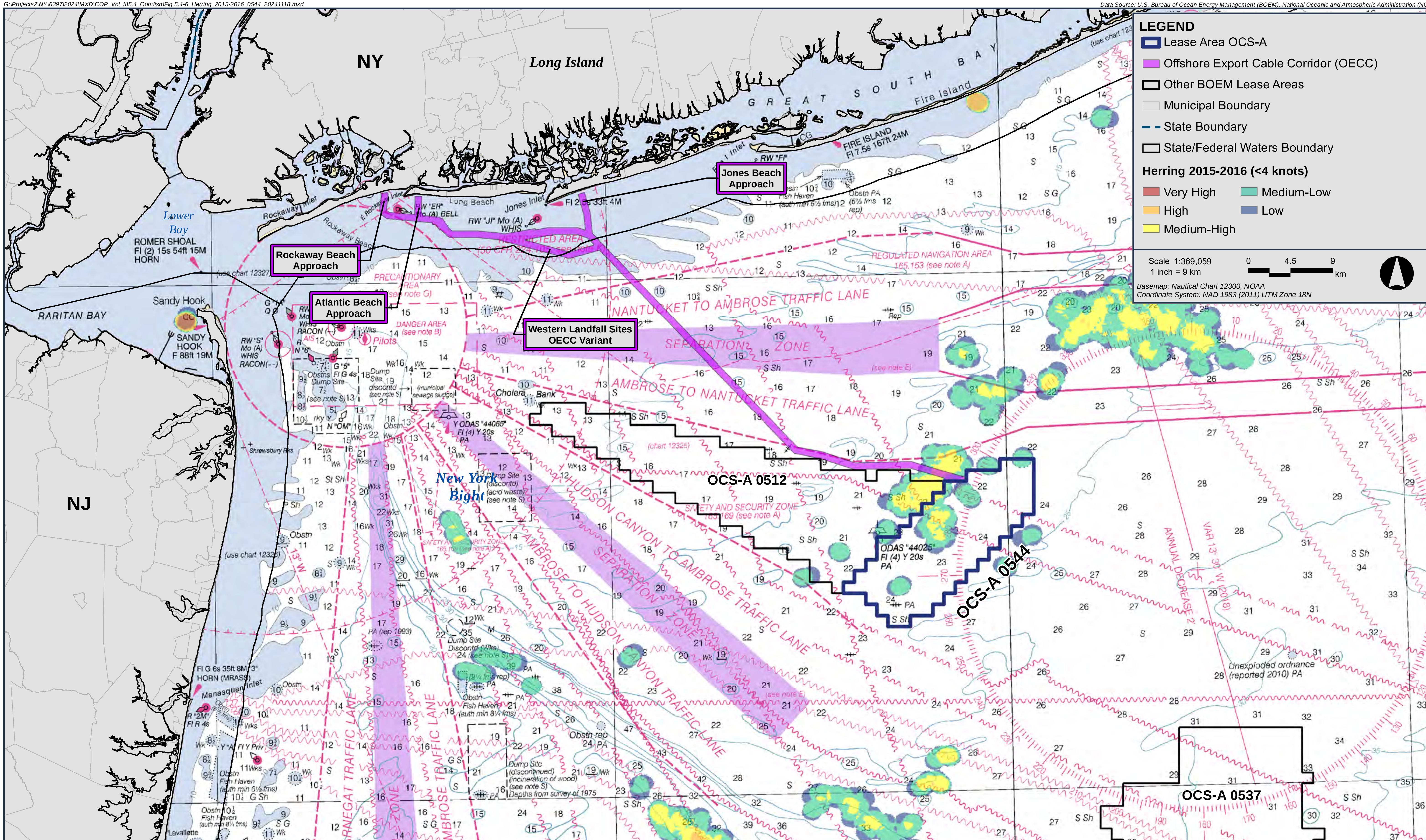

Figure 5.4-6

Herring Commercial Fishing Density 2015–2016 (<4 knots; VMS data)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-7_Bottom_Trawl_LT_65ft_2011-2015_0544_20240909.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

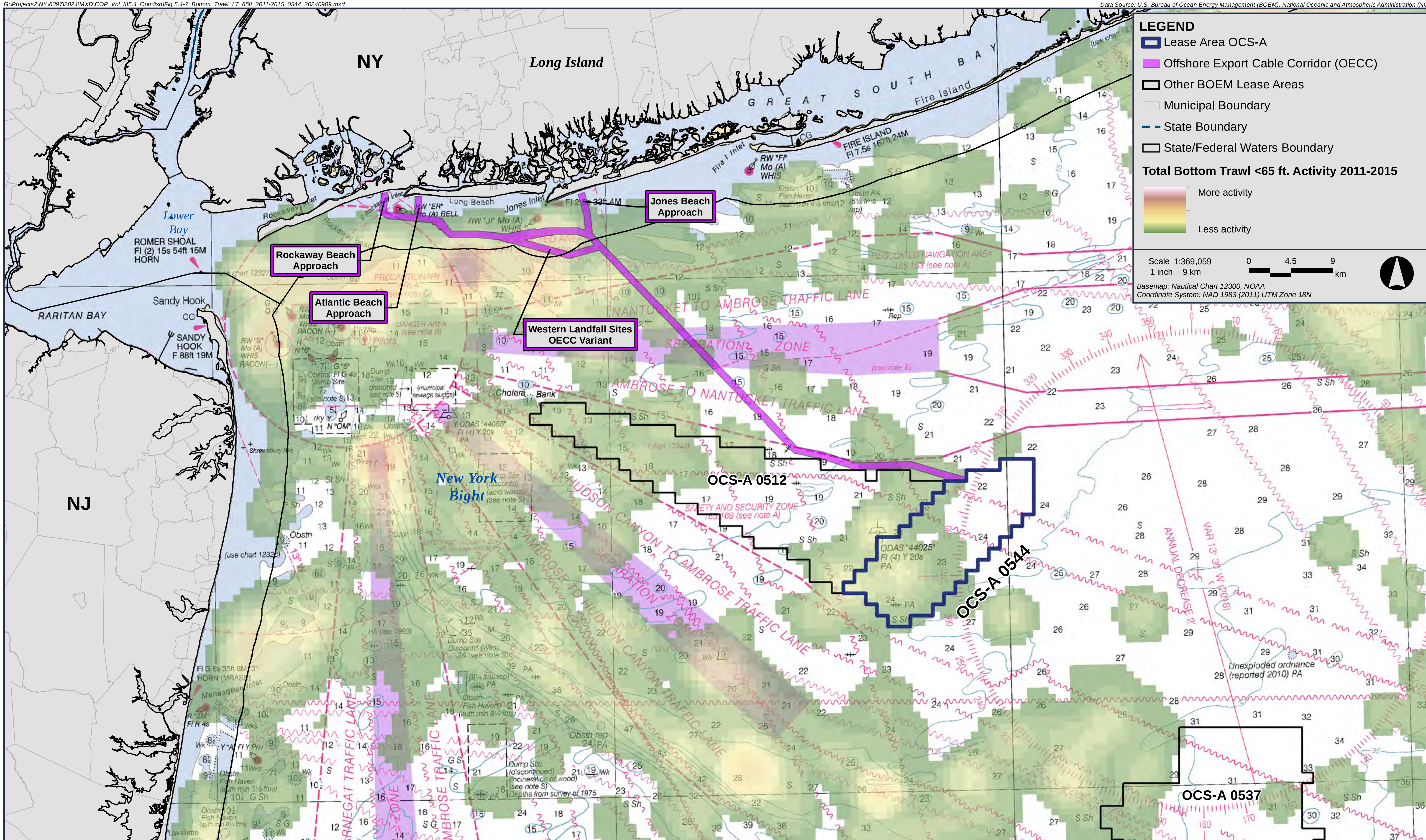

Figure 5.4-7
Bottom Trawl (Vessel <65 ft.) Fisheries 2011-2015 (VTR data)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-8_Bottom_Trawl_GT_65ft_2011-2015_0544_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

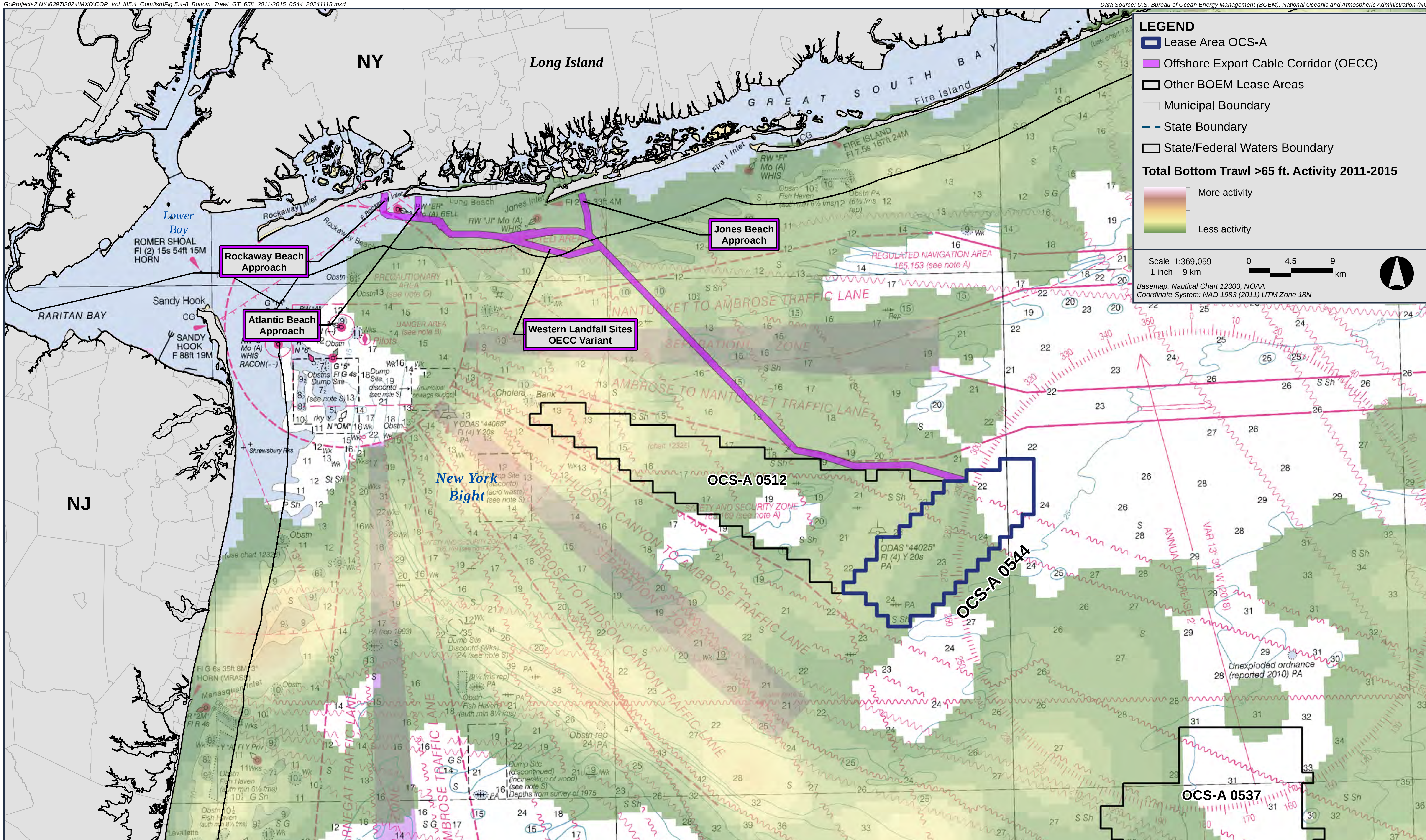

Figure 5.4-8

Bottom Trawl (Vessel >65 ft.) Fisheries 2011-2015 (VTR data)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-9_Dredge_2011-2015_0544_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

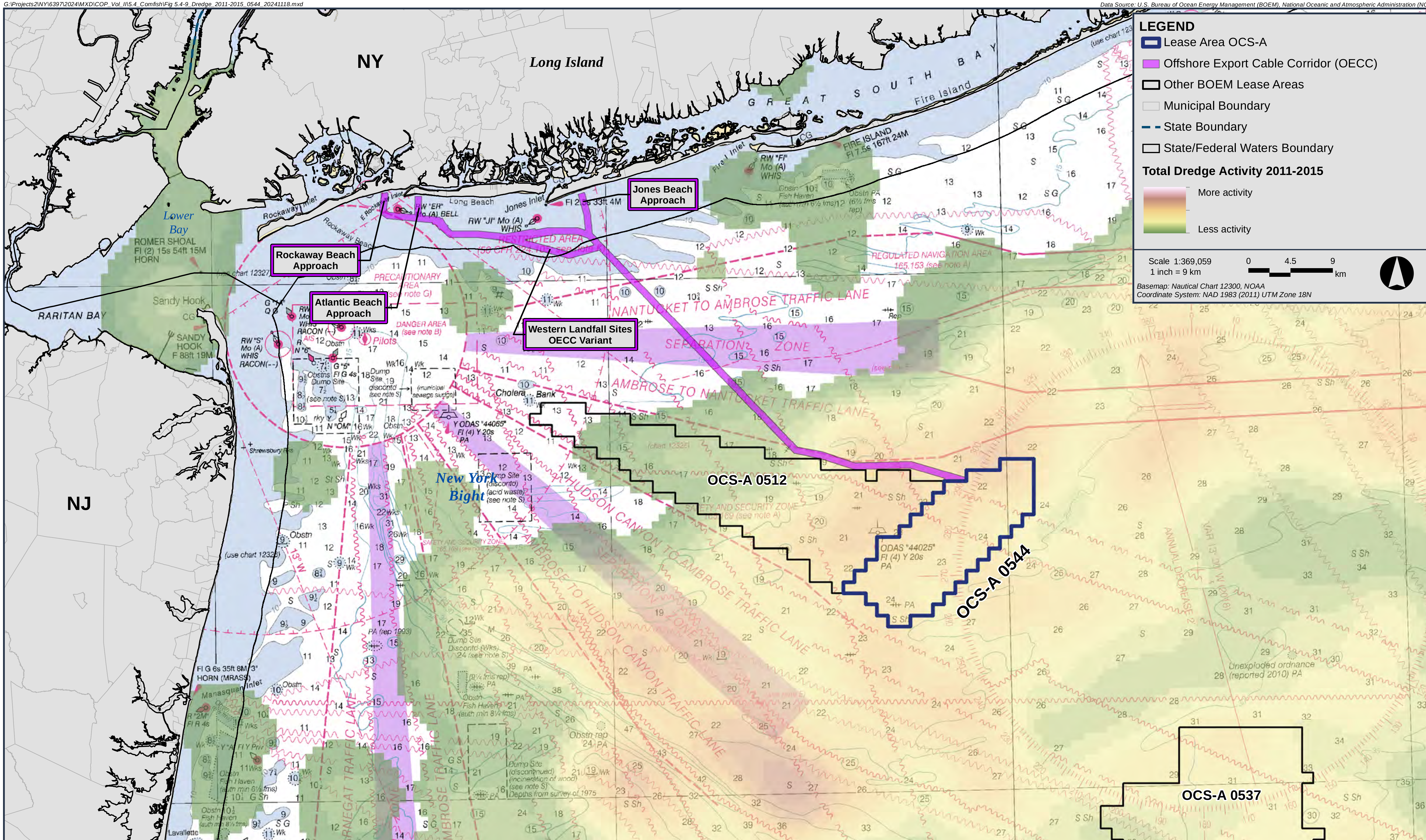

Figure 5.4-9

Dredge Fisheries 2011-2015 (VTR data)

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

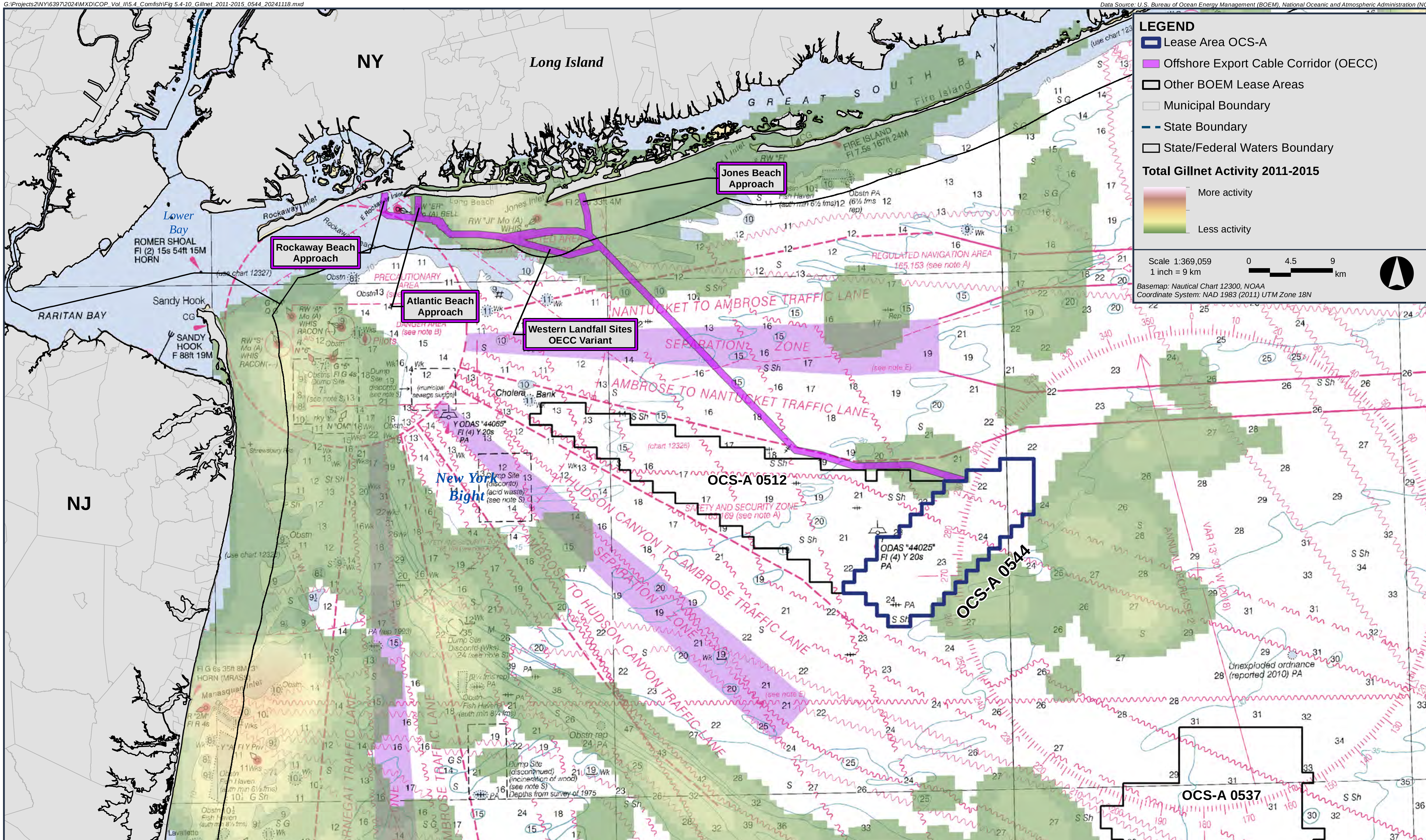

Figure 5.4-10
Gillnet Fisheries 2011-2015 (VTR data)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-11_Longline_2011-2015_0544_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

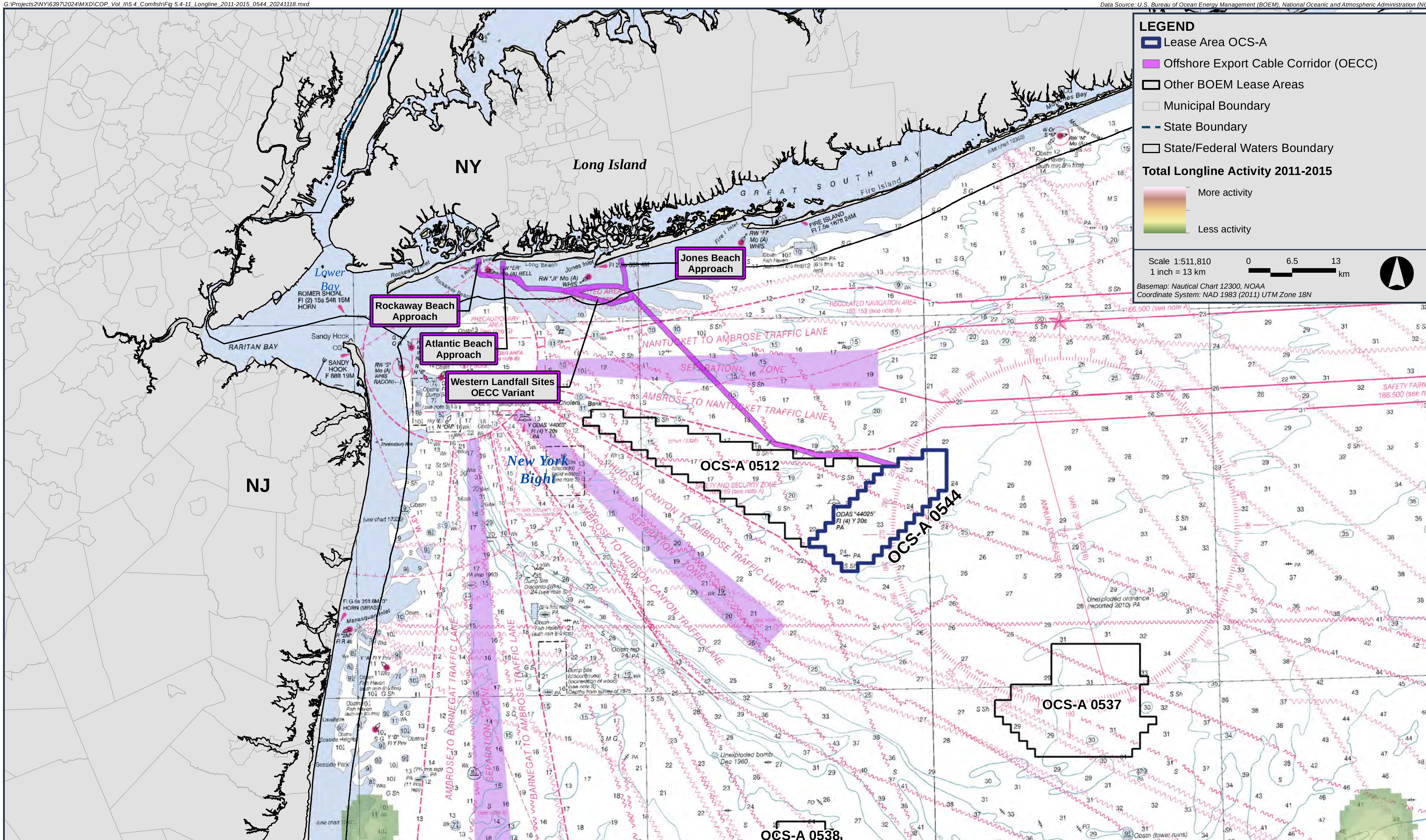

Figure 5.4-11
Longline Fisheries 2011-2015 (VTR data)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

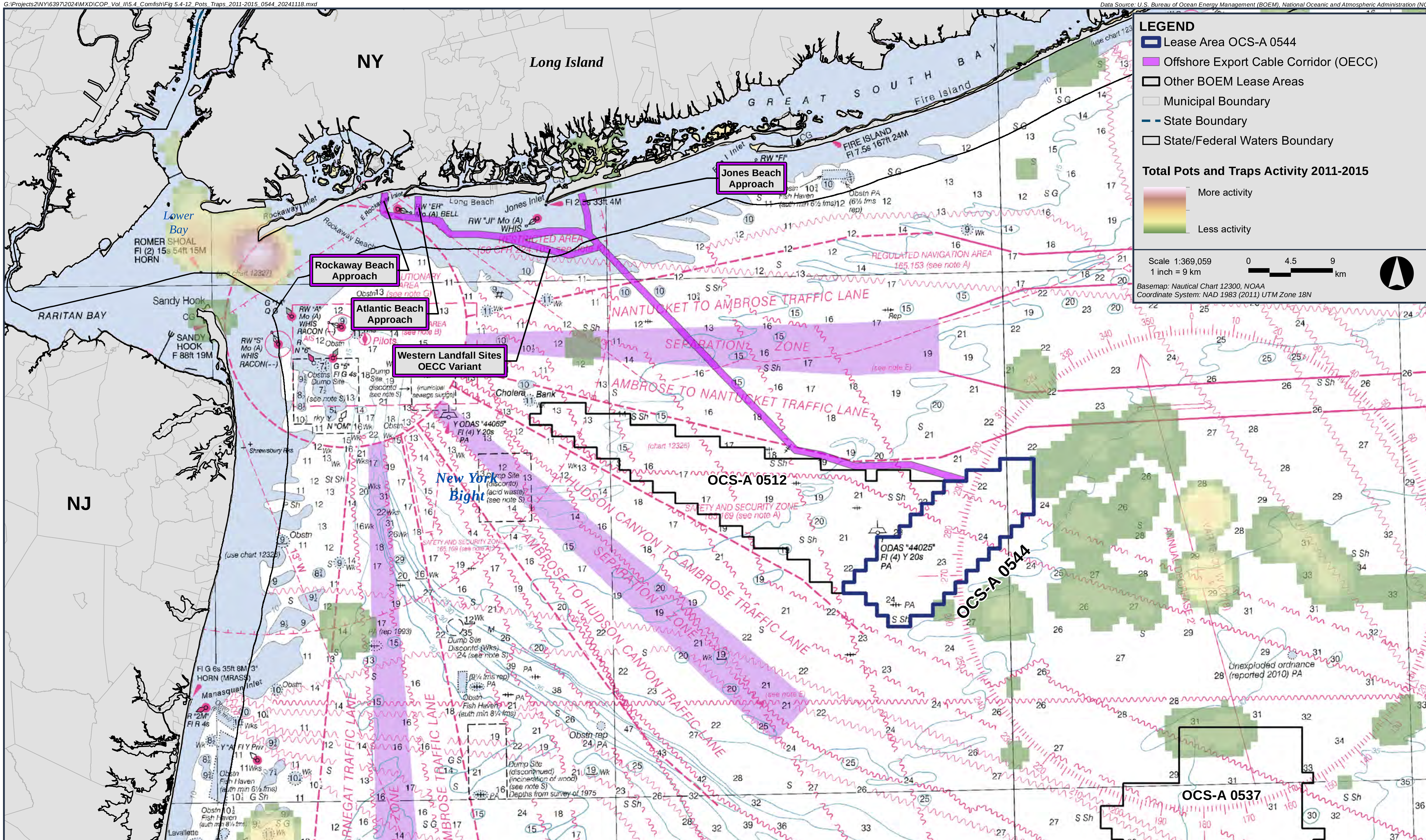

Figure 5.4-12
Pots and Traps 2011–2015 (VTR data)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

rasters use VTR data merged with at-sea fisheries observer data to aid in the development of statistical models to generate predictions for the spatial footprint of fishing reported on a VTR (Kirkpatrick et al. 2017). Similar to the other data sources used to quantify commercial fishing intensity in the Offshore Development Area, the revenue intensity rasters provide a geographic representation of commercial fishing intensity and revenue. Figure 5.4-13 through Figure 5.4-17 depict the annual revenue intensity for all FMPs during the years 2014-2018. As shown by these figures, the areas of greatest revenue intensity are located outside the Lease Area.

Based on NOAA Fisheries (2024a) data during the years 2008-2022, the average annual value of landings for all species within the Lease Area is approximately $1,950,400. Sea scallop, which is harvested by a scallop dredge, is the most valuable species in the Lease Area and accounts for approximately 89% of the average annual landings from the Lease Area.

Species harvested from the Lease Area are predominantly landed in New Jersey and Massachusetts, and to a lesser extent, Virginia. Landings from the Lease Area within those states are predominantly at the ports of New Bedford, Massachusetts; Point Pleasant, Cape May, and Barnegat, New Jersey; and Newport News, Virginia (see Table 5.4-6). See Appendix II-F for additional details of the estimated economic exposure of commercial fisheries in the Lease Area.

Quantitative Assessment of Fishing Vessel Traffic

To quantify fishing effort, AIS data were queried to establish estimates of commercial fishing vessel traffic within the Lease Area. These vessel counts are believed to capture larger commercial fishing vessels that are required to operate an AIS Class B device, such as the bottom trawl vessels over 20 m (65 ft) in length characterized by the mapping of VTR data shown in Figures 5.4-7 and 5.4-8. As described in the NSRA included in Appendix II-G, the AIS data show that historical vessel traffic levels within the Lease Area are relatively low, with only one fishing vessel entering the Lease Area per day (on average) during the peak summer months. Table 5.4-7 identifies the number of commercial fishing vessels operating within the Lease Area from 2017 to 2022 based on AIS data and broken down by vessel speed. Vessel speed reported by AIS data may indicate whether a vessel is fishing (≤four knots) or transiting (>four knots). Commercial fishing vessels are assumed to operate at vessels speeds up to four knots when mobile gear is deployed. When these vessels are transiting an open water area, they are assumed to operate at speeds greater than four knots. Table 5.4-7 shows that during 2017–2022 fishing vessels entered the Lease Area an average of 296 times per year but were engaged in fishing in the Lease Area on just 89 (30%) of those trips. During those years, the number of fishing trips in the Lease Area per month averaged over 10 during three months (August through October). See Appendix II-G for additional details on the AIS based traffic survey for the Lease Area.

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-13_FMP_Revenue_2014_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

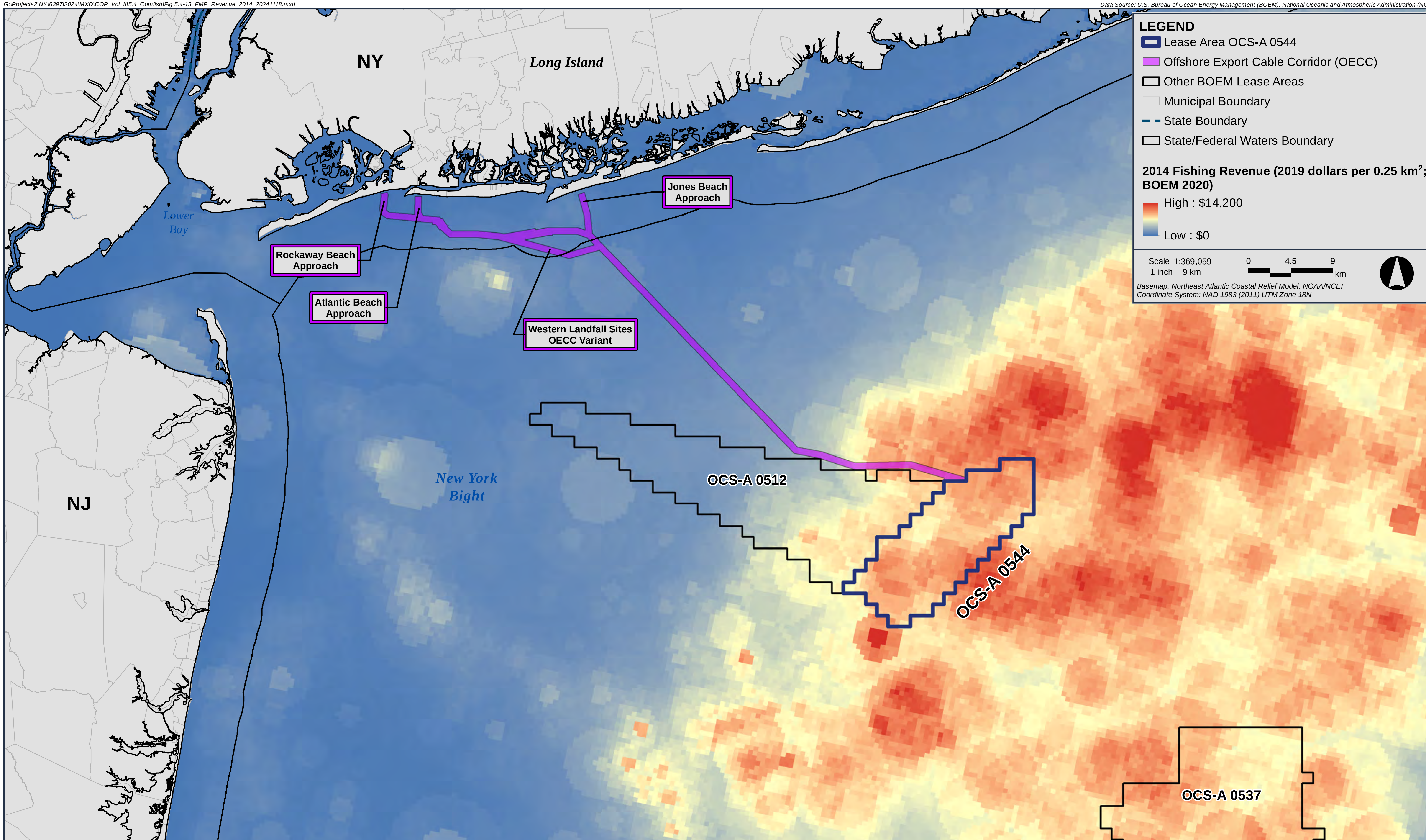

Figure 5.4-13

Revenue Intensity, All FMPs, 2014

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

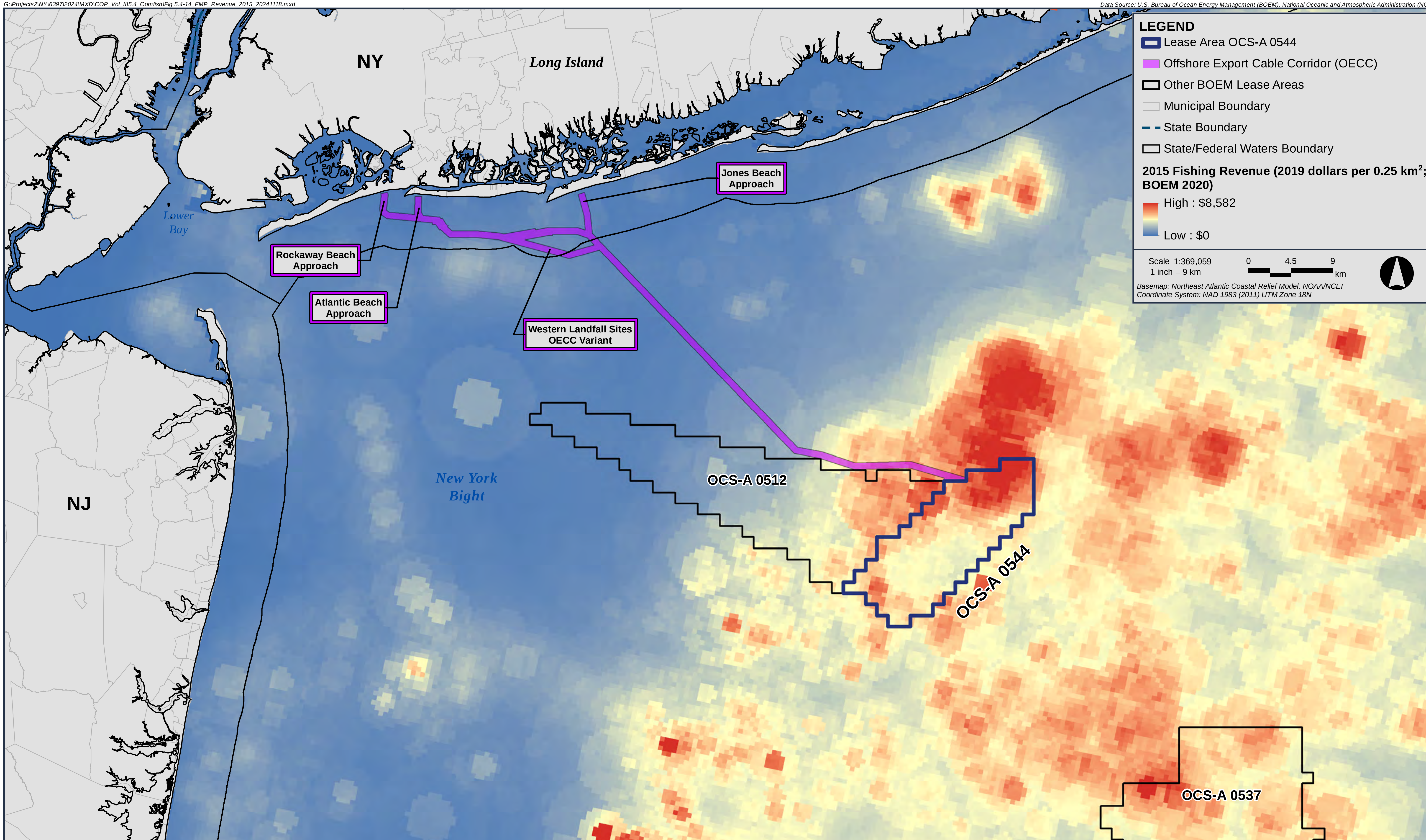

Figure 5.4-14
Revenue Intensity, All FMPs, 2015

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

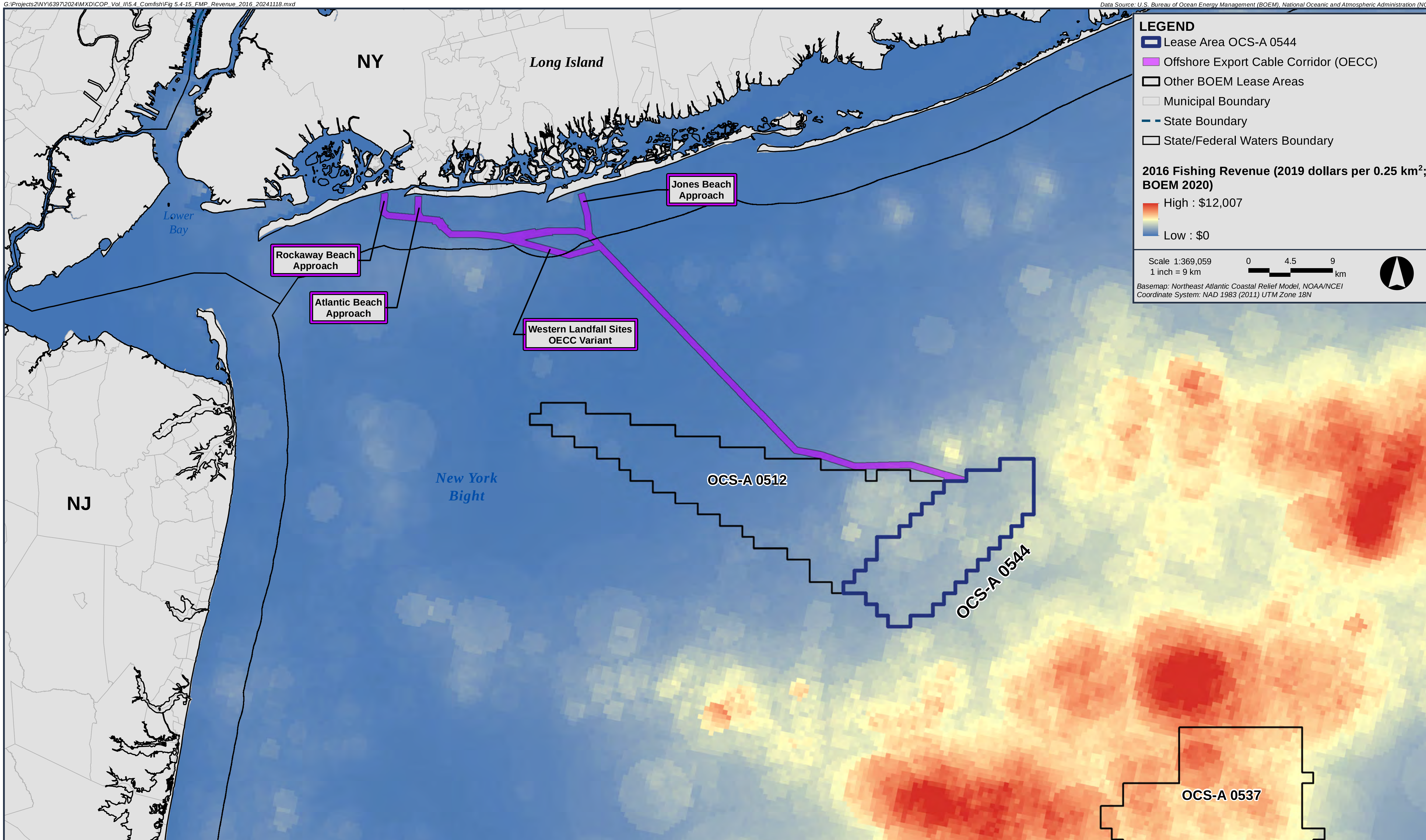

Figure 5.4-15
Revenue Intensity, All FMPs, 2016

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

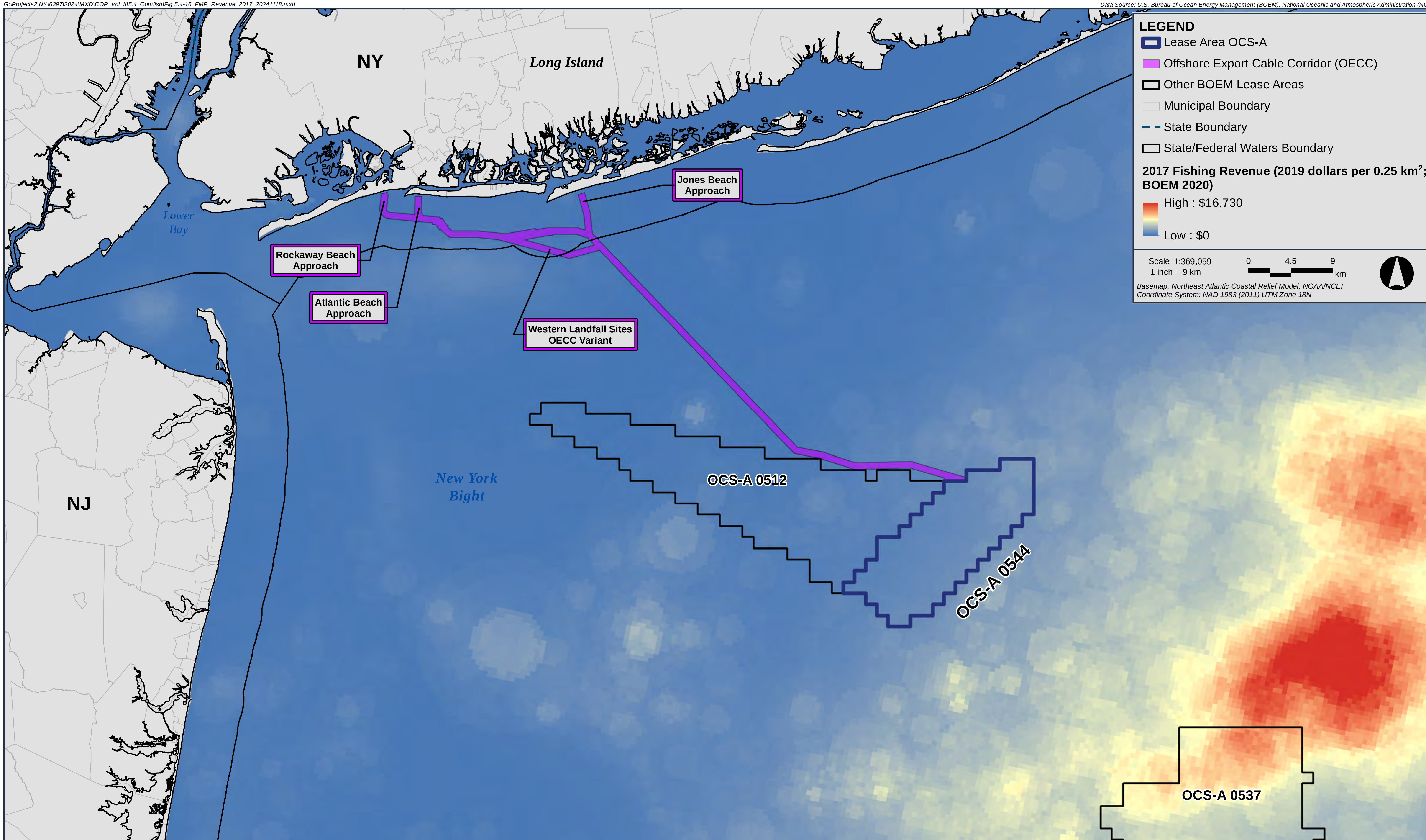

Figure 5.4-16
Revenue Intensity, All FMPs, 2017

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-17_FMP_Revenue_2018_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

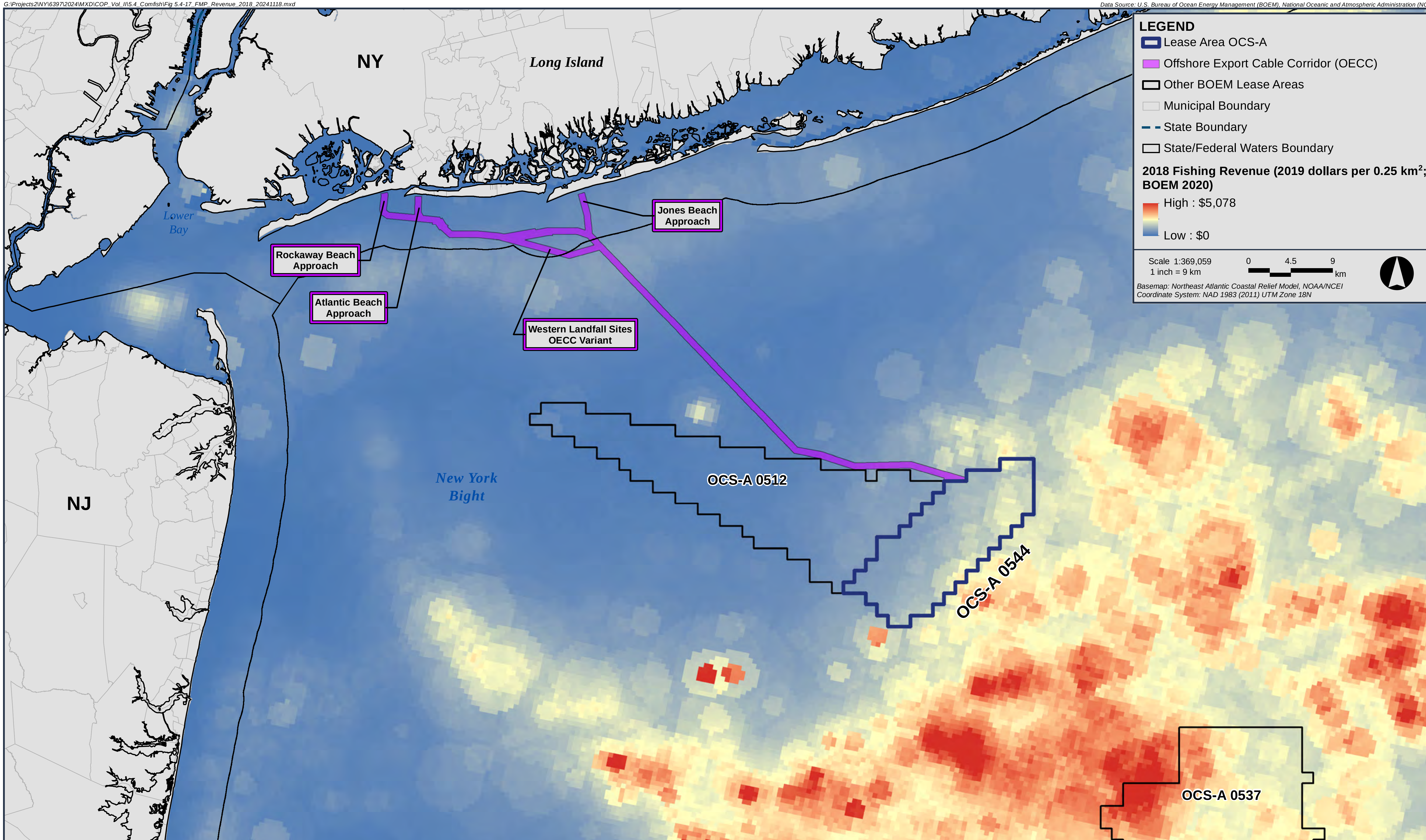

Figure 5.4-17

Revenue Intensity, All FMPs, 2018

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

Table 5.4-7 Average Monthly and Annual AIS Fishing Vessel Traffic through the Lease Area (2017–2022)

Average (2017-2022)	Monthly Average												Average Annual Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Number of Unique Fishing Vessels (fishing)	1.8	2.4	3.2	1.6	2.2	3.4	3.6	4.2	6.8	9.8	3.8	2.0	34.0
Number of Unique Fishing Vessel Tracks (fishing)	2.8	4.0	5.0	2.0	4.8	6.0	6.8	14.8	10.4	19.6	9.8	3.4	89.4
Number of Unique Fishing Vessels (transiting)	7.6	7.4	11.0	8.4	7.6	12.2	14.0	12.8	13.8	15.4	9.8	5.6	81.0
Number of Unique Fishing Vessel Tracks (transiting)	15.4	14.2	18.0	13.0	17.4	19.8	28.0	31.2	21.4	31.8	18.8	11.4	240.4
Number of Unique Fishing Vessels (all)	8.4	8.4	13.4	9.8	8.6	13.4	16.0	14.0	16.0	17.4	11.6	7.0	88.4
Number of Unique Fishing Vessel Tracks (all)	16.6	16.6	23.6	15.6	20.4	25.8	34.4	36.2	27.4	37.8	28.4	13.2	296.0

Notes:

1. Data source is Appendix II-G.
2. Analysis has been completed to separate transiting fishing vessels and those fishing vessels that are likely to be fishing (≤4 knots (kts) fishing, >4 kts transiting).
3. Vessel tracks that include some transiting and actively fishing tracks can be double counted as both transiting and fishing.

5.4.1.2 OECC

As the OECC approaches shore, it splits into three potential variations that connect to three potential landfall sites. Vineyard Mid-Atlantic will use up to two of these approaches to reach up to two landfall site(s). In order to be conservative in the OECC economic exposure analysis, the Jones Beach Approach was used to estimate the economic exposure because it has the highest average annual fishing revenue density (NOAA Fisheries 2024b).

The data summarized below are based on NOAA Fisheries' analysis of combined data from VTRs and dealer reports submitted by vessels with federal permits from 2008 to 2023 (NOAA Fisheries 2024b). Based on the NOAA Fisheries data, annual fishing revenues in the OECC (using the Jones Beach Approach) during 2008–2023 averaged $5,290 per square kilometer (km^2) (2023 dollars). Fishing will be precluded in the OECC only in areas around where pre-installation and cable installation activities are underway and will not be precluded or impaired in the rest of the OECC where cable installation is either planned or has been completed. Table 5.4-8 provides the estimate of economic exposure in the OECC and during construction. See Appendix II-F for a detailed description of potential economic exposure in the OECC. For the OECC, New Jersey and Massachusetts experience the highest percentage of economic exposure (see Table 5.4-9). The five most valuable species landed in the OECC (using the Jones Beach Approach) are sea scallop, longfin squid, surf clam, summer flounder, and monkfish (NOAA Fisheries 2024b).

Table 5.4-8 Estimate of Commercial Fishing Economic Exposure in the OECC During Construction

OECC	Average Annual Fishing Revenues per km^2	Fishing Preclusion Area (km^2)	Construction Period (years)	Economic Exposure During Construction (2023 dollars)
OECC	$5,290	3.14	3.33	$55,314

Note:

1. NOAA Fisheries 2024b

Table 5.4-9 Percentage of Revenues from the OECC by State

State	Percentage of Average Annual OECC Fishing Revenues (2008-2023)
New Jersey	38%
Massachusetts	30%
Virginia	10%
New York	9%

Table 5.4-9 Percentage of Revenues from the OECC by State (Continued)

State	Percentage of Average Annual OECC Fishing Revenues (2008-2023)
All Others	6%
Rhode Island	4%
Connecticut	3%
North Carolina	0.1%
Maryland	0.01%

Notes:

1. NOAA Fisheries 2024b.
2. "All Others" refers collectively to states with landings reported for fewer than three permits or dealers to protect data confidentiality.

New York State has a variety of shellfish available for harvest, including quahogs, blue mussels, razor clams, soft clams, oysters, and scallops. New York Department of Environmental Conservation (NYSDEC) manages shellfish harvest areas. Figure 5.4-18 identifies the status of nearshore shellfish areas within the OECC and near the landfall sites. The Rockaway Beach Approach overlaps with the Atlantic Ocean Area I commercial harvest zone, which is closed to harvesting (NYSDEC 2023a).

5.4.1.3 For-Hire Recreational Fishing

The for-hire recreational fishing fleets contribute to the overall economy in the Northeast through direct employment, income, and gross revenues of the for-hire businesses, as well as through spending on good and services, contributing indirect multiplier effects that are dependent upon the initial demands of the for-hire fleet (Steinback & Brinson 2013).

The economic contribution of for-hire charter/headboat operators was assessed in July to November 2013 along the Atlantic coast from Maine to Texas (Hutt and Silva 2015). In the Northeast, which includes the Atlantic coast from Maine to Virginia, it is estimated that there were 4,936 charter trips from July to November 2013 that targeted Atlantic highly migratory species (HMS). Hutt and Silva (2015) estimated a total of $12.1 million in gross revenue in the Northeast from July to November 2013, of which $7.3 million was used for trip expenses (fuel, crew, bait, supplies, etc.) and $4.8 million was for owner net return and operation costs. The average fee in the Northeast per charter boat trip was $2,450; after accounting for expenditures, the average net return was estimated at $969 per charter boat trip. The average fee in the Northeast per headboat trip was $6,973; after accounting for expenditures, the average net return was estimated at $2,305 per headboat trip (Hutt and Silva 2015).

For-hire recreational fishing occurs year-round but fishing effort data available from NOAA Fisheries MRIP (NOAA Fisheries 2024d) indicates that summer months correspond with the highest number of angler trips in New York Bight waters. From 2019 to 2023, there have been

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA), Northeast Ocean Data

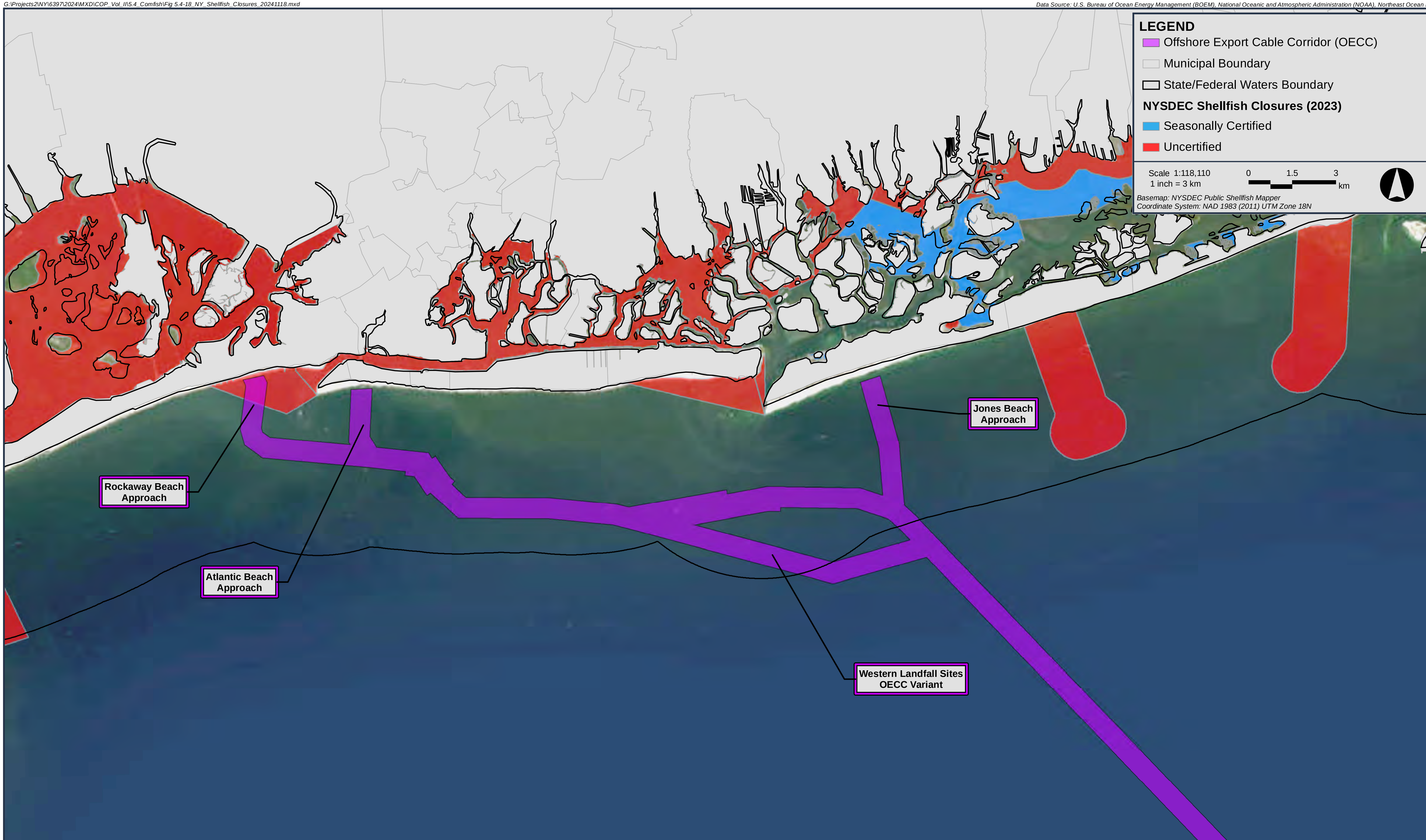

Figure 5.4-18

New York Shellfish Closures

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

approximately 15.6 million recreational angler trips (i.e., party and charter boats, rental/private boats, and shore-based) in New York ocean waters (NOAA Fisheries 2024d). Of those recreational angler trips, approximately 777,233, or 5%, are from party and charter boats trips. Additional information about private recreational fishing is provided in Section 5.3.

NOAA Fisheries (NOAA Fisheries 2024d) identified key recreational species and/or species groups in New York Bight waters. Those species include tunas and mackerels, scup, summer flounder, black sea bass, tautog, and striped bass. Vineyard Offshore's feedback from New York Bight recreational fisherman indicate that target species also include bluefish, Atlantic cod, dolphin, and yellowfin tuna in federal waters.

The New York State Department of Environmental Conservation (NYSDEC) has established 16 artificial reef sites, including nine along the south shore of Long Island (NYSDEC 2023b). New York Department of State, in collaboration with state, regional, and federal partners, gathered detailed data about the characteristics and locations of recreational fishing in New York waters. New Jersey also maintains 17 artificial reef sites off the coast and has identified locations of prime fishing areas (NJDEP 2022). Those data, along with the location of the NYSDEC artificial reefs, are shown on Figure 5.4-19. No reefs are located within the Lease Area or within OECC; however, for-hire recreational fishing vessels accessing these reefs may transit through Offshore Development Area. Data from NOAA Fisheries Large Pelagics Survey, an intercept survey that includes both for-hire recreational fishing and private recreational fishing, shows that the level of fishing effort for HMS (from 2002-2019 in June through October) was low throughout most of the Lease Area, with a small portion of high effort in the northeast corner of the Lease Area (Figure 5.4-20). VTR data for for-hire recreational fisheries (charter and headboats) for 2011-2015 shows there is minimal for-hire recreational fishing in the Lease Area and more effort within state waters near portions of the OECC (Figure 5.4-21).

NOAA Fisheries report of socioeconomic impacts of Atlantic offshore wind development describe selected fishery landings and estimates of recreational party and charter vessel revenue for offshore wind lease areas (NOAA Fisheries 2024c). Table 5.4-10 shows the estimated 15-year total party/charter revenue in the Lease Area to be $41,000, which included four years of no reported trips and six years of confidential data (i.e., less than three unique permits reported trips to the Lease Area) (NOAA Fisheries 2024c).

G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.4_Comfish\Fig 5.4-19_Fishing_Areas_20241118.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), NJ Dept. of Environmental Protection Bureau of GIS (NJDEP GIS)

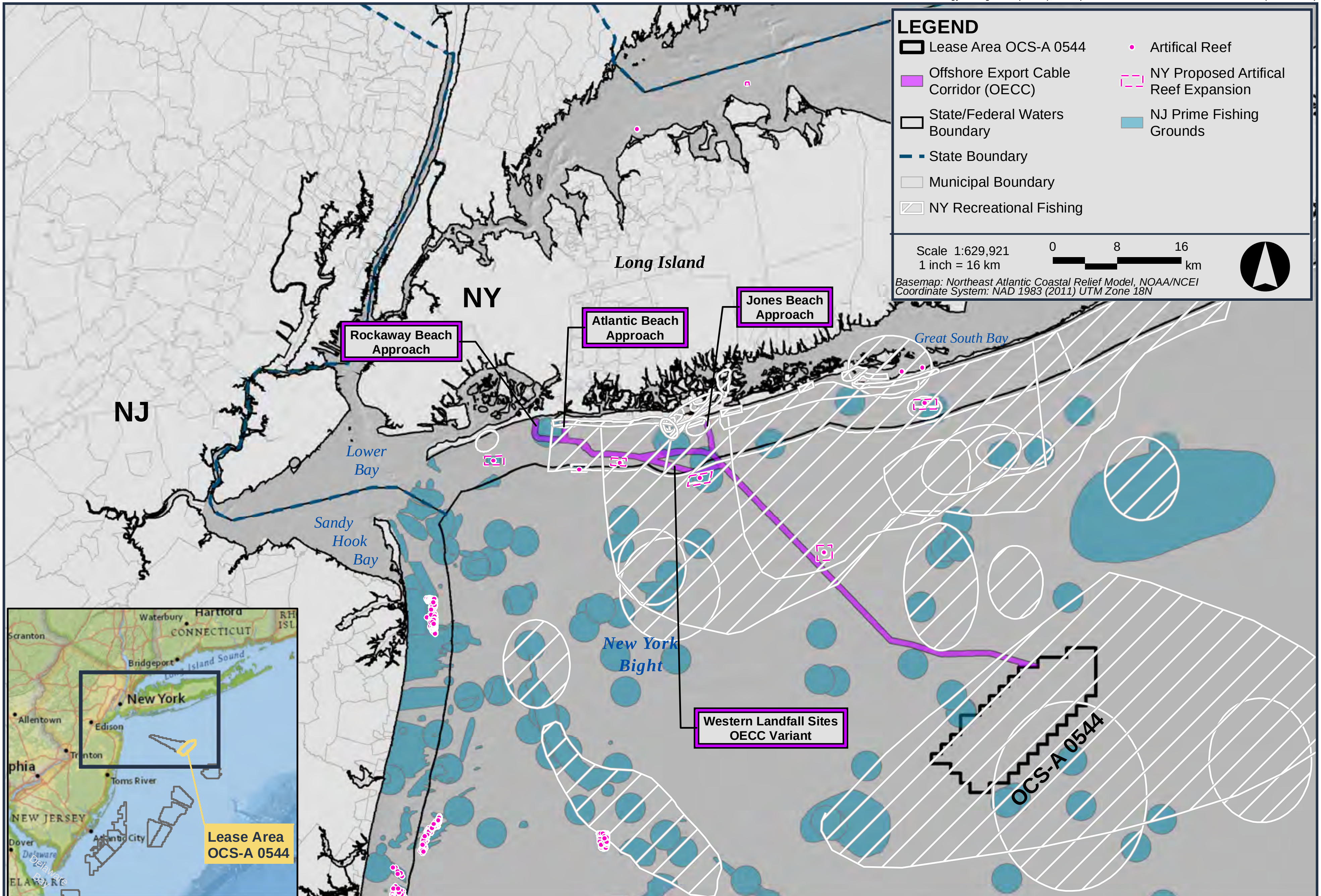

Figure 5.4-19
Fishing Areas in Proximity to the Offshore Development Area

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

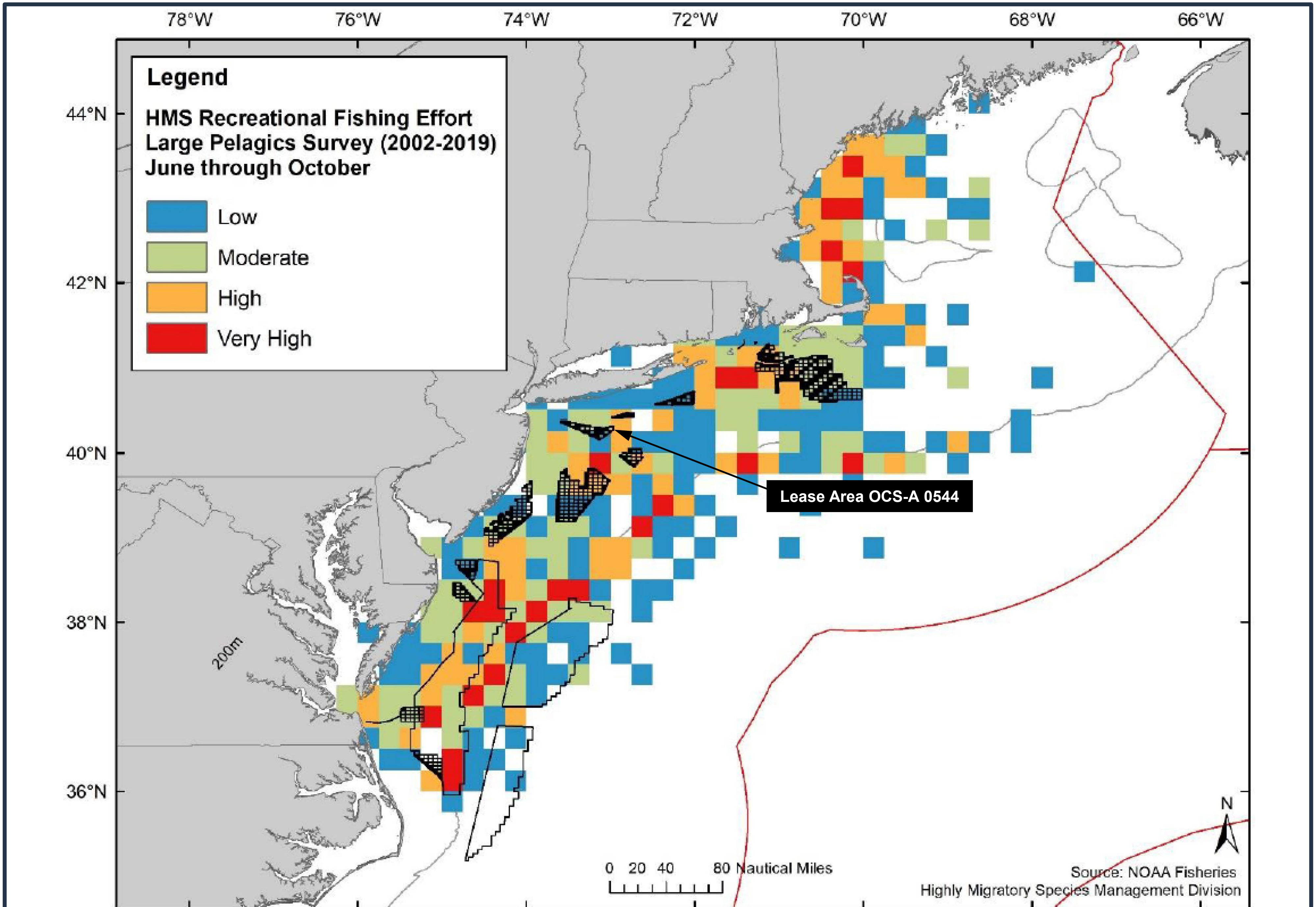

Figure 5.4-20
Fishing Effort for Highly Migratory Species in the Greater Atlantic

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

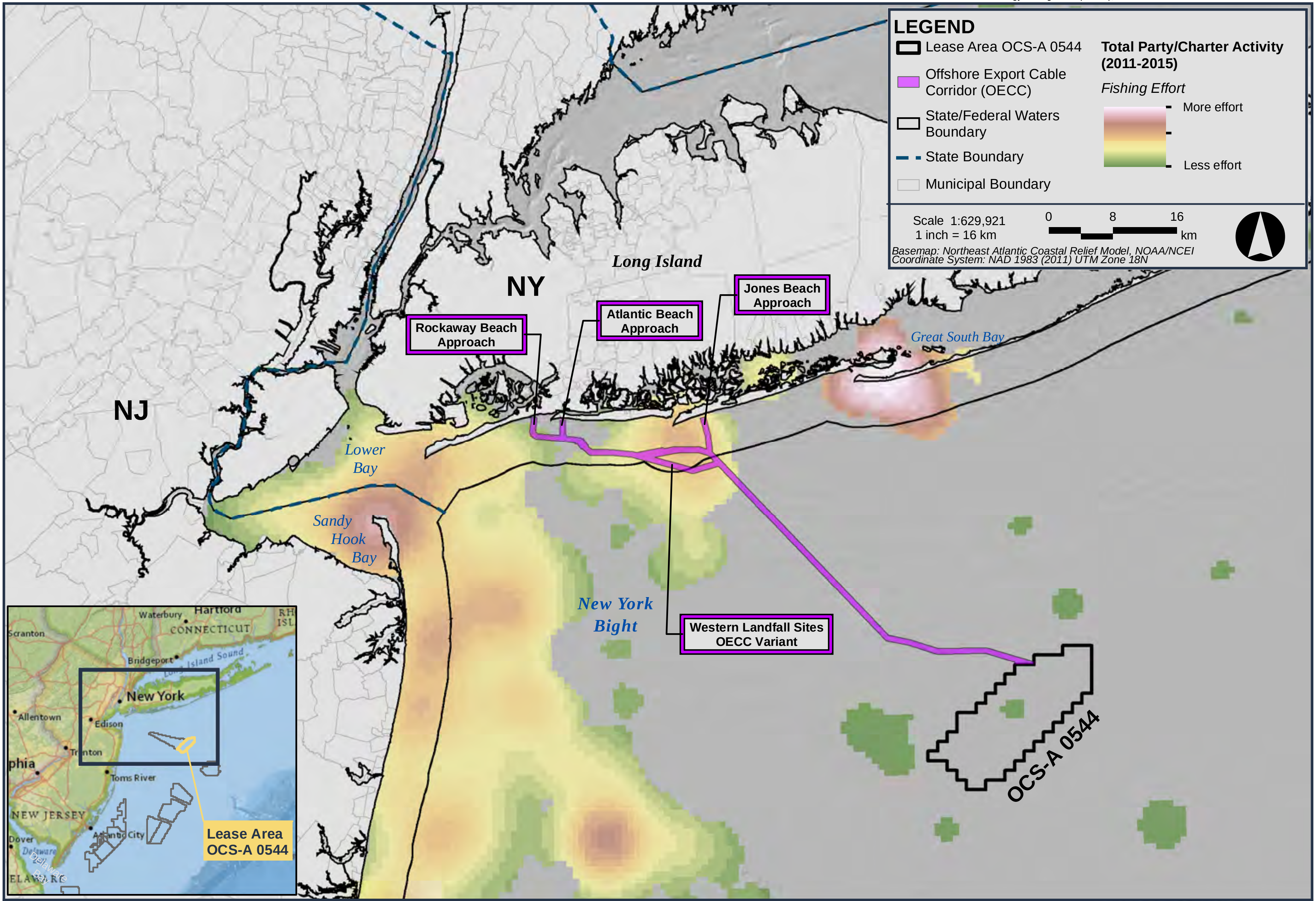

Figure 5.4-21
For-hire Recreational Fishing Effort 2011-2015 (VTR data)

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Table 5.4-10 Total Party/Charter Activity by Year in the Lease Area, 2008-2022

Year	Value (2022 dollars)
2008	No trips
2009	Suppressed
2010	$13,000
2011	Suppressed
2012	Suppressed
2013	Suppressed
2014	No trips
2015	Suppressed
2016	No trips
2017	No trips
2018	$6,000
2019	$15,000
2020	Suppressed
2021	$5,000
2022	$3,000
Total	$41,000

Notes:

1. NOAA Fisheries 2024c.
2. Values have been deflated to 2022 dollars.
3. Confidential data is listed as "Suppressed". Suppressed years have been set to 0 when calculating the total.

5.4.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect commercial fisheries and for-hire recreational fishing during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.4-11.

Table 5.4-11 Impact Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Vessel Activity[1]	•	•	•
Presence of Structures[1]		•	•
Noise	•	•	•
Port Utilization	•	•	•

Note:

1. Potential impacts from cable installation (or emplacement) and maintenance are discussed under vessel activity (for installation and maintenance activities) and under presence of structures (for the presence of cable protection).

Potential effects to commercial fishing and for-hire recreational fishing were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

5.4.2.1 Vessel Activity

Construction and support vessels will be present within the Lease Area and along the OECC during pre-installation, installation (or cable emplacement), maintenance, and decommissioning activities. All Vineyard Mid-Atlantic vessels and equipment involved in construction and operation will display the required navigation lighting and day shapes. Vessel traffic associated with Vineyard Mid-Atlantic is not anticipated to represent a significant increase over the current levels of vessel traffic within the Offshore Development Area. Navigation and vessel traffic are further discussed in Section 5.6 and Appendix II-G.

To minimize potential impacts to commercial and for-hire recreational fishing from increased vessel traffic, the Proponent will work to inform commercial and for-hire recreational fishermen of planned vessel activities during construction, maintenance, and decommissioning. During construction, a Marine Coordinator will manage construction vessel logistics and implement communication protocols with external vessels at ports and offshore. The Marine Coordinator will be the primary point of contact and will use tools such as radio communications and safety vessels to address vessels entering active work sites. Additionally, the Proponent provides Offshore Wind Mariner Updates and coordinates with the US Coast Guard (USCG) to issue Notices to Mariners (NTMs) advising other vessel operators of planned offshore activities. The Vineyard Mid-Atlantic website will be regularly updated to provide information about activities occurring in the Offshore Development Area.

Depending on the activity (e.g., cable installation and maintenance), the Proponent may request that mariners give a wide berth to active work sites or construction and maintenance vessel(s) through the issuance of Offshore Wind Mariner Updates. For example, fishing will be precluded in the OECC only in the immediate vicinity of cable installation and maintenance activities while those activities are underway. Commercial fishing will not be precluded or impaired in those areas during other times or in parts of the OECC where cable installation or maintenance is either planned or has been completed. Additionally, the Proponent may request that the USCG establish temporary safety zones, per 33 CFR Part 147, that extend 500 meters (m) (1,640 feet [ft]) around each wind turbine generator (WTG) and electrical service platform (ESP) during construction and certain maintenance activities (see Section 8.4 of COP Volume I for additional details). The presence of these safety zones would temporarily preclude commercial and for-hire recreational fishing activities in the immediate vicinity of the structures and may cause fishermen to slightly alter their navigation routes to avoid the active work sites. However, the safety zones would be limited in size and duration and would not affect the entire Lease Area at any given time.

The Proponent has developed a Fisheries Communication Plan (see https://www.vineyardoffshore.com/fisheries-544) that defines outreach and engagement with commercial and for-hire recreational fishermen during construction, operations, and decommissioning. The Proponent's fisheries communication efforts are led by a Fisheries Manager. The fisheries team also includes a Fisheries Liaison (FL), Fisheries Representatives (FRs), Onboard Fisheries Liaisons (OFLs), and scout vessels.

- FLs are employed by offshore wind developers to implement fisheries communication plans (FCPs) and serve as a communication conduit between offshore wind developers and the fishing industry. The FL serves as a readily accessible and knowledgeable point of contact within the company that fishermen and FRs can efficiently and effectively communicate with.

- FRs do not work on behalf of offshore wind developers but represent a particular fishing community, organization, gear type, port, region, state, or sector(s). FRs are responsible for communicating fisheries concerns, issues, and other input to offshore wind developers. Typically, an FR is an active fisherman or group representing active fishermen within the region, fishery, state, or sector they represent.

- OFLs are experienced fishermen employed to assist survey vessel captains with communication and to document fishing gear in the area to help avoid interactions. OFLs continue the role of the FL offshore so that there is effective communication on-site and in real-time. OFLs report to the FLs and serve as the FLs' "eyes, ears, and voice" during offshore operations.

- Scout vessels work ahead of geophysical and geotechnical site assessment survey vessels and report the fixed gear locations back to the OFL on the survey vessel to avoid any gear interaction. The scout vessel identifies fishermen actively working in the area so the FL can reach out to them with detailed survey vessel information throughout the remainder of the survey activity. This approach has proven effective at reducing the risk of fixed gear interactions during offshore activities.

As described further in the Fisheries Communications Plan, Vineyard Offshore is conducting fisheries outreach and will continue to employ a variety of outreach methods and tools to communicate and maintain relationships with commercial and recreational fishermen and fisheries stakeholders. Additionally, Vineyard Offshore has developed a fishing gear loss and compensation protocol that provides a standard approach to fishing gear loss and compensation.

5.4.2.2 Presence of Structures

During operations and maintenance of Vineyard Mid-Atlantic, the Lease Area and OECC will be open to commercial and for-hire recreational fishing vessels, and no permanent vessel restrictions are proposed. As proposed, the WTGs and ESP(s) will be oriented in west-northwest to east-southeast rows and north-to-south columns with 0.68 nautical miles (NM) (1.3 kilometers [km]) spacing between positions.[72,73] This 0.68 x 0.68 NM WTG/ESP layout provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512 (where the Empire Wind projects will be installed), in accordance with the stipulations in Lease OCS-A 0544. As described in Section 2.1 of Appendix II-G, this layout also creates north-south and northwest-southeast corridors that would accommodate all of the existing AIS-equipped fishing fleet.

If maintenance activities are required, the Proponent may request that mariners give a wide berth to active work sites or maintenance vessel(s) through the issuance of Offshore Wind Mariner Updates and may request that the USCG establish temporary safety zones that extend 500 m (1,640 ft) around the WTGs and ESPs. A detailed NSRA for Vineyard Mid-Atlantic is included as Appendix II-G and additional discussion of navigational impacts and the presence of structures in the Offshore Development Area is provided in Section 5.6.

While the layout is expected to accommodate fishing vessels, some fishermen may opt to reroute transits around the Lease Area. As described in Section 6.9 of the NSRA (see Appendix II-G), the expected increase in transit time around the Lease Area (between major fishing ports and important fishing areas) ranges from two minutes to eight minutes.

As described in Section 5.6, to aid marine navigation, the WTGs, ESP(s), and their foundations will be equipped with marine navigation lighting, marking, and signaling in accordance with USCG and BOEM guidance. Each WTG and ESP will be maintained as a Private Aid to Navigation (PATON). The Proponent will work with the USCG, BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) to determine the appropriate marine lighting, marking, and signaling scheme for the proposed offshore facilities, including the number, location, and type of AIS transponders and Mariner Radio Activated Sound Signals (MRASS). The Proponent expects to provide a detailed lighting, marking, and signaling plan to BOEM, BSEE, and USCG prior to construction of the offshore facilities. Additional information on marine navigation lighting, marking, and signaling can be found in the NSRA (see Appendix II-G). The WTGs and ESP(s) will also be identified on NOAA nautical charts.

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72 Six WTG/ESP positions along the northwestern boundary of Lease Area OCS-A 0544 are contingent upon the final layout of the neighboring Empire Wind 2 project. Vineyard Mid-Atlantic will not develop these contingent WTG/ESP positions if the final Empire Wind 2 layout includes WTGs at immediately adjacent positions within Lease Area OCS-A 0512.

73 Where necessary, WTGs and ESP(s) may be micro-sited by a maximum of 152 m (500 ft) to avoid unfavorable seabed conditions, maintain facilities within the Lease Area boundaries, and/or for other unexpected circumstances.

Appendix II-F provides a detailed description of potential economic exposure, fishing congestion impacts, and notes that a number of factors suggest that the presence of structures will have only a small economic impact on commercial fishing. Commercial fishing vessels will continue to have access to the Lease Area and OECC as currently permitted by regulation and the proposed grid layout. Additionally, alternative fishing grounds with a demonstrated higher fishery revenue density are available nearby and may be fished at little to no additional cost.

As described in Section 4.6, the addition of foundations and cable protection (if used) may attract fish species to new structured habitat, resulting in increases in biodiversity and abundance of fish (Wilhelmsson et al. 2006; Andersson and Öhman 2010; Riefolo et al. 2016; Raoux et al. 2017; The Nature Conservancy and INSPIRE Environmental 2021). It is anticipated that foundations may function as fish aggregating devices by providing additional structure for species that prefer structured habitat, thereby improving the for-hire recreational fishing experience within the Lease Area (BOEM 2012). Feedback from New York Bight recreational fishermen was that WTGs would also attract migratory species such as tuna, dolphin, and cobia in the summer months. Wind farms have also been found to have localized increases in abundance (Løkkeborg et al. 2002) and improved condition and growth rates (Reubens et al. 2013) of commercially valuable species. In the event WTGs aggregate recreationally targeted species, based on the intensity of recreational fishing within the Lease Area and its geographic scale, neither congestion effects nor gear conflicts are expected. Additional information about seafloor disturbance and habitat modification associated with foundations for the WTGs and ESPs, scour protection, export cables, inter-array and inter-link cables, and cable protection (if required) is provided in Section 4.5.

Feedback from New York Bight recreational fishermen indicates recreational fishermen are interested in seeing scour protection around WTG foundations because it provides additional structured habitat for fish such as tautog, black sea bass, summer flounder, and other species. As proposed, scour protection in the Project Design Envelope allows for an approximate maximum diameter of 96-121 m (315-397 ft)[74] for monopiles (see Tables 3.3-1 and 3.4-4 of COP Volume I). The need for scour protection is specific to the final design of the selected foundation concept(s) and will be further assessed upon detailed engineering of the foundations.

[74] A range of the approximate maximum size of scour protection is provided as detailed engineering of the foundations is ongoing.

The offshore cables will have a target burial depth beneath the stable seafloor of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters.[75] The target burial depth is at least twice the burial depth required to prevent cables from interfering with fishing activities.

While every effort will be made to achieve sufficient burial, a limited portion of the offshore cables may require remedial cable protection (rocks, rock bags, concrete mattresses, half-shell pipes, or similar) if a sufficient burial depth cannot be achieved (see Sections 3.5.5 and 3.6.5 of COP Volume I). Cable protection may also be used where the cables need to cross other infrastructure (e.g., existing cables, pipelines, etc.), to secure the cable entry protection system in place, or where a cable splice requires protection. Potential cable protection methods are described in Section 3.5.5 of COP Volume I. The Proponent will evaluate the feasibility of using nature-inclusive cable protection designs, which refers to options that can be integrated in or added to the design of cable protection to create suitable habitat for native species (Hermans et al. 2020). Nature-inclusive designs can include adding an additional layer of larger rock to provide larger crevices, using methods that can be easily relocated with minimal disturbance during cable repairs (e.g., rock bags with lifting points), using mattresses with specially-designed concrete blocks that create additional nooks and crannies. Cable protection will be designed and installed to minimize interfering with bottom fishing gear to the maximum extent practicable. After cable installation the Proponent will share the location of the cables as well as any cable protection with fishermen. However, bottom fishing gear may potentially snag on cable protection resulting in gear damage, lost fishing time, and associated economic losses. Vineyard Mid-Atlantic has established a program that will compensate commercial fishermen for economic losses associated with damaged gear.

Potential effects to and mitigation measures for fisheries research and survey vessels are described in Section 5.8.

5.4.2.3 Noise

Temporary to long-term increases in noise may occur in the Lease Area and OECC from the installation, O&M, and decommissioning of foundations, WTGs, and offshore cables. The intensity and duration of noises is expected to vary based on activity. Direct effects on managed fish species from noise can include behavioral changes, stress responses, injury, and mortality. Severity of impacts from noise during construction, maintenance activities, or decommissioning would vary based on the duration and intensity of sound and biology (e.g., auditory system and swim bladder presence) of the fish. Potential impacts on commercial fisheries and for-hire recreational fishing would depend on the duration of the activity and the

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[75] Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

corresponding impacts to managed fish and are expected to be minimal. Section 4.6.2.6 describes potential impacts to fish from noise and Appendix II-E presents modeled acoustic ranges to injury and behavioral thresholds.

5.4.2.4 Port Utilization

The Proponent has identified several ports in the US or Canada (for potential construction ports only) that may be used during construction or operations. See Sections 3.10.1 and 4.4.1 of COP Volume I for more information about potential construction or operations ports. Only a subset of the ports described in Sections 3.10.1 and 4.4.1 of COP Volume I would ultimately be used. Each port under consideration for Vineyard Mid-Atlantic is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction proceeds. The Proponent does not expect to implement any port improvements, however, port utilization would increase along with vessel activity and may cause a decrease in available dockage for commercial or for-hire recreational fishing vessels. As noted above, vessel traffic associated with Vineyard Mid-Atlantic is not anticipated to represent a significant increase over the current levels of vessel traffic, however, additional vessels could cause delays or reduced access to port services such as provisioning and fueling. Given the reasons detailed above, impacts from port utilization on commercial fisheries and for-hire recreational fishing are expected to be minimal and vary seasonally.

5.4.2.5 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to commercial and for-hire recreational fishing during Vineyard Mid-Atlantic are summarized below:

- Use of a consistent layout will allow recreational and commercial fishing vessels to continue to operate along three consistent headings (and their reciprocal courses) through the Lease Area. This 0.68 x 0.68 NM WTG/ESP layout also provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512 (where the Empire Wind projects will be installed), in accordance with the stipulations in Lease OCS-A 0544. As described in Section 2.1 of Appendix II-G, this layout also creates north-south and northwest-southeast corridors that would accommodate all of the existing AIS-equipped fishing fleet.

- The Proponent will work to inform commercial and for-hire recreational fishermen of planned vessel activities during construction, maintenance, and decommissioning. During construction, a Marine Coordinator will manage construction vessel logistics and implement communication protocols with external vessels at ports and offshore. Additionally, the Proponent provides Offshore Wind Mariner Updates and coordinates with the USCG to issue NTMs advising other vessel operators of planned offshore activities. The Vineyard Mid-Atlantic website will be regularly updated to provide information about activities occurring in the Offshore Development Area.

- The Proponent has developed a Fisheries Communication Plan (see https://www.vineyardoffshore.com/fisheries-544) that defines outreach and engagement with commercial and for-hire recreational fishermen during construction, operations, and decommissioning.

- To aid marine navigation, the WTGs, ESP(s), and their foundations will be equipped with marine navigation lighting, marking, and signaling in accordance with USCG and BOEM guidance.

- Each WTG and ESP will be maintained as a PATON.

- The Proponent has developed a fishing gear loss and compensation protocol that provides a standard approach to fishing gear loss and compensation.

- The offshore cables have a target burial depth beneath the stable seafloor of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft) in state waters to protect the cables from fishing activities.

- To the extent feasible, the amount of cable protection will be limited. Cable protection will be designed and installed to minimize interfering with bottom fishing gear to the maximum extent practicable and fishermen will be informed of areas where cable protection exists.

5.5 Land Use and Coastal Infrastructure

This section addresses the potential impacts of Vineyard Mid-Atlantic on land use and coastal infrastructure in the Onshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to land use and coastal infrastructure during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Potential impacts to recreation and tourism are discussed in Section 5.3.

5.5.1 Description of Affected Environment

The Onshore Development Area consists of the landfall site(s), onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities. With respect to land use and coastal infrastructure, the Onshore Development Area includes the communities surrounding Vineyard Mid-Atlantic's onshore facilities, operations and maintenance (O&M) facilities, construction staging areas, and port facilities. Vineyard Mid-Atlantic will use more than one port. Ports under consideration are discussed in Section 5.5.1.2 of COP Volume I.

Figures 5.5-1,5.5-2, and 5.5-3 provide an overview of planned Vineyard Mid-Atlantic onshore facilities in Long Island, New York. In Figure 5.5-4, a 0.4 kilometer (km) (0.25 mile [mi]) buffer was applied to the centerline of each onshore cable route to characterize the land use and land cover immediately adjacent to planned Vineyard Mid-Atlantic facilities utilizing the 2021 National Land Cover Database (NLCD) hosted by the United States Geological Survey (USGS) (NLCD 2021).

5.5.1.1 Onshore Development Area

<u>Landfall Sites</u>

Vineyard Mid-Atlantic's offshore export cables will transition onshore at up to two of the following landfall site(s) on the southern shore of Long Island, New York (see Figures 5.5-1, 5.5-2, and 5.5-3).

- **Rockaway Beach Landfall Site:** The Rockaway Beach Landfall Site is located in a portion of a previously disturbed area adjacent to Rockaway Beach in Queens, New York. Surrounding land uses include the beach and open space, which are bordered by commercial properties and residential high-rises.

- **Atlantic Beach Landfall Site:** The Atlantic Beach Landfall Site is located in a paved parking area near the intersection of The Plaza and Ocean Boulevard in the Town of Hempstead, New York. The town-owned parking lot is bordered to the south by the Atlantic Beach Boardwalk. Nearby uses include the beach, beach clubs, hotels, a tennis club, and private residences.

- **Jones Beach Landfall Site:** The Jones Beach Landfall Site is located in a paved parking area within Jones Beach State Park. Jones Beach State Park is a 17 square kilometer (km^2) (2,400 acre) park in the Town of Hempstead, New York that is managed by the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP [date unknown]). Surrounding land uses include the boardwalk, beach, bike path, and open space.

The precise location of the landfall site(s) will be determined through consultations and coordination with state and local officials and property owners.

[redacted]

[redacted]

[redacted]

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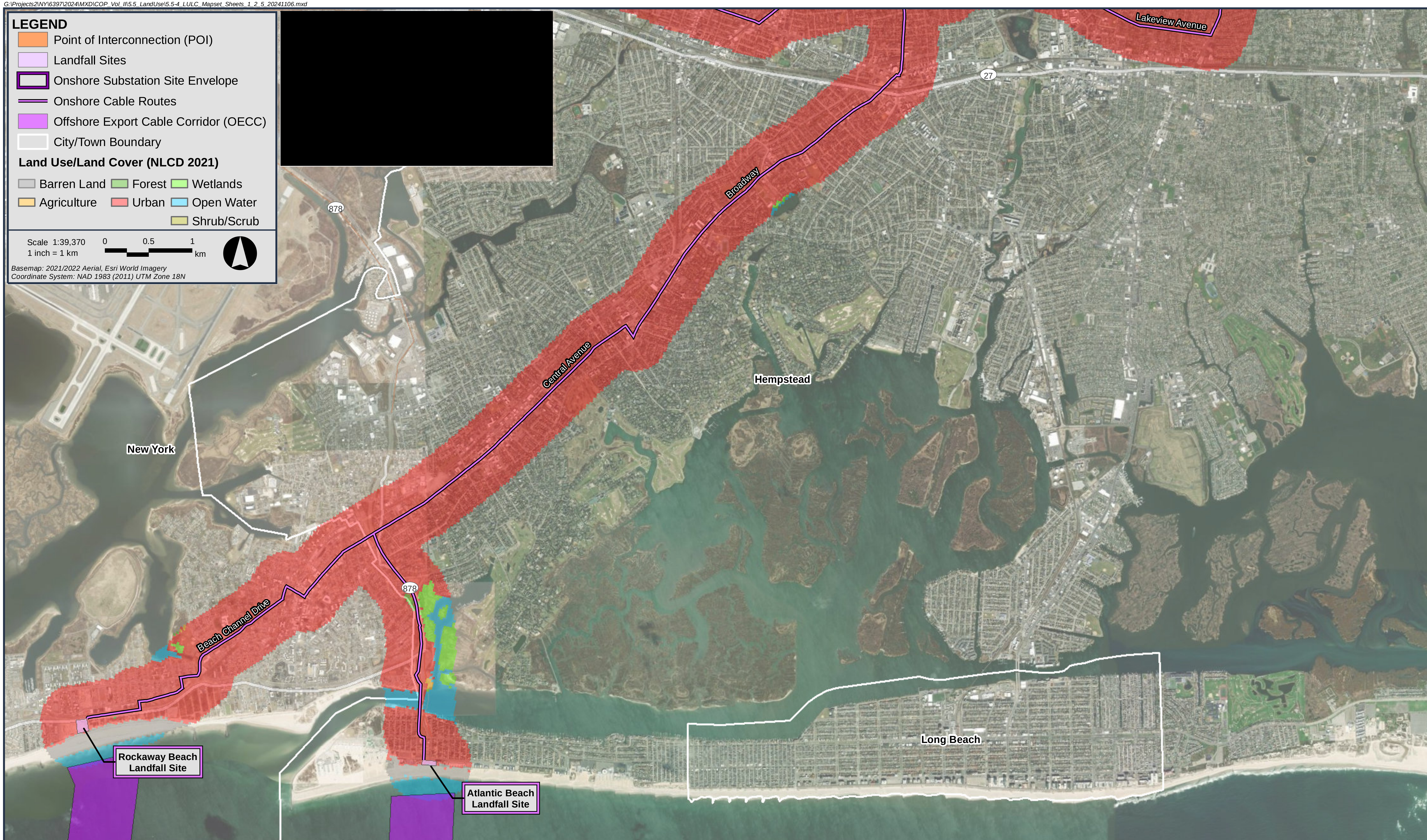

Figure 5.5-4, Map Sheet 1 of 5

Onshore Facilities

Land Use/Land Cover

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

[redacted]

[redacted]

[redacted]

[redacted]

Points of Interconnection

Power generated by Vineyard Mid-Atlantic will be delivered to the regional electric grid at up to two of the following POIs:

- **East Garden City Substation (Uniondale) POI:** The 138/345 kV East Garden City Substation is located in Uniondale, New York on Long Island. Vineyard Mid-Atlantic will interconnect to the 345 kV portion of the East Garden City Substation, which is owned and operated by the New York Power Authority (NYPA). [76] The East Garden City Substation POI is also referred to as the "Uniondale POI."

- **Ruland Road Substation POI:** The 138 kV Ruland Road Substation is located in Melville, New York on Long Island.[77] The Ruland Road Substation is operated by the Public Service Enterprise Group (PSEG) Long Island for the Long Island Power Authority (LIPA).

- **Eastern Queens Substation POI:** The proposed Eastern Queens Substation is located in Queens, New York on Long Island. Development of the Eastern Queens Substation is anticipated as part of the Consolidated Edison Company of New York, Inc.'s Reliable Clean City Project.

To deliver power to up to two POIs, underground high voltage alternating current (HVAC) or high voltage direct current (HVDC) onshore export cables will connect up to two of the potential landfall site(s) to two new onshore substations, and underground HVAC grid interconnection cables will connect the new onshore substations to the POIs. Modifications may be required at each POI to accommodate Vineyard Mid-Atlantic's interconnection. Any required system upgrades at the POI are expected to be constructed by the existing substation's owner/operator. More detailed information is available in Section 3.8 of COP Volume I.

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[76] Note the Uniondale POI contains an adjacent undeveloped portion to the west of the current 138 kV/345 kV Uniondale substation. Plans for the expansion of the 345 kV POI are in development by NYPA as part of the Long Island Offshore Wind Designated Public Policy Project. Vineyard Mid-Atlantic may connect to the expanded portion of the Uniondale POI, which will be owned and operated by NYPA.

[77] A new 345 kV substation may be constructed by other entities adjacent to the existing 138 kV Ruland Road Substation as part of the Long Island Offshore Wind Export Public Policy Transmission Need Project. Vineyard Mid-Atlantic could interconnect at the new 345 kV substation, depending on the timeline of that project.

Onshore Cable Routes

Onshore cable routes are shown on Figure 5.5-4. Each onshore cable route has been sited to predominantly follow existing city/village, town, county, and state roads. Underground trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies). More detailed information about the selection of onshore cable routes is included in Section 2.7.3 of COP Volume I.

Likely onshore cable routes are described in Sections 3.8.1 through 3.8.3 of COP Volume I; however, Vineyard Mid-Atlantic may ultimately use any combination of route segments shown on Figure 5.5-4. More detailed information is available in Sections 3.8.1 and 3.8.3 of COP Volume I.

Onshore Substations and Reactive Compensation Stations

Vineyard Mid-Atlantic will include two onshore substations on Long Island, New York. Since the Proponent has not yet secured site control for the onshore substation sites, the Proponent has identified several "onshore substation site envelopes." The two onshore substations will be located within up to two of the following onshore substation site envelopes shown in Figure 5.5-1, Figure 5.5-2, and Figure 5.5-3.

- **Onshore Substation Site Envelope A:** [redacted]
- **Onshore Substation Site Envelope B:** [redacted]
- **Onshore Substation Site Envelope C:** [redacted]

- **Onshore Substation Site Envelope D:** [redacted]

If HVAC export cables are used, an onshore RCS may be located along each onshore export cable route. These onshore substation site envelopes could also be used for an RCS, however both an RCS and onshore substation site would not be located in the same onshore substation site envelope.

Land Use/Land Cover Designations

NLCD categorizes land use/land cover into 16 main classes; seven of which are mapped in the Onshore Development Area: urban, barren, agriculture, forest, wetlands, open water, shrub/scrub (NLCD 2021). As shown on Figure 5.5-4, each potential landfall site is in a previously developed area. All potential landfall sites are in, or immediately adjacent to, NLCD mapped urban areas. The Jones Beach Landfall Site is characterized by NLCD coverage as barren land as well as urban (see Figure 5.5-4); however, as aerial mapping indicates, the site is located in a previously disturbed parking area. Similarly, NLCD indicates that each POI site is located in an area defined as urban. Similarly, the onshore substation site envelopes are primarily located in urban areas (see Figure 5.5-4). Although the Proponent may select an onshore substation site parcel that contains mapped wetlands, the footprint of the onshore substation site would be sited to avoid wetlands.

While there are multiple onshore route options under consideration, analysis of land use/land cover indicates that approximately 83-100% of each potential onshore cable route, including adjacent onshore substation site envelopes, is located in an urban area. Less than approximately 2.8% and 1.8% of each potential onshore cable route crosses wetlands and open water, respectively. Trenchless crossing methods are expected to be used where the onshore cables traverse wetlands and waterbodies. Furthermore, the onshore export cable routes are approximately 99% co-located with existing roadways and/or utility rights-of way (ROWs). Overall, the onshore cables are expected to be installed entirely underground within public roadway layouts (i.e., within previously disturbed areas) or immediately adjacent areas to minimize disturbance to existing land use and land cover.

5.5.1.2 Port Utilization

As listed in Table 5.5-1 and Table 5.5.-2, the Proponent has identified several ports in New York, New Jersey, Connecticut, Rhode Island, Massachusetts, Maryland, South Carolina, and Canada that may be used during construction or O&M to stage offshore components and/or that may be the site of a manufacturing facility. Table 3.10-1 and Table 4.4-1 of COP Volume I include more detailed information. The Proponent has identified a wide range of potential ports due to the uncertainty in Vineyard Mid-Atlantic's construction schedule and the expected demand for ports by other offshore wind developers in the coming years. Only a subset of the ports in Tables 5.5-1 and 5.5-2 would ultimately be used. The Proponent does not expect to implement any port improvements.

Some basic activities associated with marine construction in general (rather than offshore wind specifically) such as refueling,[78] restocking supplies, sourcing parts for repairs, vessel mobilization/demobilization, and infrequent crew transfer may occur out of ports other than those listed in Table 5.5-1. These activities would be well within the realm of normal port activities.

Each port under consideration for Vineyard Mid-Atlantic is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction proceeds or operation begins, and the ports have been chosen due to their ability to support Vineyard Mid-Atlantic related activities. As such, existing land uses are appropriate for Vineyard Mid-Atlantic.

Table 5.5-1 Potential Construction Ports

Port
New York Ports
Capital Region Ports: • Port of Albany-Rensselaer • New York State (NYS) Offshore Wind Port • Port of Coeymans Marine Terminal
Port of Tomkins Cove
Staten Island Ports: • Arthur Kill Terminal • Homeport Pier • Staten Island Marine Terminal • Rossville Municipal Site
Brooklyn Ports: • South Brooklyn Marine Terminal (SBMT) • GMD Shipyard
New Jersey Ports
Paulsboro Marine Terminal
New Jersey Wind Port
Port Newark Container Terminal and Other Areas in Newark Bay
Connecticut Ports
Port of Bridgeport
New London State Pier
Rhode Island Ports
Port of Davisville (Quonset)
Port of Providence (ProvPort)
South Quay Terminal

78 Some bunkering (i.e., refueling) and restocking of supplies could also occur offshore.

Table 5.5-1 Potential Construction Ports (Continued)

Port
Massachusetts Ports
Brayton Point Commerce Center
Port of New Bedford: • New Bedford Marine Commerce Terminal • Other areas in New Bedford
Salem Harbor
Maryland Ports
Sparrows Point
South Carolina Ports
Port of Charleston: • Union Pier Terminal • Columbus Street Terminal • Hugh K. Leatherman Terminal • Wando Welch Terminal
Goose Creek
Canadian Ports
Potential Canadian Ports: [2] • Port of Halifax • Sheet Harbor • Port Saint John

Notes:

1. United States (US) offshore wind component and cable manufacturing facilities identified in the above table may not necessarily be used for Vineyard Mid-Atlantic.
2. Analysis of potential Canadian ports that may be used is ongoing.

Ports identified in Table 5.5-2 for O&M activities are expected to include dock space for service operation vessels (SOVs), service accommodation and transfer vessels (SATVs), crew transfer vessels (CTVs), and/or other support vessels.

Table 5.5-2 Potential O&M Ports

Port
New York Ports
Staten Island Ports: • Arthur Kill Terminal • Homeport Pier • Staten Island Marine Terminal • Rossville Municipal Site • Atlantic Salt Terminal
Brooklyn Ports: • South Brooklyn Marine Terminal (SBMT) • GMD Shipyard • Red Hook Container Terminal • Ravenswood Generating Station

Table 5.5-2 Potential O&M Ports (Continued)

Port
New York Ports (Continued)
Long Island Ports: • Shoreham • Port Jefferson Harbor • Greenport Harbor
New Jersey Ports
Port Newark Container Terminal and Other Areas in Newark Bay
Connecticut Ports
Port of Bridgeport
New London State Pier

5.5.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect land use and coastal infrastructure during the construction, O&M, and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.5-3.

Table 5.5-3 Impact Producing Factors for Land Use and Coastal Infrastructure

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Onshore Construction and Maintenance Activities	•	•	•
Ground Disturbance	•	•	•
Port Utilization	•	•	•

Potential effects to land use and coastal infrastructure were assessed using the maximum design scenario for Vineyard Mid-Atlantic's onshore facilities as described in Section 1.5.

5.5.2.1 Onshore Construction and Maintenance Activities

Onshore construction and maintenance activities may temporarily result in impacts to land use and coastal infrastructure due to ground disturbance (see Section 5.5.2.2), traffic, emissions, and outdoor lighting.

The Proponent will work with the municipalities where onshore facilities are proposed. Specifically, the Proponent will work with state and local agencies to develop a Traffic Management Plan (TMP) prior to construction. The timing of onshore construction activities will be coordinated with state and local agencies to avoid seasons or times of peak usage and to align with planned public works projects, where feasible, to minimize traffic disruption. Onshore construction at the landfall site(s) is planned to occur outside of the period from Memorial Day to Labor Day.

Further, the Proponent will engage with the public prior to and during construction, in an effort to keep the local population informed of Vineyard Mid-Atlantic activities such as construction schedules, vehicular access impacts, lane closures, detours, parking limitations, equipment delivery, nighttime or weekend construction, repaving activities, and/or emergency vehicle access. Additionally, temporary emissions may occur from support vehicles and equipment during construction and maintenance. Such emissions are expected to be similar to other onshore construction projects.

Outdoor lighting will be used at the onshore substation sites during construction and commissioning. During operations (see Section 4 of the COP Volume I), the majority of lights will only be used on an as-needed basis (e.g., if equipment inspection is needed at night). For security reasons, a few lights will typically be illuminated on dusk–to-dawn sensors and a few lights will likely be controlled by motion-sensors. Outdoor lighting at the onshore substation sites will typically be equipped with light shields to prevent light from encroaching into adjacent areas. The Proponent will ensure that the lighting scheme complies with local requirements. A stormwater management system at the onshore substation sites will include low-impact development (LID) strategies (e.g., grass water quality swales to capture and convey site runoff, deep sump catch basin(s) to pretreat surface runoff, etc.), which are designed to capture, treat, and recharge stormwater runoff.

If an onshore RCS is needed, the Proponent will ensure that the outdoor lighting scheme complies with local requirements and that the onshore RCS would be equipped with a stormwater management system.

5.5.2.2 Ground Disturbance

Localized ground disturbance will occur from construction, O&M, and decommissioning of the landfall site(s), onshore cable routes, new substations, and onshore RCSs (if used). To minimize disturbance, the Proponent has located the onshore cable routes primarily within public roadway layouts (or immediately adjacent areas).[79] The Proponent intends to prioritize onshore substation sites and onshore RCS sites (if used) in industrial/commercial areas that have been previously disturbed, although land clearing and grading may be needed depending on the sites ultimately selected. Ground disturbance associated with Vineyard Mid-Atlantic will be temporary and disturbed areas will be restored to their existing conditions. Construction will be conducted in accordance with soil erosion and sedimentation control plans.

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[79] In limited areas, the onshore cable routes may follow ROWs or depart from public roadway layouts, particularly at complex crossings.

Landfall Sites and Onshore Cable Routes

As further detailed in Section 3.7.1 of COP Volume I, at each landfall site, the offshore export cables are expected to transition onshore using horizontal directional drilling (HDD). HDD also avoids or minimizes impacts to boardwalks and any jetties located near the landfall site(s). HDD at the landfall site(s) will require a staging area to be located in a parking lot or previously disturbed area. Further detail regarding dimensions and anticipated temporary disturbances associated with the approach pit, exit pit, and staging areas are located in Section 3.7.2 of COP Volume I.

The Proponent will work with municipalities to develop the construction schedule and hours in accordance with local ordinances and in coordination with other planned public works projects, where feasible. Certain activities cannot stop once they are initiated, such as conduit pull-in for the HDD work, which may extend work in some circumstances. Disturbed ground and/or infrastructure will be restored to existing conditions following completion.

The onshore cables are expected to be installed entirely underground primarily within public roadway layouts (or immediately adjacent areas). The onshore cables may be installed within a duct bank or installed within directly buried conduit(s). Both HVDC and HVAC onshore cables typically require splices every 152–457 m (500–1,500 ft) or more. At each splice location, one or more splice vaults will be installed. The duct bank and splice vaults are expected to be installed in open trenches using conventional construction equipment (e.g., hydraulic excavator, loader, dump trucks, flatbed trucks, crew vehicles, cement delivery trucks, and paving equipment). While one trench will typically be used, two trenches may be needed for portions of the onshore cable routes. The trench dimensions will vary along the onshore cable route (depending on the duct bank layout) but are expected to measure up to approximately 3.4 m (11 ft) in depth, 4.0 m (13 ft) in width at the bottom, and 4.3 m (14 ft) in width at the top. In locations where splice vaults are necessary, the excavated area will be larger (up to approximately 13 m [43 ft] wide, 15 m [50 ft] long, and 6 m [20 ft] deep). Since the splice vaults may be installed anywhere along the onshore cable routes, the maximum extent of disturbance along the entire route is based on the dimensions of the area excavated for splice vaults.

Any pavement will be removed before excavating and shoring the trenches. Minimal tree trimming and/or tree clearing may be needed where the routes follow existing roadway layouts, depending on the final duct bank alignment.[80] Tree trimming, tree clearing, and/or grading may be required to facilitate onshore cable installation in limited areas where the routes depart from the public roadway layout (particularly at complex crossings) and at

80 Subject to further engineering and consultations with local and state agencies (e.g., New York State Department of Transportation [NYSDOT]).

trenchless crossing staging areas (see Section 3.8.4.3 of COP Volume I). The work, however, will be confined to as narrow a corridor as possible. Excavated material will be hauled away in trucks daily and recycled or disposed of in accordance with state regulations.

Underground trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies).

The Proponent's contractor will identify construction staging areas (i.e., equipment laydown and storage areas) proximate to the onshore cable routes. With exception of staging areas for trenchless crossings (see Section 3.8.4.3 of COP Volume I), the Proponent anticipates construction staging areas will either be in paved areas or at locations already utilized for similar activities and are therefore not expected to cause new ground disturbance.

Mitigation measures such as erosion and sedimentation controls will be utilized during construction. No permanent impacts to existing land uses are expected upon completion of landfall site construction and onshore cable installation due to the planned restoration of any temporarily disturbed areas and because the infrastructure is proposed to be installed entirely underground.

During O&M, periodic maintenance may be required. If onshore cable repairs are required, the cables would typically be accessed through manholes installed at the splice vaults and transition vaults thereby avoiding and minimizing land disturbance.

Onshore Substations and Reactive Compensation Stations

Construction of each onshore substation, and onshore RCS (if used) will include site preparation (e.g., land clearing and grading), installation of the substation equipment and cables, commissioning, and site clean-up and restoration. Temporary fencing and a security gate will be installed around the perimeter of the construction area and temporary erosion control measures will be installed. Land clearing and grading may be needed. Onshore substation sites may require up to approximately 0.06 km^2 (15 acres) of tree clearing and ground disturbance (per site) from grading, excavation, and trenching.[81] Construction of each onshore RCS may require up to ~0.008 km^2 (2 acres) of tree clearing and ground disturbance.[82]

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[81] The actual size of the onshore substation site parcel may be larger than the area cleared and disturbed to accommodate the onshore substation.

[82] The actual size of the parcel may be larger than the area cleared and disturbed to accommodate the onshore RCS.

Upon completion of construction of the onshore substation, or onshore RCS (if used), a permanent fence will be installed and the disturbed area immediately adjacent and outside of the fence will be restored and revegetated (if required). Visual screening and sound attenuation walls may be installed, if needed. The Proponent will coordinate with local municipalities regarding local ordinances.

Periodic maintenance will likely occur within the fenced perimeter of the onshore substation site and onshore RCS site (if used). During decommissioning, potential impacts are expected to be similar to construction and appropriate environmental protection measures, such as installing erosion and sedimentation controls, will be implemented.

5.5.2.3 Port Utilization

Vineyard Mid-Atlantic construction, O&M, and decommissioning will require the use of ports. Vineyard Mid-Atlantic has identified several existing and planned ports to be utilized for construction and O&M (see Tables 5.5-1 and 5.5-2, respectively). Each port under consideration for Vineyard Mid-Atlantic is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction or operation proceeds. As described in Section 3.10.1 of COP Volume I, the Proponent does not expect to implement any port improvements. The Proponent has identified a wide range of potential staging ports due to the uncertainty in Vineyard Mid-Atlantic's construction schedule and to minimize any potential conflicts due to the expected demand for ports by other offshore wind developers in the coming years.

Section 5.6 and the Navigation Safety Risk Assessment (NSRA) included as Appendix II-G provide further detail; however, vessel operations and frequency may increase near the selected port facilities during construction, O&M, and decommissioning. The O&M facilities, which could be located at or near any of the ports identified in Table 4.4-1 of COP Volume I, are expected to include dock space for SOVs, SATVs, CTVs, and/or other support vessels (see Section 4.4.2 of COP Volume I). The O&M facility would likely be used for dispatching technicians and crew exchange, bunkering, and loading supplies and spare parts onto vessels. Vessel use during O&M is not anticipated to interfere with normal port operations.

Furthermore, the potential ports and surrounding waterways are expected to have the necessary capacity for the potential vessel traffic. Vessel movements will be managed by a Marine Coordinator. Additional mitigation measures are detailed in Section 5.6.

5.5.2.4 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to land use and coastal infrastructure during Vineyard Mid-Atlantic are summarized below:

- HDD is expected to be used at the landfall site(s) to avoid or minimize disturbance.

- Underground trenchless crossing methods (e.g., HDD) are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies) to avoid impacts to those features.

- Onshore cables are expected to be installed entirely underground to minimize disturbance.

- Onshore cable routes have been sited primarily within public roadway layouts and the Proponent intends to prioritize onshore substation sites and onshore RCS sites (if used) in industrial/commercial areas that have been previously disturbed with land uses consistent with the proposed Vineyard Mid-Atlantic facilities.

- Ground disturbance will be temporary, and all disturbed areas will be restored.

- Elements such as natural barriers and landscaping will be incorporated to minimize any effects to surrounding land uses and communities.

- Best management practices for erosion and sedimentation control measures will be utilized during construction.

- The timing of onshore construction activities will be coordinated with state and local agencies to avoid seasons or times of peak usage. Onshore construction at the landfall site(s) is planned to occur outside of the period from Memorial Day to Labor Day.

- Security measures will be implemented to prevent public access to Vineyard Mid-Atlantic facilities.

- Vessel movements during construction, O&M, and decommissioning activities will be managed by a Marine Coordinator.

- A range of potential ports have been identified to add flexibility to Vineyard Mid-Atlantic activities and to minimize any potential conflicts due to the expected demand for ports by other offshore wind developers in the coming years.

5.6 Navigation and Vessel Traffic

This section addresses the potential impacts of Vineyard Mid-Atlantic on navigation and vessel traffic in the Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to navigation and vessel traffic during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

A Navigation Safety Risk Assessment (NSRA) is presented in Appendix II-G.

5.6.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the offshore export cable corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic-related activities. For the purpose of assessing effects to navigation and vessel traffic, the Offshore Development Area also includes the waters and ports in which Vineyard Mid-Atlantic-related vessels and equipment may operate.

The following analysis relies upon the methodology and findings of an NSRA conducted for Vineyard Mid-Atlantic as required by the United States Coast Guard (USCG). Information on the affected environment is summarized here and presented in greater detail in the NSRA (see Appendix II-G).

5.6.1.1 Navigation Overview

Aids to navigation including Private Aids to Navigation (PATONs), Federal Aids to Navigation (ATONs), and radar transponders are located throughout the Offshore Development Area (see Figure 5.6-1). These aids to navigation serve as visual and audible references to support safe maritime navigation and consist of buoys, lights, sound horns, and onshore lighthouses. Federal ATONs are developed, operated, and maintained or regulated by the USCG to assist mariners in determining their position, identify safe courses, and warn of dangers and obstructions. ATONs are marked on the National Oceanic and Atmospheric Administration (NOAA) nautical charts.

PATONs and Federal ATONs are located in the vicinity of the Lease Area and OECC. With the exception of Vineyard Mid-Atlantic's temporary meteorological oceanographic ("metocean") buoy, which is marked as a PATON, there are no other PATONs or Federal ATONs in the Lease Area. The closest Federal ATON to the Lease Area is the NOAA Data Lighted Buoy 44025 located approximately 0.43 kilometers (km) (0.23 nautical miles [NM]) northwest of the Lease Area. As shown on Figure 5.6-1, there is only one ATON within 500 meters (m) (1,640 feet [ft]) of the edge of the OECC. As the OECC approaches shore, it splits into three variations to connect to three potential landfall sites: the Rockaway Beach Approach, the Atlantic Beach Approach, and the Jones Beach Approach. Vineyard Mid-Atlantic will only use up to two of these approaches to reach up to two landfall sites. Rockaway Beach Approach has one ATON which is located within 500 m (1,640 ft) of the OECC, while all other approaches have no ATONs within 500 m (1,640 ft) of the OECC (see Figure 5.6-1). Additional information about PATONs, Federal ATONs, and radar transponders in the Offshore Development Area is provided in the NSRA (see Appendix II-G).

The Lease Area is in relatively deep water ranging from approximately 39.5 to 47.1 m (130 to 155 ft); therefore, navigation is not limited by water depth. There are several vessel routing measures in the vicinity of the Lease Area, including a traffic separation scheme (TSS) and fairways (see Figure 5.6-2). Fairways are the corridors in which no artificial islands or fixed

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

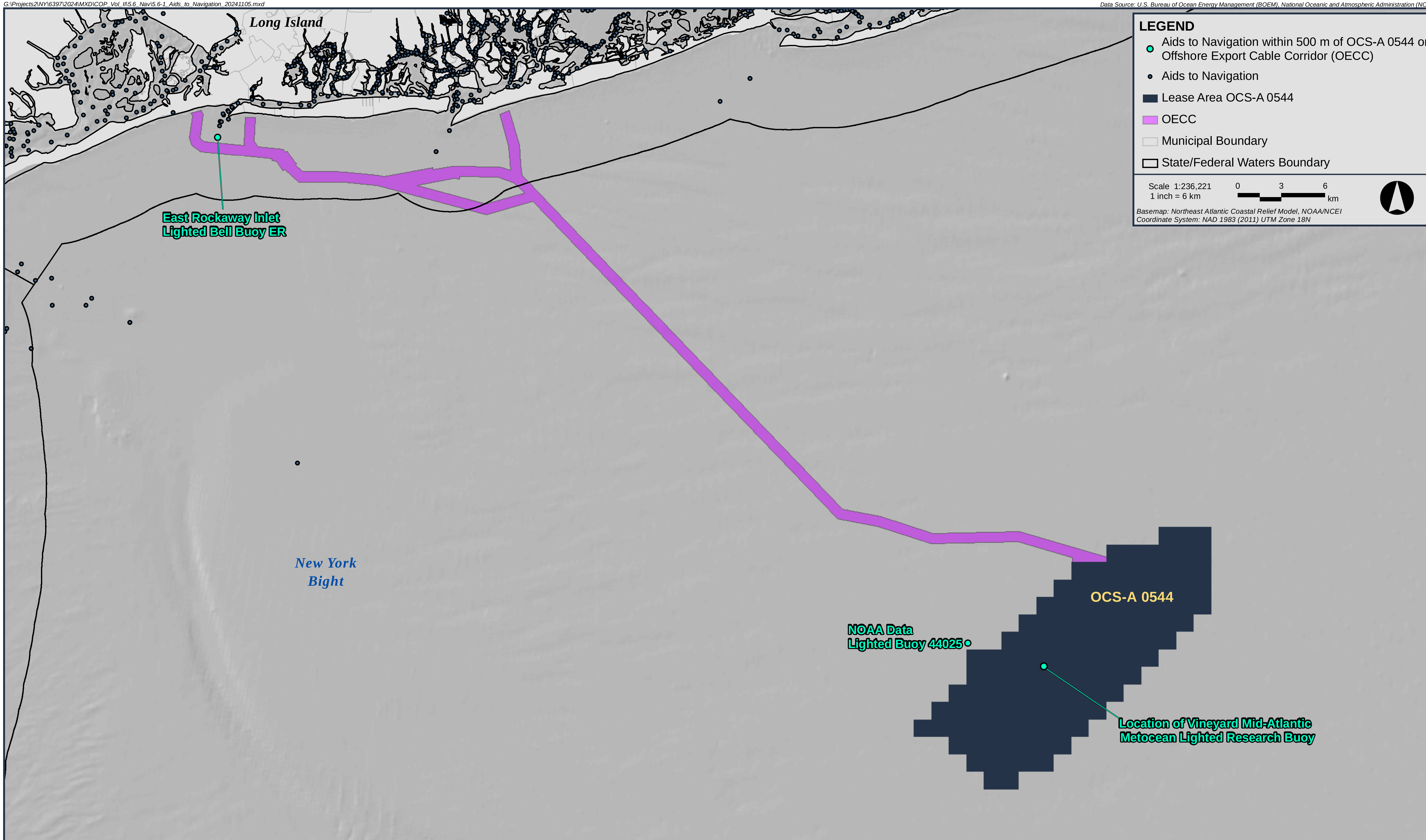

Figure 5.6-1
Aids to Navigation

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

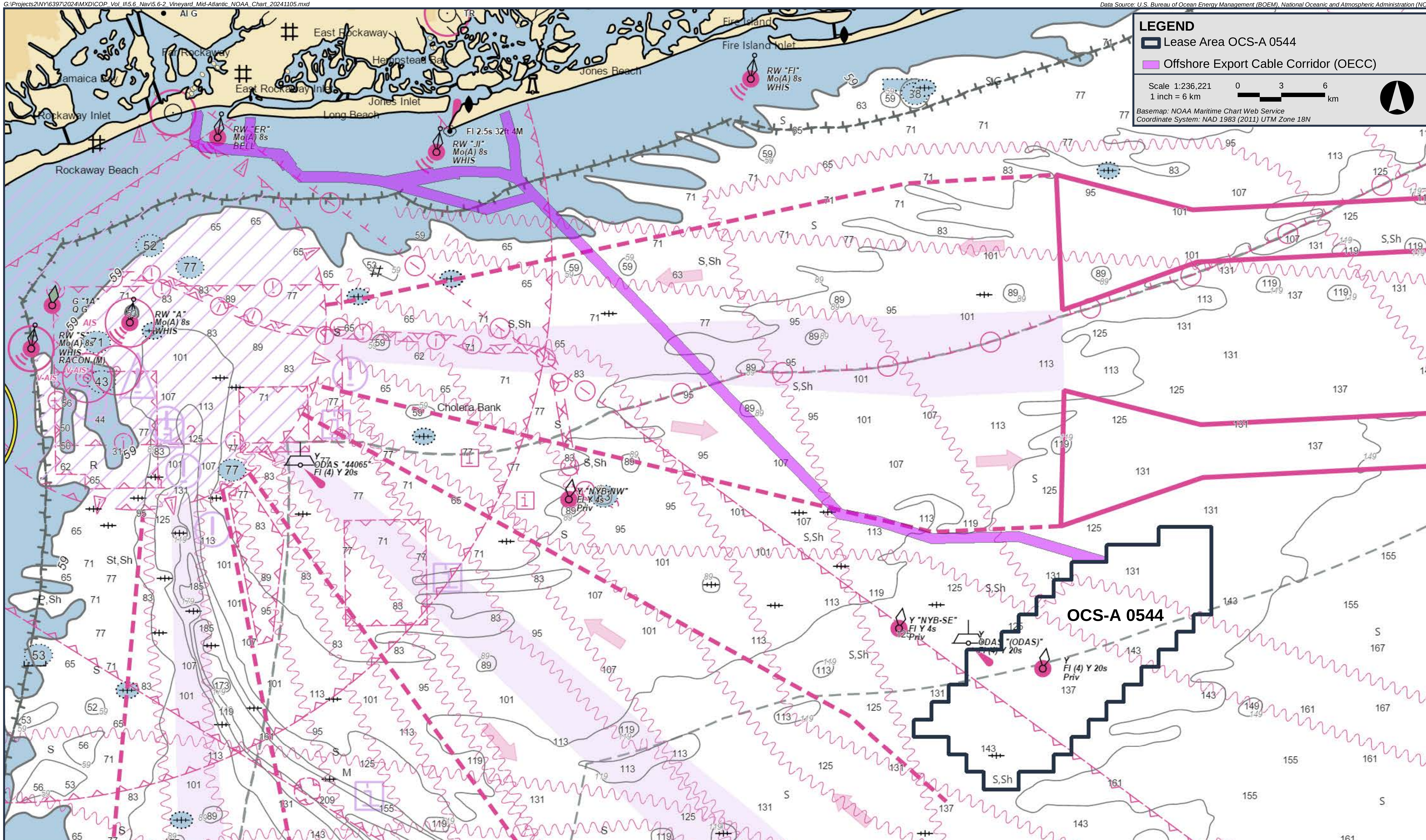


Figure 5.6-2
Vineyard Mid-Atlantic Overlaid on NOAA Chart

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

structures are permitted. A TSS separates opposing streams of vessel traffic by creating separated, unidirectional traffic lanes and is typically designed to safely guide commercial vessels transiting to and from major ports. Most vessels which transit in the Offshore Development Area but not through the Lease Area move along the marked fairways and TSSs. The Lease Area is adjacent to two TSSs, the Nantucket to Ambrose TSS and the Hudson Canyon to Ambrose TSS. Each TSS consists of two, one way traffic lanes and a separation zone between the traffic lanes. The Nantucket to Ambrose Traffic Lane (eastbound) is located approximately 2.2 km (1.2 NM) north of the northern boundary of the Lease Area while the Nantucket to

Ambrose Traffic Lane (westbound) is located approximately 16.5 km (8.9 NM) north of the Lease Area. The Hudson Canyon to Ambrose Traffic Lane (northwest bound) is located approximately 1.8 km (1 NM) south of the southern boundary of the Lease Area while the Hudson Canyon to Ambrose Traffic Lane (southeast bound) is located approximately 16.9 km (9.1 NM) south of the Lease Area. Information on navigation is presented in greater detail in the NSRA (see Appendix II-G).

5.6.1.2 Vessel Traffic

Vessel traffic in the Offshore Development Area includes a variety of types of vessels including commercial fishing vessels, recreational vessels, passenger vessels, cargo vessels, tankers, and tug-tow vessels. Each of these vessel types operate differently and may have unique operational and navigational requirements.

Vessel traffic in the Offshore Development Area is typically quantified using Automatic Identification System (AIS) and Vessel Monitoring System (VMS) data. AIS is a shipborne mobile equipment system that allows vessels to monitor marine traffic in their area and broadcast their location to other vessels with AIS equipment onboard. VMS data are collected by NOAA Fisheries through a satellite monitoring system that is primarily used for monitoring the location and movement of certain commercial fishing vessels fishing for certain species (i.e., not all fishing vessels are included) in United States (US) federal waters.

The NSRA presents an assessment of vessel traffic within the Offshore Development Area based on AIS data from 2017 through and including 2022. AIS equipment is not required for vessels less than 20 m (65 ft) in length, so not all vessels, particularly smaller fishing and recreational vessels, are equipped with AIS equipment. To address the fact that not all fishing and recreational vessels may have AIS, the AIS traffic volumes assumed in the risk modeling (see Section 6.7 of Appendix II-G) were adjusted to account for non-AIS equipped fishing and recreational vessels.

Based on AIS data from 2017–2022, a total of 1,195 unique vessels passed through the Lease Area. Fishing vessels were responsible for over half (52%) of the vessel tracks passing through the Lease Area. Unique vessel types identified using AIS data in the Lease Area (from most common to least common) include recreational vessels, fishing vessels, cargo vessels, tankers, other vessels, tug-tow vessels, and passenger vessels (see Table 5.6-1). The AIS data indicated that recreational vessels are responsible for the next greatest number of unique tracks through the Lease Area (26%). The OECC has an average crossing rate of 10.7 vessels per day based on AIS data from 2017 to 2022. Figures 5.6-3 through 5.6-7 present colored contour maps of the annual average vessel traffic density for different vessel types. Additional information on vessel traffic is presented in greater detail in the NSRA (see Appendix II-G).

Table 5.6-1 Numbers of Vessels Entering the Lease Area (July 2017–June 2022)

Vessel Type	Unique Vessels		Unique Tracks	
	Number	Percentage	Number	Percentage
Cargo Vessels	163	14%	208	7%
Tankers	127	11%	148	5%
Passenger Vessels	19	2%	42	1%
Tug-tow Vessels	43	4%	74	3%
Recreational Vessels	530	44%	733	26%
Fishing Vessels	251	21%	1,480	52%
Other Vessels	62	5%	155	5%
Total (July 2017–June 2022)	1,195	100%	2,840	100%
Annual Average	304[2]		568	

Notes:

1. Data source is Appendix II-G.
2. The number of unique vessels in each year is determined, summed, and divided by the total number of years used in the analysis (five years).

5.6.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect navigation and vessel traffic during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.6-2.

Table 5.6-2 Impact Producing Factors for Navigation and Vessel Traffic

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Vessel Activity	•	•	•
Presence of Structures	•	•	•

Potential effects to navigation and vessel traffic were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

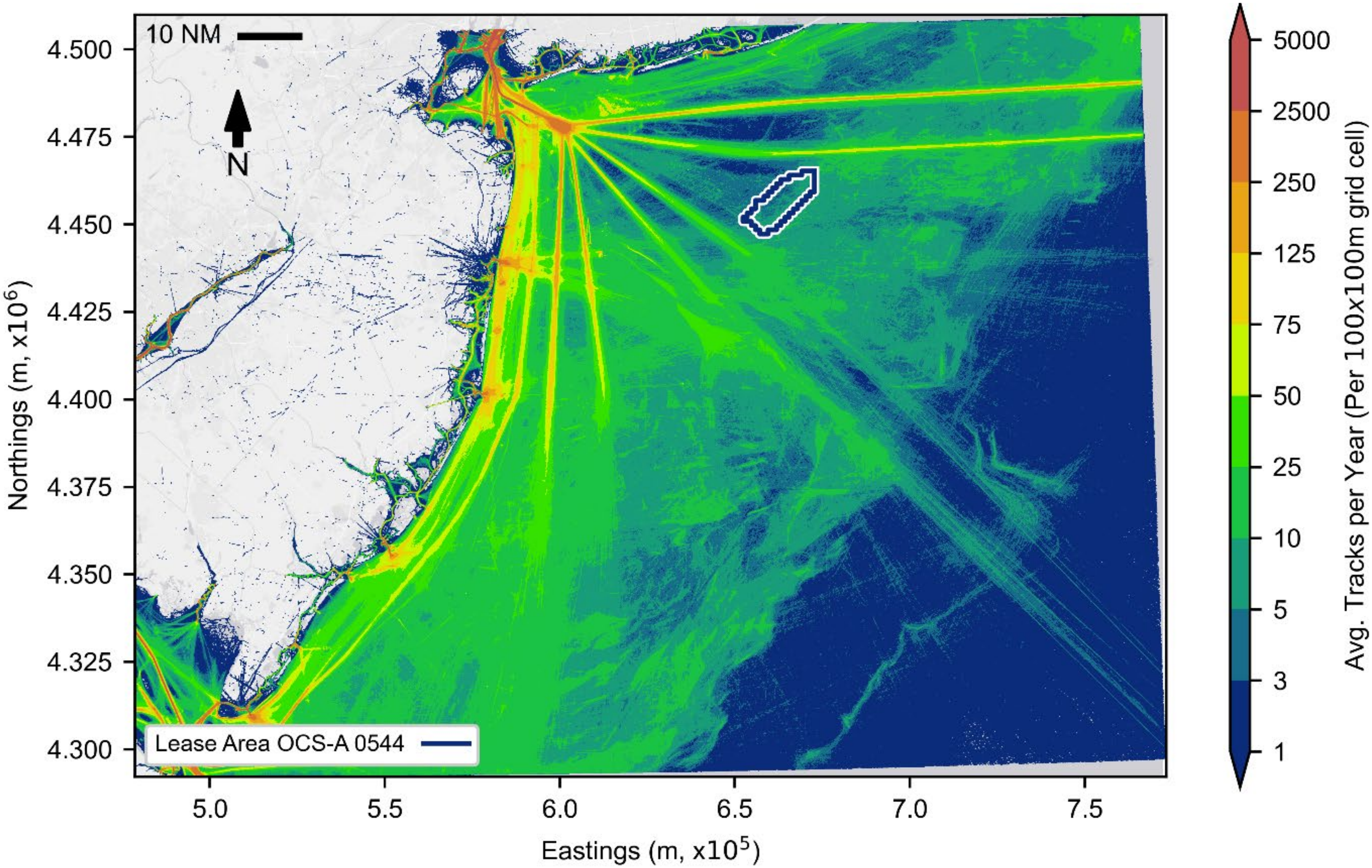


Figure 5.6-3
Annual Average Vessel Traffic Density for AIS-Equipped Vessels

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

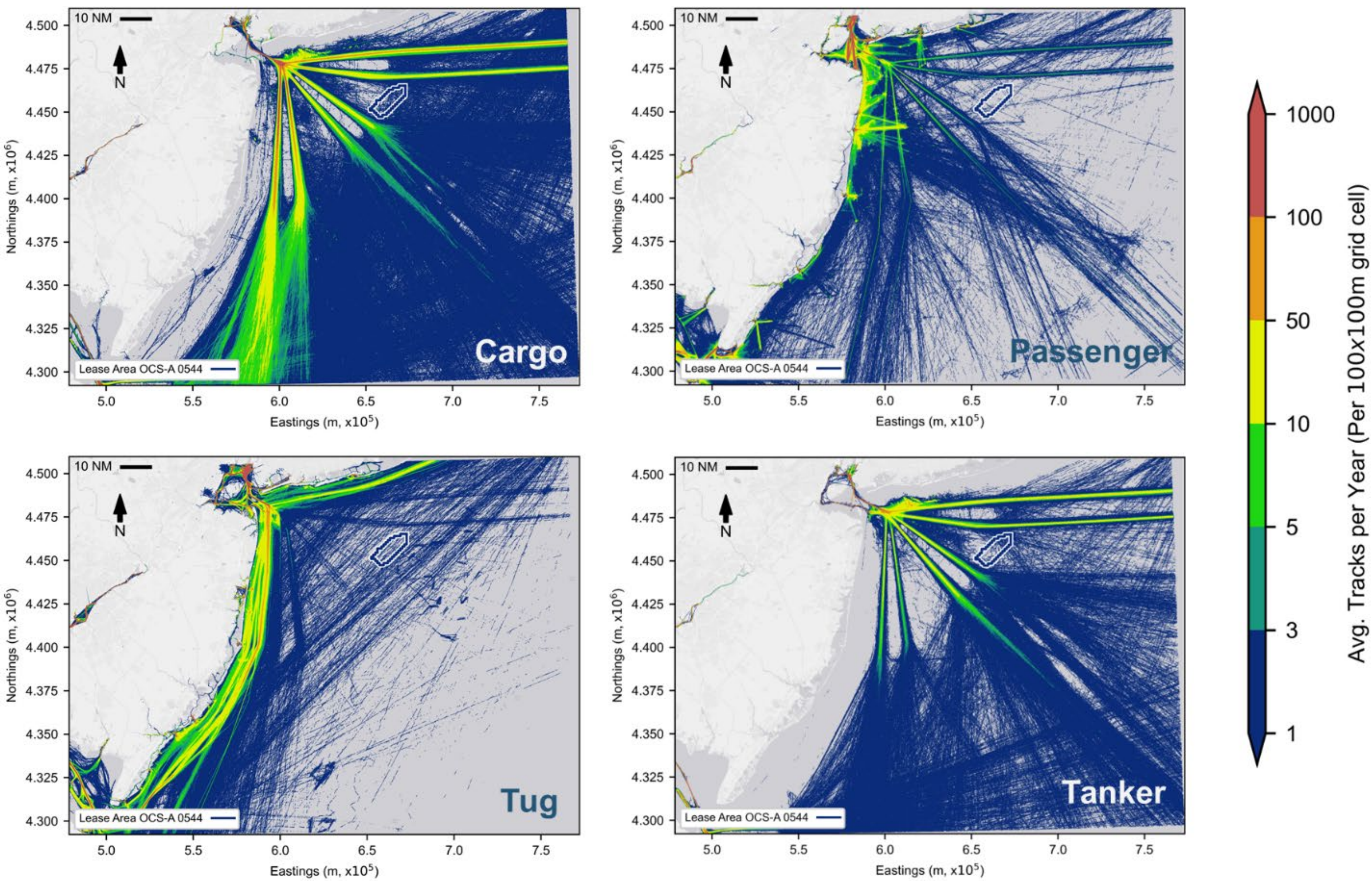
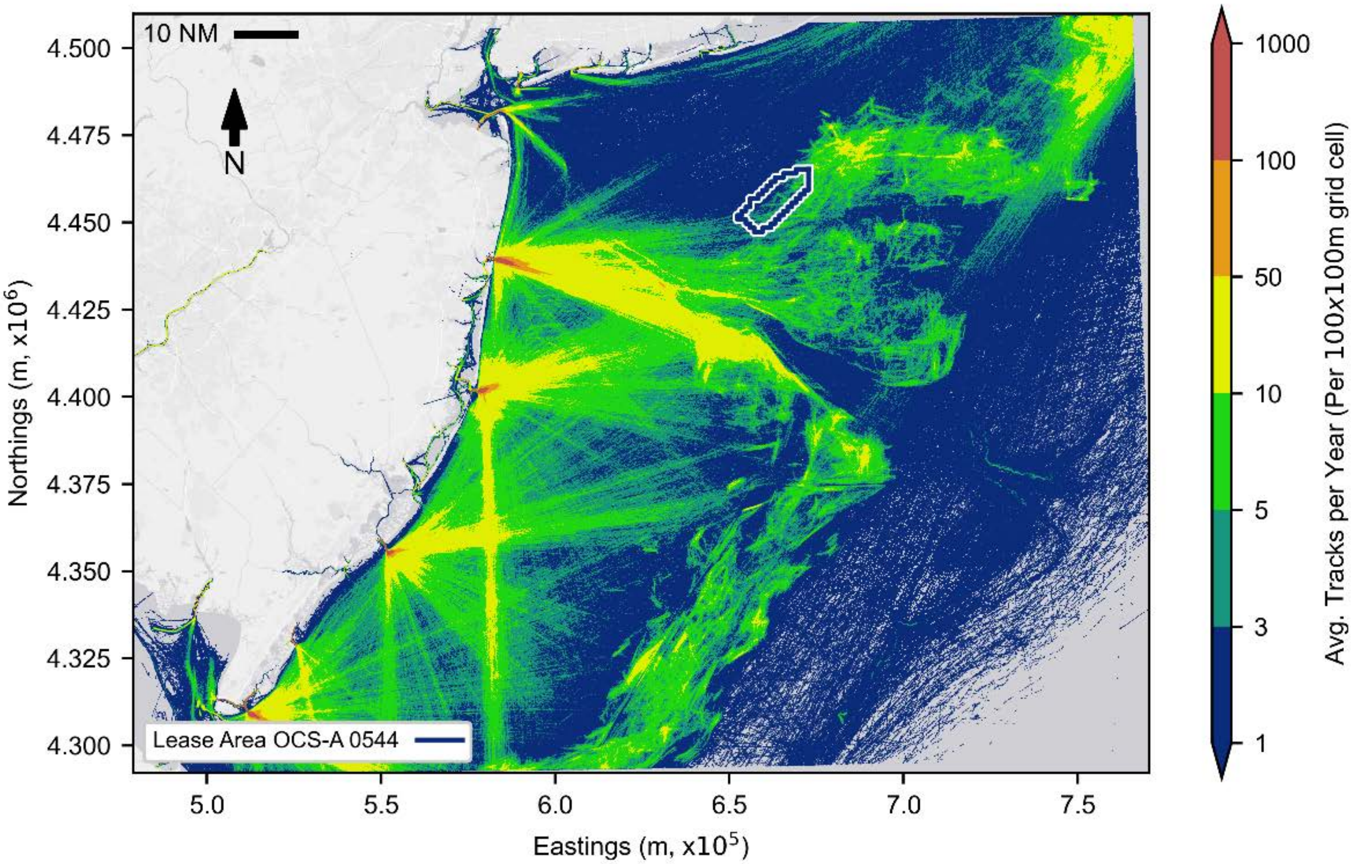


Figure 5.6-4
Commercial (Non-Fishing) Vessel Average Annual Traffic Densities

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE



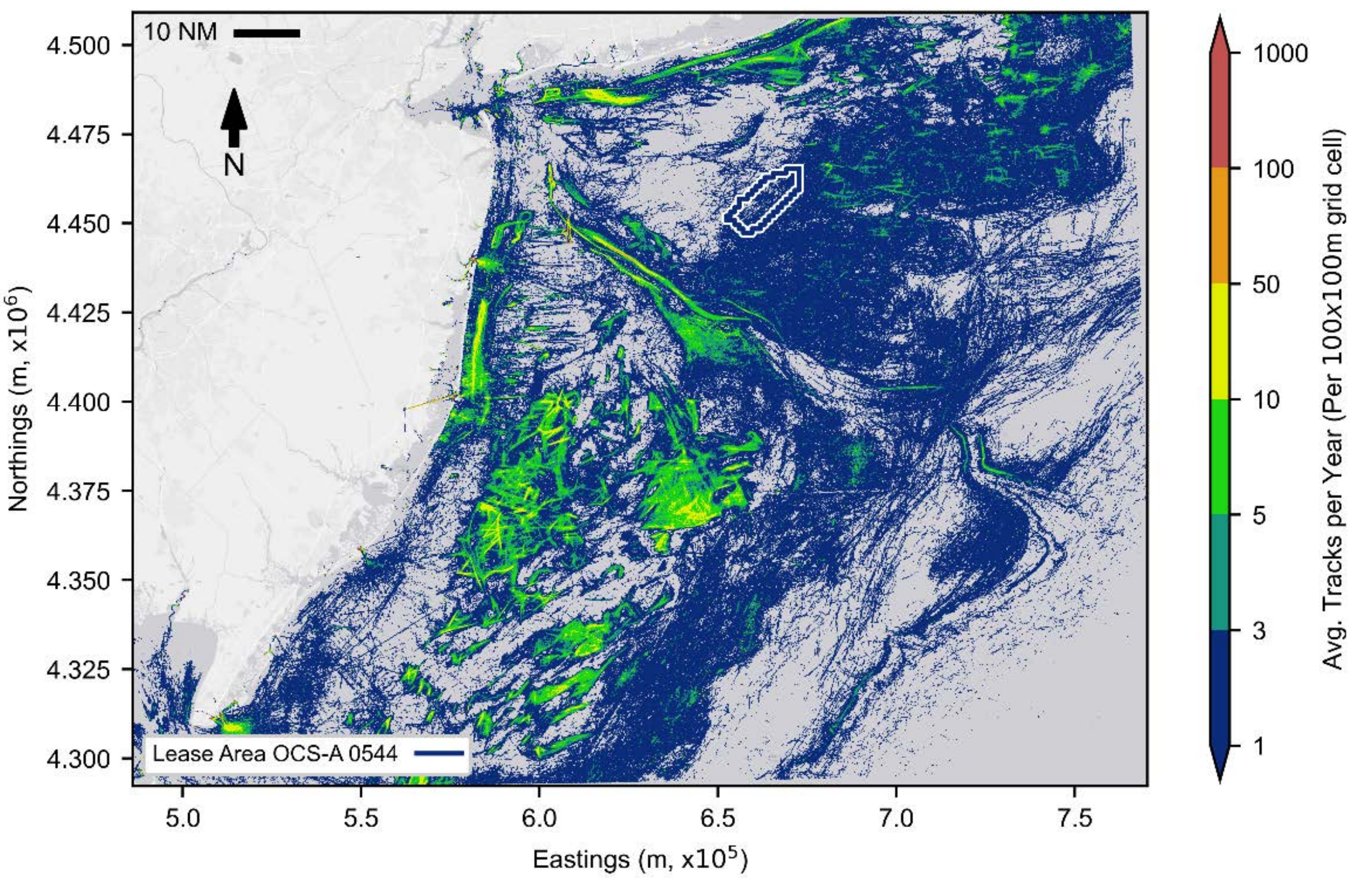


Figure 5.6-5
Transiting (top) and Actively Fishing (bottom) Vessel Average Annual Traffic Density

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

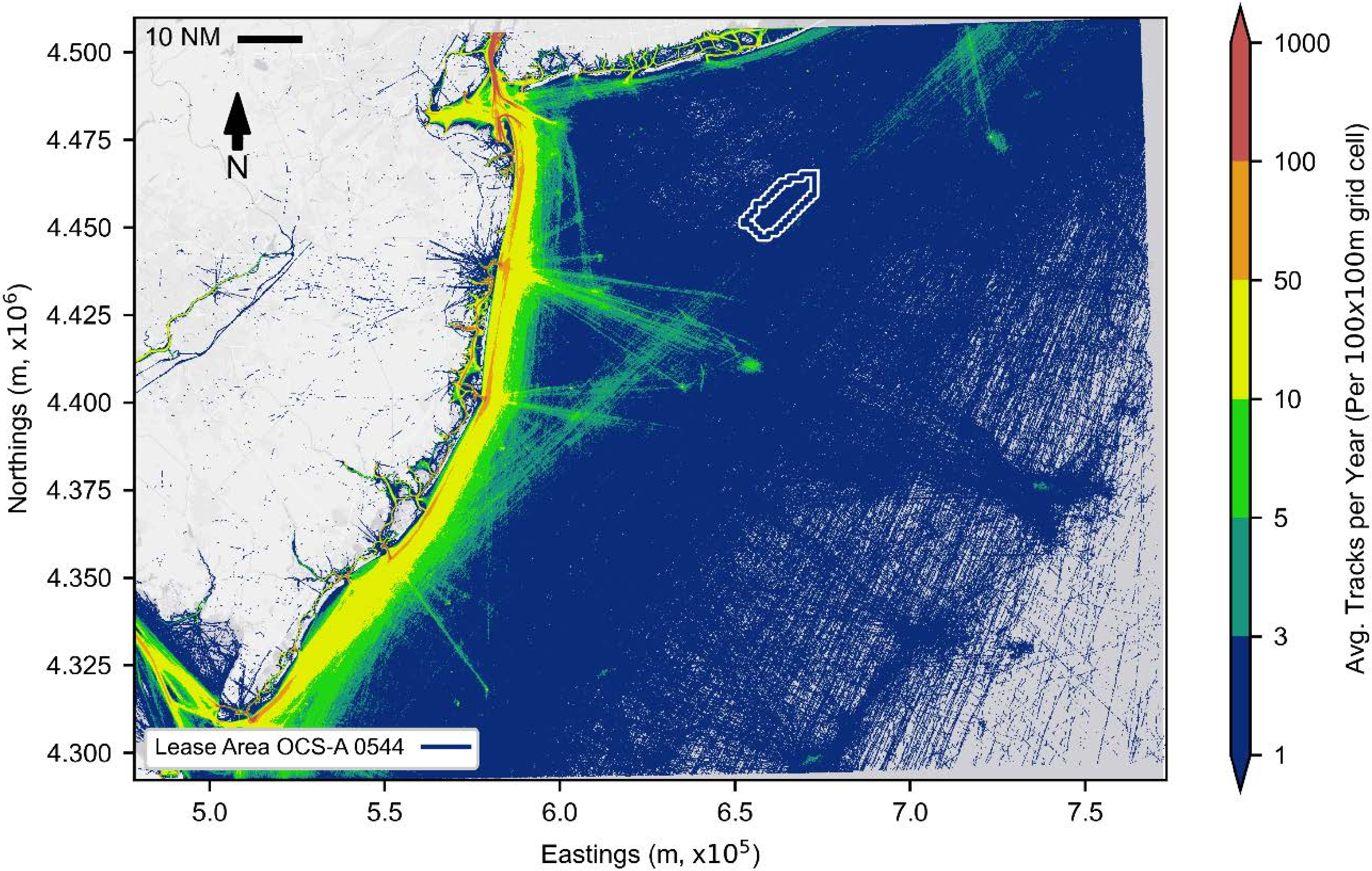


Figure 5.6-6
Recreational Vessel Average Annual Traffic Densities

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

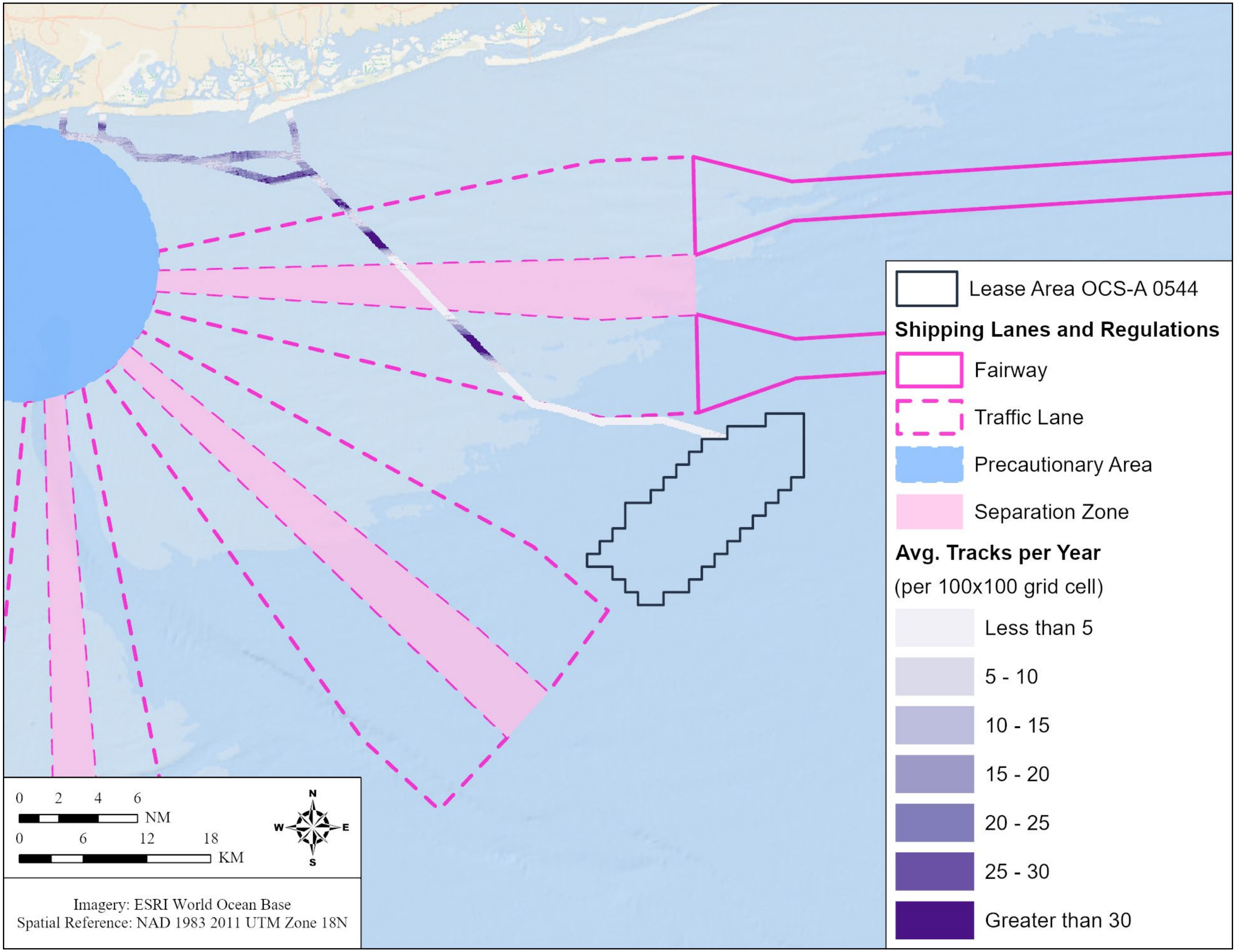


Figure 5.6-7

Annual Average Track Densities for Vessels Crossing the Offshore Export Cable Corridor

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

5.6.2.1 Vessel Activity

Construction, O&M, and decommissioning activities will cause increased vessel activity within the Offshore Development Area. Vessel activity for decommissioning activities is anticipated to be similar to construction needs. Vessels associated with other marine uses could experience localized disruption due to vessel traffic associated with Vineyard Mid-Atlantic activities. Vineyard Mid-Atlantic vessels operating in the Offshore Development Area may temporarily affect other vessel activities within the immediate vicinity or cause other vessels to slightly alter their routes to avoid Vineyard Mid-Atlantic activities, particularly during construction activities within the Lease Area and OECC. Vessel traffic associated with Vineyard Mid-Atlantic is not anticipated to represent a significant increase over the current levels of vessel traffic within the Offshore Development Area (see Appendix II-G).

Offshore construction and O&M will require several types of vessels, many of which will be specifically designed for offshore wind construction and cable installation. The types of vessels that are expected to be used during offshore construction of Vineyard Mid-Atlantic are provided in Table 3.10-2 of COP Volume I and include jack-up vessels, heavy lift vessels, tugboats, barges, cable laying vessels, sand bedform leveling vessels, crew transfer vessels (CTVs), service operation vessels (SOVs), and others. All construction and installation vessels and equipment will display the required navigation lighting and day shapes and make use of AIS as required by the USCG. As described further in Section 4.4.2 of COP Volume I, the Proponent expects to use one or a combination of the following logistical approaches during the routine O&M of Vineyard Mid-Atlantic: SOVs during multi-week service trips to the Lease Area, service accommodation and transfer vessels (SATVs) for multi-day or week-long service trips, and multiple CTVs and/or helicopters for frequent trips (e.g., daily) to transfer crew and supplies between the offshore facilities and shore. The Proponent may periodically use larger vessels (e.g., jack-up vessels, cable laying vessels) to perform certain maintenance and repair activities, if needed. These vessels would be similar to the vessels used during construction.

It is challenging to precisely quantify the number of vessels and vessel trips from each port at the early planning stages of Vineyard Mid-Atlantic because they depend on: (1) the specific vessels and ports used; (2) the final construction schedule; and (3) the installation and transportation methods employed, which continue to evolve rapidly and will vary based on the final project design. The estimated number of vessels and vessel trips presented below, which are based on current understanding of a potential construction schedule, are likely conservative and subject to change.

Assuming the maximum design scenario (see Section 1.5), it is estimated that an average of ~22 vessels would operate at the Lease Area or along the OECC at any given time during offshore construction. During the most active period of construction, it is conservatively estimated that a maximum of approximately 60 vessels could operate in the Offshore

Development Area at one time.[83] Up to approximately 2,200 total vessel round trips from ports are expected to occur during the busiest year of offshore construction. During the most active month of construction, it is anticipated that an average of approximately 12 daily vessel round trips from ports could occur.

During the busiest year of O&M, an average of approximately nine vessels are anticipated to operate in the Offshore Development Area at any given time, although additional vessels may be required during certain maintenance or repair activities. Based on the maximum design scenario, approximately 575 vessel round trips from ports are estimated to take place annually during O&M. However, these estimates are highly dependent on the logistics approach used during O&M, the location of the O&M facilities, the timing and frequency of activities, and the final design of the offshore facilities. All vessels used during the operation of Vineyard Mid-Atlantic will be equipped with AIS to track vessel activity and monitor compliance with permit requirements.

The Proponent has identified several ports in New York, New Jersey, Connecticut, Rhode Island, Massachusetts, Maryland, South Carolina, and Canada that may be used to stage offshore components (see Table 3.10-1 and Figure 3.10-1 of COP Volume I). Only a subset of the ports described in Table 3.10-1 of COP Volume I would ultimately be used. These staging ports could be used for frequent crew transfer and to offload, store, pre-assemble, inspect, pre-commission, and/or load components onto vessels for delivery to the Lease Area and OECC.[84] The Proponent expects most vessel activity during operations to be based out of one or more of the ports listed in Table 4.4-1 of COP Volume I. See Sections 3.10.1 and 4.4.1 of COP Volume I for a complete list of ports that may be used for construction and O&M activities. Vessel operations and frequency may increase near the port facilities during construction, O&M, and decommissioning. Vessel and port utilization will be highest during construction and decommissioning. Also, the use of larger vessels will be more prevalent during the installation phase. The potential ports and surrounding waterways are expected to have the capacity for the potential increase in vessel traffic during all Vineyard Mid-Atlantic-related activities. Further, the Proponent has defined a wide range of port facilities, which will allow use of the most appropriate port facilities for a given activity, including consideration of the capacity of a port to accommodate the planned vessel traffic.

To minimize effects to existing maritime activities, the Proponent employs a Marine Liaison Officer who is responsible for safe marine operations and ensuring that the Proponent is a good neighbor while on the water. The Marine Liaison Officer currently serves as the Proponent's point of contact for all external maritime agencies, partners, and stakeholders, including USCG, US Navy, port authorities, state and local law enforcement, and commercial

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[83] This includes vessels at the Lease Area, at the OECC, and in transit to, from, or within a port.

[84] Some components (e.g., monopiles) may instead be pulled by tugs while floating in the water rather than loaded onto vessels.

operators (e.g., ferry, tourist vessels, and other offshore wind developers). The Marine Liaison Officer is also a member of New York State Energy Research and Development Authority's (NYSERDA's) Maritime Technical Working Group (M-TWG). There is frequent interaction, information exchange, and coordination between the Marine Liaison Officer and the fisheries team regarding fisheries outreach.

During construction, the Proponent expects to employ a dedicated Marine Coordinator to manage construction vessel logistics and implement communication protocols with external vessels at ports and offshore. During construction, the Marine Coordinator will be the primary point of contact with external maritime agencies, partners, and stakeholders for day-to-day offshore operations. The Marine Coordinator will use tools such as radio communications and safety vessels to address vessels entering active work sites. The safety vessels would provide guidance to mariners and fishing vessels, explain the ongoing activities, and request that they give a wide berth to the work site or construction vessel(s), if necessary. These safety vessels would have no enforcement authority; the safety vessels would only assist mariners in navigating in the vicinity of the activity.

As described below, the Proponent will inform mariners of construction and certain maintenance activities, including the anticipated locations of those activities, allowing vessels to alter their navigation routes if needed to avoid affected areas. Some of the measures to minimize effects to mariners include:

- The Marine Liaison Officer will issue Offshore Wind Mariner Updates to notify maritime stakeholders of the Proponent's offshore activities. The Offshore Wind Mariner Updates will include a description of the planned activity, pictures of the vessel(s) and equipment to be deployed, a chart showing the location of the activity, vessel contact information, and the Proponent's Onboard Fisheries Liaisons' contact information (if applicable). Depending on the activity, the Offshore Wind Mariner Update may request that mariners give a wide berth to the work site or construction and maintenance vessel(s). These updates are published on the Proponent's website, social media channels, and sent via email and SMS text alert to those who have opted-in to receive notifications from the Proponent.

- The Proponent distributes a weekly email to consolidate and recirculate active Offshore Wind Mariner Updates in order to help mariners and fishermen keep track of the various notifications that they receive.

- The Proponent also coordinates with the USCG to issue Notices to Mariners (NTMs) to notify recreational and commercial vessels of their planned offshore activities.

- To help ensure safety within the vicinity of active work areas, the Proponent may request that the USCG establish temporary safety zones, per 33 CFR Part 147, that extend 500 m (1,640 ft) around each wind turbine generator (WTG) and electrical service platform (ESP) during construction and certain maintenance activities (see Section 8.4 of COP Volume I for additional details). The safety zones would be limited in size and duration and would not affect the entire Lease Area at any given time.

5.6.2.2 Presence of Structures

The presence of structures, including the WTGs, ESP(s), and offshore cable system may affect vessel traffic, search and rescue (SAR) activities, marine radar and communications, and other activities.

General Navigation Effects

General navigation effects from the presence of structures could occur during the later stages of construction as WTGs and ESP(s) are installed and could continue until the structures are removed during decommissioning. During O&M, the Lease Area and OECC will be open to marine traffic, other than any temporary safety zones established by USCG during limited maintenance activities in the Lease Area. As described in the NSRA (see Appendix II-G), the Lease Area is not generally subject to dense traffic, which limits the scale of potential navigational effects.

As proposed, the WTGs and ESP(s) will be oriented in west-northwest to east-southeast rows and north-to-south columns with 0.68 NM (1.3 km) spacing between positions (see Figure 5.6-8). [85,86] This 0.68 x 0.68 NM WTG/ESP layout provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512 (where the Empire Wind projects will be installed), in accordance with the stipulations in Lease OCS-A 0544. As described in Section 2.1 of Appendix II-G, this arrangement also creates north-south navigation paths with a width of 0.66 NM (1.2 km), diagonal navigation paths in the northwest-southeast direction with a width of 0.66 NM (1.2 km), and diagonal navigation paths in the southwest-northeast direction with a width of 0.53 NM (0.98 km). The 0.66 NM (1.2 km) navigation paths would accommodate all of the existing AIS-equipped fishing fleet and 99.8% of the AIS-equipped recreational vessels, with an assumed 50 m (164 ft) buffer around the WTGs. For the minimum 0.53 NM (1.0 km) southwest-northeast navigation paths, depending on the assumed buffers around the WTGs (0 m or 50 m [164 ft]), between 96.5% and 98.8% of recreational vessels and 100% of the fishing vessels could transit through the navigation paths based on the navigation paths width analysis in Appendix II-G.

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85 Six WTG/ESP positions along the northwestern boundary of Lease Area OCS-A 0544 are contingent upon the final layout of the neighboring Empire Wind 2 project. Vineyard Mid-Atlantic will not develop these contingent WTG/ESP positions if the final Empire Wind 2 layout includes WTGs at immediately adjacent positions within Lease Area OCS-A 0512.

86 Where necessary, WTGs and ESP(s) may be micro-sited by a maximum of 152 m (500 ft) to avoid unfavorable seabed conditions, maintain facilities within the Lease Area boundaries, and/or for other unexpected circumstances.

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

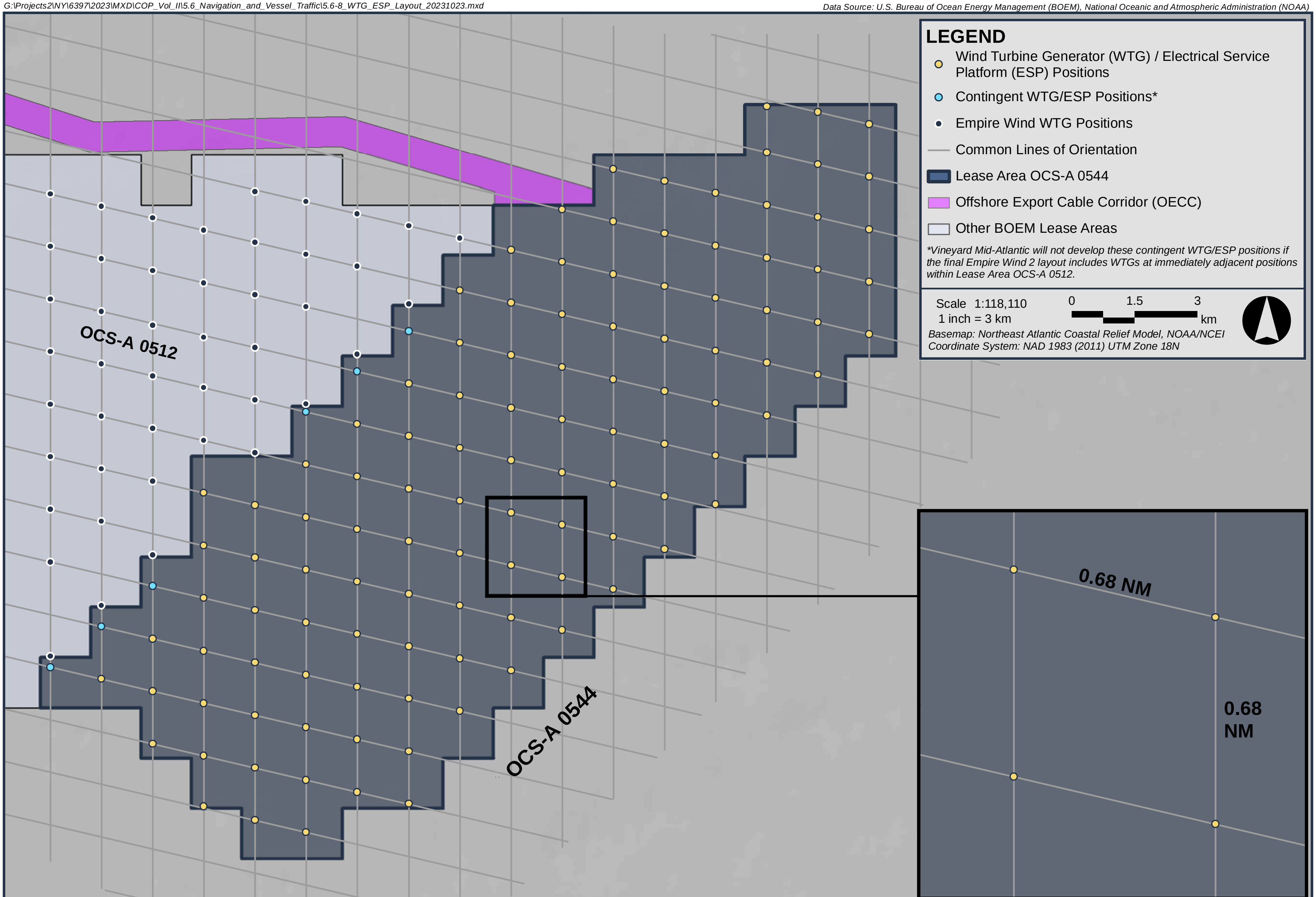

Figure 5.6-8
WTG/ESP Layout

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

It is anticipated that larger commercial vessels (e.g., cargo, tanker, passenger, and tug tow vessels) may navigate around the Lease Area toward and along shipping routes rather than through the Lease Area. While rerouting around the Lease Area may add to transit time for these vessels, the increase in duration is estimated to be less than 11 minutes to the overall journey time based on the average vessel speed.

Sailboat excursions will need to consider the presence of offshore facilities in the Lease Area. Large sailing craft transiting in this region with mast heights that exceed the maximum allowable air draft (i.e., the maximum distance from the water line to the highest point on the vessel) should take this into account and may elect to travel around the Lease Area rather than through it. The minimum blade tip clearance is 27 m (89 ft) relative to Mean Lower Low Water (MLLW). Highest Astronomical Tide (HAT) is 2.02 m (6.63 ft) above MLLW. Therefore, the maximum allowable vessel air draft, when allowing for a 1.5 m (5 ft) safety margin, is approximately 23.4 m (77 ft). This air draft assumes calm conditions; the presence of waves will reduce the air draft further. The Proponent will provide information on the air draft restrictions in the Lease Area to the USCG and NOAA so that these restrictions can be identified by means of NTMs, in the Coast Pilots, and on navigational charts. Note that sailing vessels are at little risk of interacting with the WTGs under normal conditions.

To aid marine navigation, the WTGs, ESP(s), and their foundations will be equipped with marine navigation lighting, marking, and signaling in accordance with USCG and Bureau of Ocean Energy Management (BOEM) guidance. Each WTG and ESP will be maintained as a PATON. Based on USCG current guidance, the Proponent expects the lighting, marking, and signaling scheme of the offshore facilities to include the following:

- Unique alphanumeric identifiers will be displayed on the WTGs, ESP(s), and/or their foundations to aid mariners and aviators in determining their location within the Lease Area (see Appendix I-A1 of COP Volume I).[87] For the WTGs, the alphanumeric identifiers will be on the tower, nacelle, and potentially the foundation. The alphanumeric identifiers on the WTG tower will be as close to 3 m (10 ft) high as possible and will be visible from all directions. The alphanumeric identifiers on the ESP(s) will be as close to 3 m (10 ft) high as possible and will be visible from all directions.
- The WTG's air draft restriction will be indicated directly on the WTG foundation and/or tower and will be visible in all directions.
- Each foundation will be coated with high-visibility yellow paint above sea level.

[87] The final alphanumeric identification scheme will be determined in consultation with USCG.

- Each structure will include yellow flashing lights that are visible in all directions at a distance of 3.7 to 9.5 km (2 to 5 NM).[88] The intensity of the lights will depend on the location of the structure within the Lease Area.

- Mariner Radio Activated Sound Signals (MRASS) will be located on select foundations.

- AIS will be used to mark the WTGs and ESP(s) (virtually or using physical transponders).

The Proponent will work with the USCG, BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) to determine the appropriate marine lighting, marking, and signaling scheme for the proposed offshore facilities, including the number, location, and type of AIS transponders and MRASS. The Proponent expects to provide a lighting, marking, and signaling plan to BOEM, BSEE, and USCG prior to construction of the offshore facilities. Additional information on marine navigation lighting, marking, and signaling can be found in the NSRA (see Appendix II-G).

Collisions and Allisions

The frequency of collisions and allisions of marine vessels may be influenced by increased vessel traffic associated with Vineyard Mid-Atlantic and the presence of new offshore structures (e.g., WTGs, ESPs, etc.). The Proponent conducted a quantitative risk assessment for existing conditions and post-construction within the Lease Area using Baird's proprietary Navigational and Operational Risk Model (NORM). The model utilizes raw AIS data, wind, current, and visibility data as inputs along with the geometric layout and Vineyard Mid-Atlantic-specific dimensions of the WTGs and ESPs. The results of the model show that the overall risk for potential marine accidents is relatively low for both pre-construction and post-construction conditions, and that the bulk of the risk is for fishing and cargo vessels. The risk of a potential accident changes from an average of one in every 219 years (pre-construction) to one in every 127 years (post-construction) and is primarily attributed to O&M traffic and allisions with WTGs, which translates to one additional accident every 250 years. A cumulative post-construction scenario, which included neighboring Lease Area OCS-A 0512, was also modeled using NORM. See the NSRA in Appendix II-G for a detailed assessment of the risk of collision and allision due to Vineyard Mid-Atlantic.

The Proponent will minimize the risk of collisions and allisions by following mitigation measures to aid mariners navigating within and near the Lease Area, including marking and lighting all structures in accordance with BOEM and USCG guidelines, maintaining each WTG and ESP position as a PATON, using AIS to mark each WTG and ESP, including unique alphanumeric

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[88] The approximate maximum height of the marine navigation lights above water is equal to the maximum height of the foundation (including the transition piece) above water, which is provided in Table 3.3 1 of COP Volume I.

identification on each foundation, providing lights on each foundation that are visible in all directions, and including sound signals on select foundations. The Proponent will continue to coordinate with BOEM and USCG on measures to maintain safe navigation.

Marine Radar and Communications Effects

Marine radar is an electromagnetic system used for the detection of ships and obstacles at sea, which provides the operator with an estimate of the distance and bearing to any object. Studies have been conducted to evaluate concerns that the WTGs may affect some shipborne radar systems, potentially creating false targets on the radar display or causing vessels navigating within the Lease Area to become "hidden" on radar systems due to shadowing created by the WTGs. WTGs can also mask or shadow weaker signal returns from smaller objects within a turbine field (Angulo et al. 2014). The effectiveness of radar systems and any effects from WTGs will vary from vessel to vessel based on several factors, including radar equipment type, settings, and installation (including location of placement on the vessel). As identified in previous studies of this issue in Europe (BWEA 2007), the potential effects of WTGs may be reduced through adjustment of the gain setting on the radar.

The USCG's (2020) Massachusetts and Rhode Island Port Access Route Study (MARIPARS) reviewed several studies on the relationship between offshore renewable energy installations and marine radar interference. After reviewing these studies, the USCG concluded that, "To date, the USCG is not aware of an authoritative scientific study that confirms or refutes the concern that WTGs will degrade marine radar." According to the MARIPARS, United Kingdom studies show that, "additional mitigation measures, such as properly trained radar operators, properly installed and adjusted equipment, marked wind turbines and the use of AIS, enable safe navigation with minimal loss of radar detection."

In recognition of the concerns associated with potential radar system impacts from offshore wind development, the Wind Turbine Radar Interference (WTRIM) Working Group has been established with the support of a number of agency and partners including BOEM, the Department of Energy, the Department of Defense, the Federal Aviation Administration (FAA), NOAA, and the Department of Homeland Security. The purpose of this working group is to mitigate the technical and operational impacts of wind turbine projects on critical radar missions. The goal is to develop near- (5-year), mid- (10-year), and long-term (20-year) mitigation solution recommendations, recognizing that these will be primarily technology driven. In 2022, the National Academy of Sciences, Engineering, and Medicine published the *Wind Turbine Generator Impacts to Marine Vessel Radar* (NASEM 2022), which provides a comprehensive overview of marine radar impacts and lays out potential mitigation measures as well as providing recommendations for future work.

Vineyard Mid-Atlantic, as with many other similar facilities around the world, may have an impact on certain marine radar systems. The principal issue appears to be the shadow effect and the detection of vessels that are located within the wind turbine field. The issue of radar clutter and false targets when navigating outside the wind turbine field, as will occur south and east of the Lease Area, is common to wind farms in Europe, some of which are located adjacent to heavily used shipping channels. Vessels safely navigate outside these wind farms despite the radar impacts. The lighting and marking of the WTGs and ESP(s), as well as the use of AIS and MRASS as per USCG requirements will help mitigate potential allision risk due to the presence of Vineyard Mid-Atlantic offshore facilities. Mitigation for radar impacts (if needed) as well as communications consistency measures are expected to be based on regional efforts. Further, it is expected that mariners in the region will "adopt both technological and non-technology-based measures to reduce impacts on marine radar, including greater use of AIS and electronic charting systems, new technologies like Light detection and Ranging (LiDAR), employing more watchstanders, and simply avoiding wind farms altogether " (BOEM 2023).

Based on a review of various studies, the Vineyard Mid-Atlantic WTGs are expected to have little impact on very high frequency (VHF) communications or AIS reception. Additional information on marine radar and communications effects can be found in the NSRA (see Appendix II-G).

Search and Rescue Effects

Using vessel and helicopter assets, the USCG conducts SAR missions for incidents including vessels capsizing, disabled vessels, vessels taking on water, and persons in water. A review of an approximately 10.5-year period (January 2014 through July 2024) of historical USCG SAR data for an area within a 20 NM (37 km) buffer around the Lease Area documented that there were 11 incidents within or immediately adjacent (within 1.9 km [1 NM]) to the Lease Area. Of the 226 reported SAR incidents within the 37 km (20 NM) range around the Lease Area, approximately half of the incidents occurred in the summer months of June through August, with an average of 21.5 incidents per year. There was one reported collision in the Lease Area vicinity (see Appendix II-G).

The WTG spacing and minimum tip clearance of the blades is not expected to affect the operation of USCG marine assets (or commercial salvors' vessels) that are in use in the area. It is expected that these marine assets will be able to safely navigate and maneuver adequately within the Lease Area. Given the WTG spacing and relative size, the Proponent anticipates that Vineyard Mid-Atlantic will not affect travel times to and within the Lease Area by vessels responding to SAR distress calls; however, search patterns may need to be altered to account for presence of structures.

Vineyard Mid-Atlantic may facilitate SAR operations as the WTGs and ESP(s) will be marked and lighted and Vineyard Mid-Atlantic vessels will operate frequently within the Lease Area. Alphanumeric markings on the WTGs may also aid mariners in reporting their position during distress calls. The Proponent will work with the USCG and the Department of Defense (DoD) to develop an operational protocol that outlines the procedures for the braking system on requested Vineyard Mid-Atlantic WTGs to be engaged within a specified time upon request from the USCG or DoD during SAR operations and other emergency response situations. The formal shutdown procedure will be described in the Proponent's Emergency Response Plan (see Section 6.1 of COP Volume I) and will be tested on a regular basis.

If the ESP(s) include a helipad, the helipad will be designed to accommodate USCG rescue helicopters. Enabling USCG helicopters to land on the ESP(s) could allow for more efficient responses to potential emergency situations within and outside the Lease Area. The Proponent is also evaluating the use of cameras on WTGs and/or ESP(s), which may aid in the detection of distressed mariners and enhance the USCG's ability to respond in emergency situations. Additional information on SAR operations and mitigations are discussed in the NSRA (see Appendix II-G).

Other Marine Transportation Effects

Other potential effects on marine transportation associated with the WTGs, ESP(s), offshore cable system, and other components include anchoring risk, potential impacts to existing aids to navigation, attraction of more fishing activity to the Lease Area, and potential increased tour vessel traffic.

The presence of offshore cables within the Lease Area is not anticipated to interfere with any typical anchoring practices. There are no designated anchoring areas in proximity to the Lease Area and the Ambrose Anchorage is located approximately 1.5 km (0.81 NM) south of the OECC. The offshore cables will have a target burial depth beneath the stable seafloor of 1.2 m (4 ft) in federal waters and 1.8 m (6 ft)[89] in state waters. The target burial depth is at least twice the burial depth required to protect the cables from fishing activities and also generally provides a maximum of 1 in 100,000 year probability of anchor strike, which is considered a negligible risk.

As described in Section 5.6.1.1, there are no Federal ATONs or PATONs in the Lease Area besides Vineyard Mid-Atlantic's own metocean buoy. The Proponent will engage with the USCG early in the permitting process and coordinate closely to address the ATON in proximity to the OECC (within 500 m [1,640 ft] of the edge of the OECC). This ATON will be avoided and, if needed, the Proponent will micro-site the offshore export cables (within the OECC) around the ATON in accordance with USCG's Minimum Safe Distance requirements.[90]

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89 Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

90 USCG defines the Minimum Safe Distance (MSD) as greater than or equal to the Position Tolerance (PT) + Chain Length (CL) + Length of Servicing Vessel (LSV) (+ shoaling consideration). The specific inputs for the ATON would be obtained from USCG.

The presence of structures in the Lease Area may become an attraction for fishing. The foundations may create an artificial reef effect which could cause fish aggregation (see Sections 5.3 Recreation and Tourism and 5.4 Commercial Fisheries and For-Hire Recreational Fishing). This in turn could result in an increase in certain types of commercial and recreational fishing in the Lease Area.

5.6.2.3 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to navigation and vessel traffic during Vineyard Mid-Atlantic are summarized below:

- Utilize a Marine Coordinator to manage all construction vessel logistics and implement marine communication protocols and a Marine Liaison Officer who will act as the strategic maritime liaison between Vineyard Mid-Atlantic's internal parties and all external maritime partners and stakeholders.

- Provide Offshore Wind Mariner Updates and coordinate with the USCG regarding the issuance of NTMs advising other vessel operators of Vineyard Mid-Atlantic's activities.

- Regularly provide updates as to the locations of installed WTGs and ESP(s) to the USCG and NOAA for use in navigational charts.

- Light and mark the WTGs, ESP(s), and their foundations in accordance with USCG and BOEM requirements. Each structure will be marked with a unique alphanumeric identifier to aid in visual confirmation of vessel location. Each WTG and ESP will be maintained as a PATON per the requirements of the USCG.

- Use of a consistent layout will allow recreational and fishing vessels to continue to operate along three consistent headings (and their reciprocal courses) through the Lease Area. This 0.68 x 0.68 NM WTG/ESP layout also provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512 (where the Empire Wind projects will be installed), in accordance with the stipulations in Lease OCS-A 0544.

- Provide temporary lighting and marking on foundation structures as they are built, depending on the sequence and timing of construction.

- Include an aviation obstruction lighting system on the WTGs and ESP(s) (if they exceed a height of 60.96 m [200 ft] above Mean Sea Level or any obstruction standard contained in 14 CFR Part 77) in compliance with FAA and BOEM requirements.

- Require all Vineyard Mid-Atlantic construction vessels and equipment to display required navigation lighting and day shapes.

- Work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested Vineyard Mid-Atlantic WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations.

- Coordinate with the USCG to identify ways for Vineyard Mid-Atlantic to support SAR efforts, which may include the use of cameras on WTGs and/or ESP(s) to aid in the detection of distressed mariners.

- Design the helipads on the ESP(s), if present, to accommodate USCG rescue helicopters.

- Engage with the USCG early in the permitting process and coordinate closely to address the ATON in proximity to the OECC. This ATON will be avoided and, if needed, the Proponent will micro-site the offshore export cables (within the OECC) around the ATON in accordance with USCG's Minimum Safe Distance requirements.

- Request that the USCG establish temporary safety zones, per 33 CFR Part 147, that extend 500 m (1,640 ft) around each WTG and ESP during construction and certain maintenance activities to help ensure safety within the vicinity of active work areas.

- When feasible, deploy one or more safety vessels to monitor vessel traffic approaching the construction areas.

- Include MRASS and AIS transponders in the design of the offshore facilities to enhance safety; the number, location, and type of these items will be determined in coordination with the USCG.

5.7 Aviation, Military, and Radar Uses

This section addresses the potential impacts of Vineyard Mid-Atlantic on aviation, military, and radar uses in the Onshore Development Area and Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to aviation, military, and radar uses during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

Appendix II-H includes the aviation and radar studies conducted for Vineyard Mid-Atlantic.

5.7.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The description of the affected environment is informed by the following studies included in Appendix II-H:

- Obstruction Evaluation and Airspace Analysis
- Air Traffic Flow Analysis
- Radar and Navigational Aid Screening Study

5.7.1.1 Aviation and Military Uses

Aviation Airspace

Territorial airspace is airspace over the United States (US), its territories and possessions, and over US territorial waters out to 22 kilometers (km) (14 miles [mi]) from the coast. The Lease Area is located approximately 38 km (24 mi) from Fire Island, which is outside territorial airspace. 14 CFR Part 77 applies to all structures within US territorial airspace. 14 CFR Part 77.9 requires that all structures exceeding 61.0 meters (m) (200 feet [ft]) above ground level (AGL) be submitted to the Federal Aviation Administration (FAA) so that an aeronautical study can be conducted. For the portions of a project that lie outside of US territorial airspace and in Bureau of Ocean Energy Management (BOEM) jurisdiction, BOEM will consult with the FAA for airspace impacts.

An Obstruction Evaluation and Airspace Analysis (OE/AA) was completed for the proposed Vineyard Mid-Atlantic wind turbine generators (WTGs) (see Appendix II-H). The OE/AA determined proximity to airports, published instrument procedures, enroute airways, FAA minimum vectoring altitude and minimum instrument flight rules (IFR) altitude charts, as well as military airspace and training routes. The OE/AA also evaluated all 14 CFR Part 77 imaginary surfaces, published instrument approach and departure procedures, visual flight rules operations, FAA minimum vectoring altitudes, minimum IFR altitudes, and enroute operations.

The closest public airports in proximity to Vineyard Mid-Atlantic include:

- Bayport Aerodrome (23N)
- Republic Airport (FRG)
- Monmouth Executive Airport (BLM)
- John F Kennedy International Airport (JFK)

- LaGuardia Airport (LGA)
- New York Skyports Inc (6N7)
- Downtown Manhattan/Wall Street Heliport (JRB)
- East 34th Street Heliport (6N5)
- West 30th St (JRA)

Additional private-use airports are also present on the south coast of New York and east coast of New Jersey, as shown on Figure 1 of the OE/AA in Appendix II-H.

The OE/AA identified two obstacle clearance surfaces overlying Vineyard Mid-Atlantic that may require increases for the proposed WTGs. These obstacle clearance surfaces are associated with the minimum obstruction clearance altitude (MOCA) of the enroute airway T320-MANTA to BEADS and the minimum vectoring altitude (MVA) of the New York (N90) Terminal Radar Approach Control (TRACON), The two obstacle clearance surfaces are shown in relation to the Lease Area in Figures 9 and 10 of the OE/AA in Appendix II-H.

It is noted that, although the Lease Area is outside territorial airspace, portions of the OECC, portions of the vessel routes between port facilities and the Lease Area, and the port facilities themselves are within territorial airspace.

Military Airspace and Training Areas

The US Navy has a significant presence along the US northeastern seaboard. Several naval facilities located in the broader region may conduct training or operations within the Offshore Development Area.

The US Navy maintains three range complexes located along the mid-Atlantic and northeastern seaboard of the US. A range complex is a designated set of specifically bounded geographic areas where training and testing of military platforms, tactics, munitions, explosives, and electronic warfare systems occur. They include established Operating Areas (OPAREAs) and special use airspace, which may be further divided to provide better control of an area and events being conducted for safety reasons. The Lease Area is located within the Narragansett Bay Range Complex and Narragansett Bay OPAREA (see Figure 5.7-1). This OPAREA is a surface and subsurface exercise/operating area, extending approximately 185 km (100 nautical miles [NM]) south and 407 km (220 NM) east of the coasts of Massachusetts, Rhode Island, and New York. Submarine Transit Lanes, which are transit corridors where submarines may navigate underwater, are also located within the broader region but are outside of the Lease Area.

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

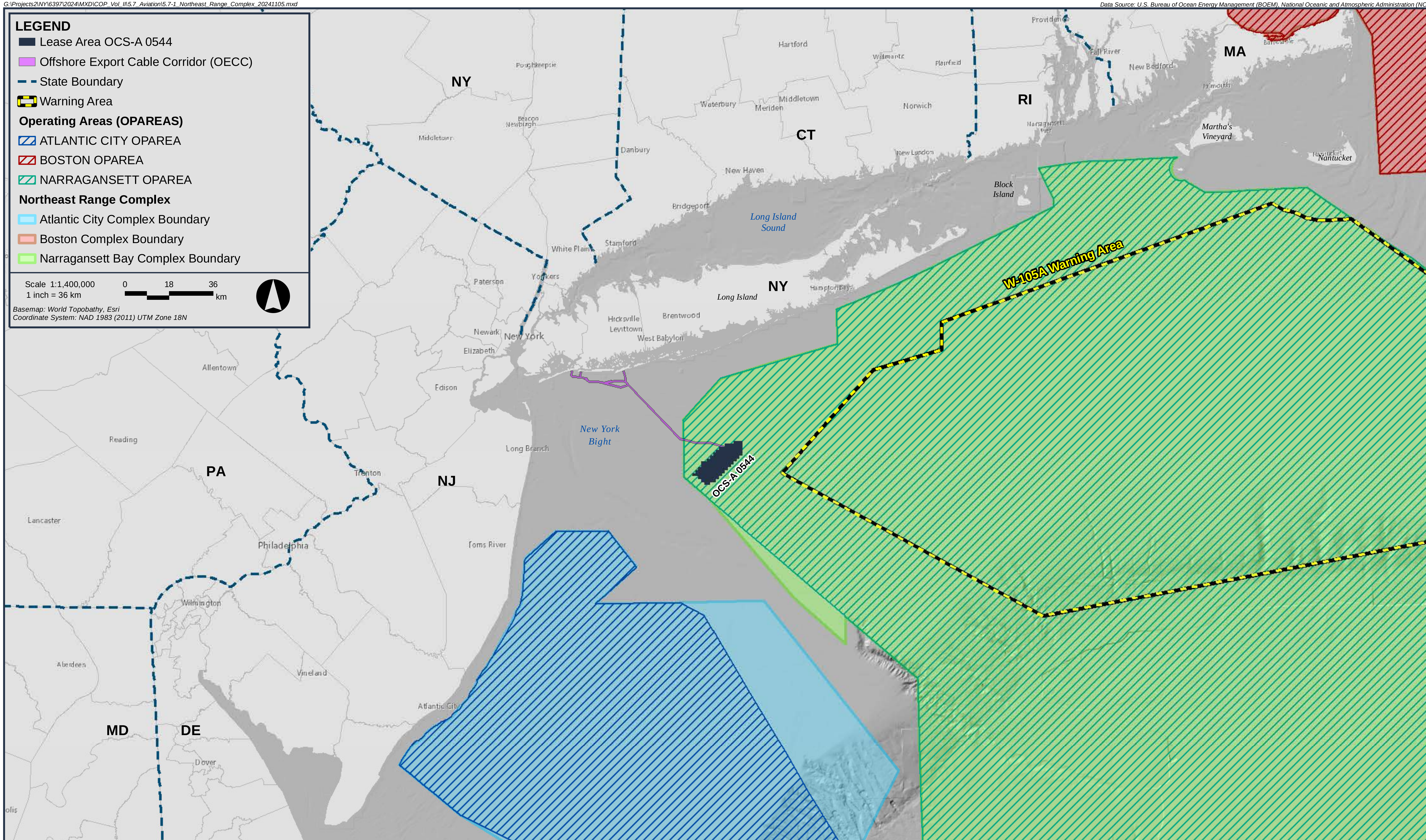

Figure 5.7-1
Military and Airspace Uses

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Additionally, the US Navy and/or Air Force use the airspace over and adjacent to the Lease Area. The DoD uses domestic and international airspace for readiness training and exercises. To make “nonparticipating pilots” aware of military operations, the FAA designates sectors of airspace as Warning Areas and charts these areas on aeronautical charts with an identifying number. Within Warning Area airspace, limitations may be imposed on aircraft not participating in military operations. Warning Area 106 (W-106) is a special-use airspace over the Narragansett Bay OPAREA that is used for US Navy subsurface and surface training and testing activities. The Lease Area is located within both W-106A and W-106B, which are blocks of airspace ranging from 0–914.4 m (0–3,000 ft) above mean sea level (AMSL) and 0-2,438.4 m (0-8,000) AMSL, respectively. The Lease Area is also located within the 92.6 km (50 NM) low-altitude tactical navigation (LATN) buffer from Gabreski Air Force National Guard Base, which has a minimum altitude of 91 m (300 ft) AGL.

United States Coast Guard

The US Coast Guard (USCG) 1st District is headquartered in Boston, Massachusetts and is responsible for USCG activities in Northern New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, and Maine (USCG 2022a). The USCG 5th District, headquartered in Portsmouth, Virginia, maintains maritime safety and security of 404,038 square kilometers (km^2) (156,000 square miles [mi^2]) of navigable waterways in the Mid-Atlantic Region, from South Carolina to New Jersey (USCG 2022b). Each district is further divided into sectors.

The Lease Area and OECC are located within Sector Long Island Sound and Sector New York (see Figure 5.7-2). Sector Long Island Sound is responsible for an area that covers Long Island Sound from the New York-Connecticut border to the Connecticut-Rhode Island border and extends 370 km (200 NM) out to sea. Sector Long Island Sound includes the entire Connecticut coastline as well as the northern and southern coastlines of Long Island. Sector New York is responsible for an area that spans from Sandy Hook, New Jersey, north through the port of New York/New Jersey, up the Hudson River to just south of Lake Champlain, and up the East River to the Long Island Sound/Connecticut border and extends 370 km (200 NM) out to sea.

Air Station Atlantic City, the closest of the three USCG Aviation Facility to the Lease Area in the Mid-Atlantic, is located at Atlantic City International Airport. Air Station Atlantic City provides search and rescue (SAR) operations, maritime law enforcement, port security, and marine environmental protection.

Additionally, vessels transiting to and from potential ports in New York, New Jersey, Connecticut, Rhode Island, Massachusetts, Maryland, and South Carolina may pass through Sector Boston, Sector Southeastern New England, Sector Long Island Sound, Sector New York, Sector Delaware Bay, Sector Maryland, Sector Virgina, and Sector North Carolina (see Figure 5.7-2).

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

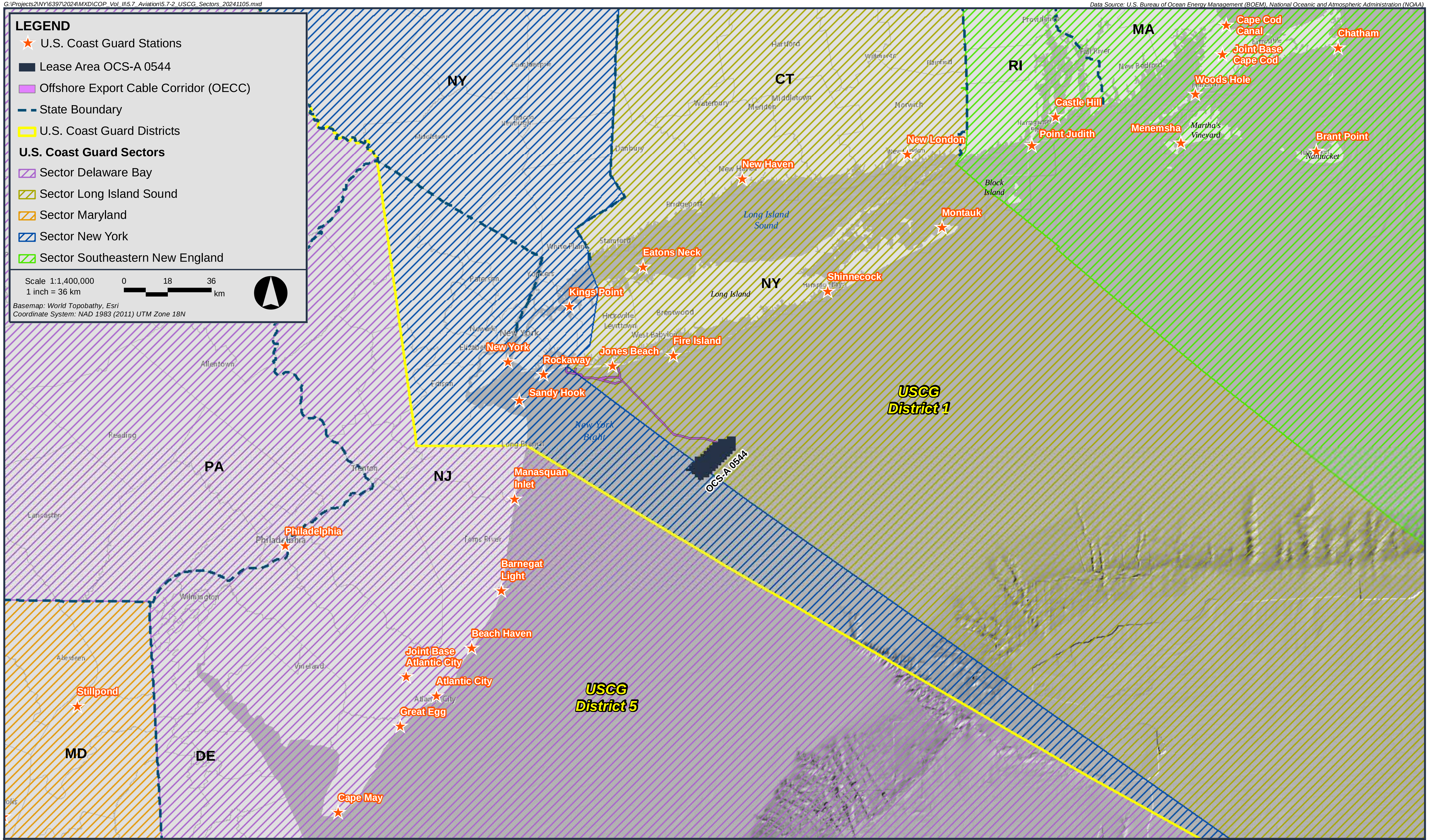

Figure 5.7-2

U.S. Coast Guard Sectors

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

5.7.1.2 Radar Uses

Different types of radar sites are present within the Onshore Development Area and Offshore Development Area (see Figure 5.7-3).

Air Route Surveillance Radar and Airport Surveillance Radar

The following 10 air route surveillance radar (ARSR) and airport surveillance radar (ASR) sites are located in the vicinity of Vineyard Mid-Atlantic:

- Atlantic City Airport Surveillance Radar-9 (ASR-9)
- Gibbsboro Air Route Surveillance Radar-4 (ARSR-4)
- Islip ASR-9
- McGuire Air Force Base (AFB) Digital Airport Surveillance Radar (DASR)
- Naval Air Station (NAS) Willow Grove Airport Surveillance Radar-11 (ASR-11)
- New York ASR-9
- Newark ASR-9
- Philadelphia ASR-9
- Riverhead ARSR-4
- White Plains ASR-4

The DoD uses these radar sites for air defense at the North American Aerospace Defense Command, and the Department of Homeland Security (DHS) uses these radar sites for homeland security at the Air and Marine Operations Center. In addition, the DoD uses the McGuire AFB DASR for air traffic control at the McGuire AFB Radar Approach Control facility.

The FAA uses the Atlantic City ASR-9, the Gibbsboro ARSR-4, the Islip ASR-9, the NAS Willow Grove ASR-11, the New York ASR-9, the Newark ASR-9, the Philadelphia ASR-9, the Riverhead ARSR-4, and the White Plains ASR-9 radar sites for air traffic control at multiple facilities, including the Atlantic City TRACON, the New York Air Route Traffic Control Center, the New York TRACON, and the Philadelphia TRACON.

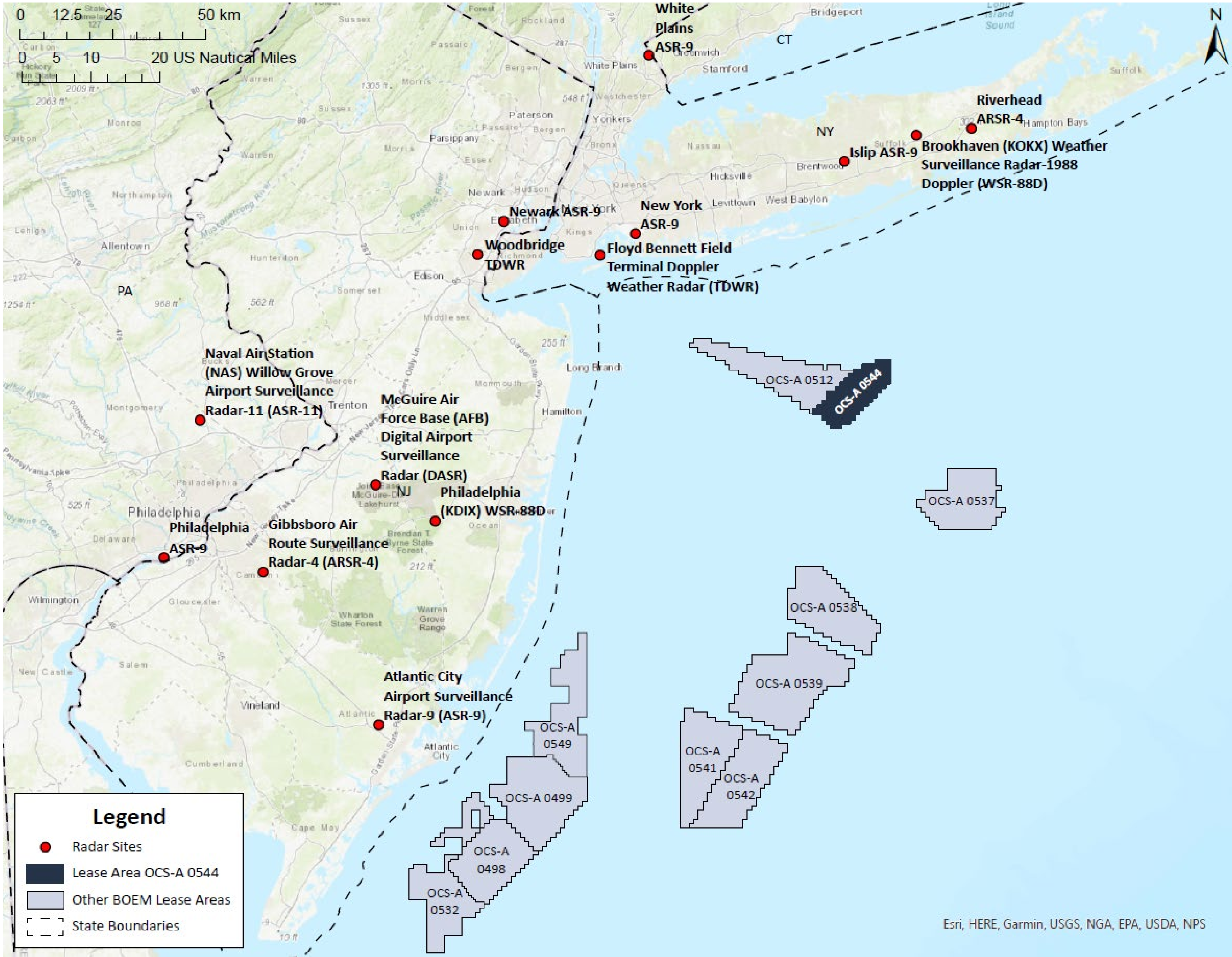

Figure 5.7-3
Radar Sites

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

Co-Located Secondary Surveillance Radar

The following secondary surveillance radar systems co-located with the ARSR and ASR systems are located in the vicinity of Vineyard Mid-Atlantic:

- An Air Traffic Control Beacon Interrogator-5 is co-located with the Atlantic City ASR-9
- An Air Traffic Control Beacon Interrogator-6 is co-located with the Gibbsboro ARSR-4 and the Riverhead ARSR-4.
- A Mode S is co-located with the Islip ASR-9, the New York ASR-9, the Newark ASR-9, the Philadelphia ASR-9, and the White Plains ASR-9.
- A Monopulse Secondary Surveillance Radar is co-located with the McGuire AFB DASR and the NAS Willow Grove ASR-11.

In general, secondary surveillance radar systems are less susceptible to interference from WTGs than primary surveillance radar systems, such as the ARSR and ASR systems.

Terminal Doppler Weather Radar (TDWR)

The following two TDWR sites are located in the vicinity of Vineyard Mid-Atlantic:

- Floyd Bennet Field TDWR
- Woodbridge TDWR

The FAA uses these radar sites for air traffic control at the New York TRACON. In addition, the National Weather Service (NWS), part of the National Oceanic and Atmospheric Administration (NOAA), uses these radar sites for weather operations at the New York Weather Forecast Office (WFO).

Weather Surveillance Radar-1988 Doppler (WSR-88D) Sites

The following two WSR-88D sites are located in the vicinity of Vineyard Mid-Atlantic:

- Brookhaven WSR-88D
- Philadelphia WSR-88D

The NWS uses these radar sites for weather operations at multiple facilities, including the New York WFO and the Philadelphia/Mount Holly WFO. In addition, the DoD may use these radar sites for weather operations.

Coastal High Frequency (HF) Radar

The following 10 HF radar sites are located in the vicinity of Vineyard Mid-Atlantic:

- Amagansett HF radar
- Block Island Long Range HF radar
- Bradley Beach Long Range HF radar
- Brigantine Long Range HF radar
- Hempstead HF radar
- Loveladies HF radar
- Moriches HF radar
- Sandy Hook HF radar
- Sea Bright HF radar
- Seaside Park HF radar

These HF radar sites are operated by Rutgers University. In partnership with the NOAA Integrated Ocean Observing System (IOOS), various federal agencies use the ocean surface current and wave data provided by these HF radar sites in support of multiple missions.

5.7.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect aviation, military, and radar uses during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.7-1.

Table 5.7-1 Impact Producing Factors for Aviation, Military, and Radar Uses

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Presence of Structures	•	•	•
Vessel Activity	•	•	•

Potential effects to aviation, military, and radar uses were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore and onshore facilities as described in Section 1.5.

5.7.2.1 Presence of Structures

The presence of structures, such as WTGs, may cause radar effects or clutter including a partial loss of primary target detection and false targets within the vicinity of offshore wind projects. Such effects could occur during the later stages of construction as WTGs are installed and could continue until WTGs are removed during decommissioning. A radar line-of-sight study was conducted to evaluate effects to the various radar systems (see Appendix II-H). Additionally, the presence of structures may affect obstacle clearance surfaces considered by the FAA and may influence military activities where WTGs are located within W-106A and W-106B.

Radar Systems

Air Route Surveillance Radar (ARSR) and Airport Surveillance Radar (ASR)

For the 10 identified ARSR and ASR radar sites:

- Vineyard Mid-Atlantic WTGs are beyond the instrumented range of the Atlantic City ASR-9, the McGuire AFB DASR, the NAS Willow Grove ASR-11, and the Philadelphia ASR-9.
- Vineyard Mid-Atlantic WTGs are beyond the radar line-of-sight for the Gibbsboro ARSR-4 and the Newark ASR-9.
- Vineyard Mid-Atlantic WTGs are within the radar line-of-sight for the Islip ASR-9, the New York ASR-9, the Riverhead ARSR-4, and the White Plains ASR-9.

For the Islip ASR-9, the New York ASR-9, and the White Plains ASR-9, the radar site uses adaptive processing techniques to self-optimize the radar settings such that separate mitigation may not be required. Mitigation may be required for the Riverhead ARSR-4. Mitigation options include optimization (referred to as Radar Adverse-impact Mitigation) to minimize false primary targets and maximize primary target detection. The Proponent is consulting with the DoD through the Military Aviation and Installation Assurance Siting Clearinghouse (DoD Siting Clearinghouse) process to understand potential impacts to radar systems and develop appropriate mitigation measures, as needed.

Co-Located Secondary Surveillance Radar

In general, secondary surveillance radar systems are less susceptible to interference from WTGs than primary surveillance radar systems, such as the ARSR and ASR systems. It is not expected that WTGs will affect the secondary surveillance radar systems co-located with the Islip ASR-9, the New York ASR-9, the Riverhead ARSR-4, or the White Plains ASR-9.

Terminal Doppler Weather Radar (TDWR)

Vineyard Mid-Atlantic WTGs are beyond the instrumented range of Woodbridge TDWR, so no effects are expected. Vineyard Mid-Atlantic WTGs will not penetrate any of the elevation angles scanned by the Floyd Bennett Field TDWR, so no effects are expected.

Weather Surveillance Radar-1988 Doppler (WSR-88D) Sites

The next generation weather radar (NEXRAD) screening analysis for the Philadelphia WSR-88D shows that all Vineyard Mid-Atlantic WTGs will fall within a no-impact zone and are not expected to interfere with this radar site. The analysis for the Brookhaven WSR-88D shows that 27 of the 118 proposed Vineyard Mid-Atlantic WTGs will fall within a notification zone and the remaining 91 proposed WTG locations will fall within a no-impact zone. The Proponent will consult with the NWS through the National Telecommunications and Information Administration (NTIA) (the NTIA is essentially a clearinghouse for other federal agencies, including NOAA) review process and the DoD through the DoD Siting Clearinghouse process to understand potential impacts to radar systems and develop appropriate mitigation measures, as needed. It is expected that NWS will likely state low impacts to WFO operations.

Coastal High Frequency (HF) Radar

Of the ten identified HF radar sites, some or all of Vineyard Mid-Atlantic's WTGs are within line-of-sight of six of these HF radars. Where the WTGs are within line-of-sight, potential effects may include clutter in the vicinity of the WTGs (Trockel et. al 2021). While less likely, clutter in the vicinity of WTGs beyond line-of-sight may also occur due to the propagation of HF electromagnetic waves over the ocean surface. As noted above, the USCG has integrated HF radar data into its SAR planning systems. Thus, any potential impact on these identified HF radar sites may impact the USCG's ability to conduct SAR operations (see the Navigation Safety Risk Assessment provided as Appendix II-G for additional details).

Potential mitigation options include implementation of a software package to address interference and/or installation of other current or wave sensors in the Lease Area (Trockel et. al 2021). The Proponent will consult with the DoD Siting Clearinghouse for an informal review, with the USCG, with the NTIA, and with NOAA's IOOS Program Office regarding potential effects to HF radar sites.

Military Airspace and Training Areas

The Lease Area is located within both W-106A and W-106B, which are special-use airspaces over the Narragansett Bay OPAREA. These areas are designated for aircraft operations that could potentially be hazardous to uninvolved aircraft. Additionally, the US Air Force operates out of the Gabreski Air Force National Guard Base which has an associated 50 NM LATN buffer zone surface at 91 m (300 ft) AGL. The Proponent recognizes that such military training and airspace use occurs in the vicinity of the Lease Area and will continue to coordinate with the DoD Siting Clearinghouse to understand potential impacts and develop appropriate mitigation measures, as needed.

Obstacle Clearance Surfaces

An increase to the enroute airway T320-MANTA to BEADS global navigation satellite system (GNSS) MOCA from 396 to 671 m (1,300 to 2,200 ft) is expected to be required. A review of flight track data, as described in the Air Traffic Flow Analysis included in Appendix II-H, determined as many as 75 flights (1.44 per week) operate along the affected segment of this enroute airway at altitudes that will be affected by the 355m (1,165 ft) WTGs. An increase to the GNSS MOCA may be acceptable to the FAA given that the GNSS minimum enroute altitude (MEA) is 762 m (2,500 ft) and the Lease Area is located more than 22 km (12 NM) offshore. Additionally, an increase to New York (N90) TRACON Sector L MVA from 610 to 671 m (2,000 to 2,200 ft) could be required throughout the Lease Area. However, the flight track data indicated that only one flight (0.02 per week) operated in the affected airspace which is below the FAA threshold for a significant volume of IFR operations (one per week). Given the low number of operations and that the Lease Area is located more than 22 km (12 NM) offshore, an increase to the TRACON Sector L MVA may be acceptable to the FAA. The Proponent will continue to coordinate with the FAA on potential impacts, necessary filings, and appropriate minimization and mitigation measures.

5.7.2.2 Vessel Activity and Activities at Construction Staging Areas

While all Vineyard Mid-Atlantic WTGs are outside territorial airspace, No Hazard Determinations from the FAA may be required for activities at construction staging areas and vessel transits based on proximity to airport runways and whether certain imaginary surface heights are exceeded. As the development of Vineyard Mid-Atlantic progresses, the Proponent will continue to evaluate potential vessel transit routes and the heights of components being transported and will file a request for a No Hazard Determination with the FAA as necessary.

5.7.2.3 Summary of Avoidance, Minimization, and Mitigation Measures

The Proponent's proposed measures to avoid, minimize, and mitigate potential effects to aviation, military, and radar uses during Vineyard Mid-Atlantic are summarized below:

- The Proponent is consulting with the DoD Siting Clearinghouse to understand potential impacts to military uses (airspace and training areas) and radar systems and develop appropriate mitigation measures as needed.

- The Proponent will continue to coordinate with the FAA on potential impacts, necessary authorizations (for potential increases to obstacle clearance surfaces, activities at construction staging areas, and vessel transits), and appropriate minimization and mitigation measures.

- The Proponent will consult with BOEM, USCG, the NTIA, and with NOAA's IOOS Program Office on potential effects to HF radar sites.

5.8 Other Marine Uses

This section addresses the potential impacts of Vineyard Mid-Atlantic on other marine uses in the Offshore Development Area. An overview of the affected environment is provided first, followed by a discussion of impact producing factors (IPFs) and the Proponent's proposed measures to avoid, minimize, and mitigate potential effects to other marine uses during the construction, operation, and decommissioning of Vineyard Mid-Atlantic.

The state and federal waters associated with the Offshore Development Area support a myriad of marine-based uses. This section addresses sand and mineral resources, offshore energy, cables and pipelines, and scientific research and surveys occurring within or adjacent to the Offshore Development Area. Marine uses associated with recreation and tourism, commercial fisheries and for-hire recreational fishing, navigation and vessel traffic, and aviation and military uses are addressed in Sections 5.3, 5.4, 5.6, and 5.7, respectively. Oil and gas operations are not expected to be proposed within the Offshore Development Area and will not be considered further at this time.

5.8.1 Description of Affected Environment

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities.

The following section is based on state and federal agency correspondence and publications, online databases, maps, and portals, including the following:

- Bureau of Ocean Energy Management (BOEM) Renewable Energy State Activities (BOEM 2020)
- BOEM's Marine Minerals Information System (MMIS)
- United States Army Corps of Engineers (USACE) sand borrow areas
- National Oceanic and Atmospheric Administration's (NOAA) Raster Navigational Charts
- New Jersey Geologic and Water Survey (NJGWS) information on sand resource areas (NJGWS 2019)
- NOAA Northeast Fisheries Science Center (NEFSC) information on fisheries surveys (NOAA Fisheries 2022)

5.8.1.1 *Sand and Mineral Resources and Ocean Disposal Sites*

Sand and mineral resources can be used for coastal resilience and restoration projects to protect coastal communities from coastal storm damage or other effects associated with climate change-induced sea level rise. BOEM funded offshore surveys between 2015–2017 as part of the Atlantic Sand Assessment Project to identify new sources of sand in federal waters approximately 5.5–15 kilometers (km) (3–8 nautical miles [NM]) offshore.

BOEM's Marine Minerals Program (MMP) has developed Outer Continental Shelf (OCS) block aliquots (1/16th of OCS protraction grid blocks) that contain identified sand resources and areas of sediment disposal under their management (BOEM 2023; see Figure 5.8-1). These aliquots are used during the planning process for entities to reference when inquiring about specific resources within their areas of interest. BOEM MMP also maintains Federal OCS Sand and Gravel Borrow Areas (Lease Areas), which are areas where entities that have entered into or have requested a Negotiated Non-Competitive Lease or Memorandum of Agreement with BOEM can dredge sand, gravel or shell resources from the OCS (BOEM 2023; Figure 5.8-1). The Federal OCS Sand and Gravel Borrow Areas are categorized as complete, active, proposed, or expired. BOEM MMP also identifies Sand Resource Areas, delineations of areas in the OCS where there is some likelihood that a usable sand resource exists (BOEM 2023). The sand resource areas have been identified and characterized during governmental reconnaissance- and design-level studies where various geological (e.g., sediment cores, sediment profile images, etc.) and geophysical (e.g., high-resolution swath bathymetry, side-scan sonar, seismic reflection profiles, magnetometer surveys) data were collected in OCS focus areas. These areas are categorized as proven, potential, unverified, and unusable (see Figure 5.8-1).

A review of BOEM's MMIS indicates that no marine mineral lease areas (complete, active, proposed, or expired) are intersected by the Lease Area or OECC (BOEM 2023). The nearest marine mineral lease area, which is categorized as "complete," is located offshore New Jersey approximately 92 km (57 miles [mi]) from the Lease Area and 98 km (61 mi) from the OECC (BOEM 2023). There are no identified Sand Resource Areas located in the Lease Area; however, a small portion of the OECC overlaps potential and unverified sand resource areas (see Figure 5.8-1). Potential areas are those where existence of sand resources has been verified through sufficient geotechnical and geophysical data; however, thickness and/or lateral extent has not been fully determined. Unverified areas are those hypothesized to exist on the basis of indirect evidence (seismic profiles, bathymetry, or sidescan sonar); however inferred sediment types, unit thicknesses and lateral extents have not been confirmed through direct sampling methods (BOEM 2023). The nearest proven sand resource is located approximately 1.4 km (0.8 mi) from the OECC and approximately 50 km (31 mi) from the Lease Area (see Figure 5.8-1). The USACE New York District has also identified several sand borrow areas as active (see Figure 5.8-1). None of these directly overlap the Offshore Development Area, with the closest one being the Long Island Sand Borrow Area, approximately 1.4 km (0.8 mi) from the Western Landfall Sites OECC Variant (see Figure 5.8-1).

Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

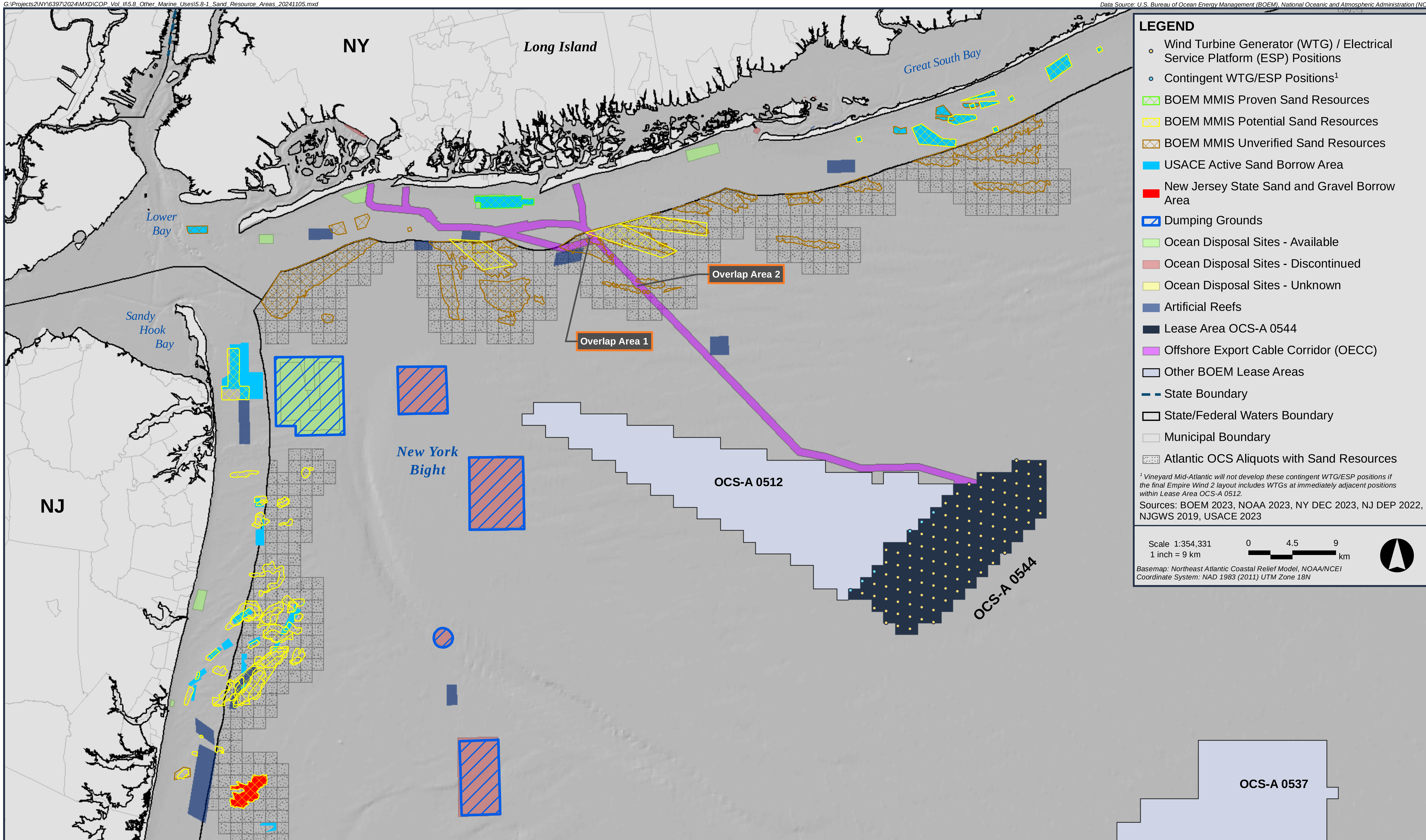

Figure 5.8-1
Mapped Sand Resource Areas

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

To further aid in the assessment of the overlap of the OECC with potential and unverified sand resources, BOEM MMP conducted a generalized analysis to approximate the volume of OCS sand that may become inaccessible within an overlapping 500 meter [m] (1,640 foot [ft]) buffer zone with the centerline of the OECC. Based on a 1.5 m (5 ft) sand thickness, the volume of potential and unverified OCS sand resources that may become inaccessible due to this overlap is 662,600 cubic meters (m^3) (8,666,450 cubic yards [yd^3]) in the area where the main OECC and Western Landfall Sites OECC Variant converge (see Overlap Area 1 in Figure 5.8-1) and 871,784 m^3 (1,140,250 yd^3) farther offshore along the main OECC (see Overlap Area 2 in Figure 5.8-1). All potential and unverified sand resources that may become inaccessible are located in federal waters. According to BOEM MMP, the highly variable thickness and lithology of the surficial sediment (see Appendix II-B) combined with the unresolved contribution of oblique shoreface-attached sand ridges to the coastal sediment budget in this region cause the potential OCS sand resources in the overlap area with the OECC to be an undesirable source material for future beach nourishments (BOEM 2024).

The states of New York and New Jersey have designated additional sand resource areas to help restore coastal erosion and damage that resulted from Superstorm Sandy (BOEM 2014, NJGWS 2019). Sand resource areas are delineated areas in the OCS where there is some likelihood that a usable sand resource exists due to the identification by a survey or study; however, it does not indicate there are direct plans to use these resources at present. The closest sand resource area designated by New York and New Jersey is located off the coast of Mantoloking, New Jersey as shown in Figure 5.8-1.

As discussed further in Section 2.8 of COP Volume I, the siting of the OECC took into consideration multiple constraints that the developer must navigate to avoid; thus, it was challenging to avoid all of the sand borrow areas. For instance, multiple agencies (e.g., United States Coast Guard (USCG), New York Department of State [NYSDOS]) recommended routing cables as far east from the proposed Ambrose Anchorage as possible to minimize the risk of anchor strikes, given that vessels have historically anchored east of the proposed anchorage area (and will likely continue doing so). Taking these constraints into consideration, OECC was sited to avoid active and proposed USACE sand borrow areas by at least 500 m (1,640 ft). Careful consideration was taken to avoid the sand borrow areas to the greatest extent feasible and only a trivial overlap exists.

The Marine Protection, Research, and Sanctuaries Act (MPRSA) authorizes the United States Environmental Protection Agency (EPA) to designate areas for ocean dumping and requires sites selected in locations that mitigate adverse impacts to the greatest extent practicable. EPA bases the designation of an ocean disposal site on environmental studies of a proposed site, environmental studies of regions adjacent to the site, and historical knowledge of the impact of disposal on areas similar to the sites in physical, chemical and biological characteristics (EPA 2022). As noted in Section 2.8 of COP Volume I, the OECC was sited to avoid the ocean disposal sites (dredged material disposal sites). None of the ocean disposal sites intersect the Lease Area or OECC with the nearest available ocean disposal site on the western edge of the

Rockaway Beach Approach (see Figure 5.8-1). While the OECC avoids most artificial reefs in the area (see Figure 5.8-1), there is a minimal area of overlap between the OECC and the Hempstead Reef, an established site located to the south of the Western Landfall Sites OECC Variant, and between the OECC and the proposed Sixteen Fathom Reef (see Section 6.2.1.2 of Appendix II-B). For the Hempstead Reef, less than 1% of the reef's total area (or 0.02 square kilometers [0.008 square miles]) overlaps with the OECC and the Proponent expects to site export cables outside of the area of overlap. While the Sixteen Fathom Reef has not yet been constructed (NYSDEC 2023), the Proponent would site export cables outside any potential area of overlap.

5.8.1.2 Offshore Energy

As mentioned earlier, the Lease Area is one of six New York Bight Lease Areas identified by BOEM, following a public process and environmental review, as suitable for offshore wind energy development. Lease Area OCS-A 0544 abuts Lease Area OCS-A 0512, where the Empire Wind 1 and Empire Wind 2 projects (collectively, the "Empire Wind projects") will be installed. BOEM has also leased four other areas in the New Jersey Wind Energy Area (NJ WEA) to Atlantic Shores, LLC (a joint venture between EDF Renewables and Shell) and Ocean Wind, LLC (Ørsted). The closest project in the Massachusetts Wind Energy Area (MA WEA) is Lease Area OCS-A 0487, Sunrise Wind, with a proposed export cable route located 28 mi (45 km) to the northeast of the Lease Area OCS-A 0544. Therefore, as of January 2024, the following developments are planned within the vicinity of Vineyard Mid-Atlantic:

- Empire Wind LLC, OCS-A 0512
- Sunrise Wind, OCS-A 0487
- Bluepoint Wind, OCS-A 0537
- Attentive Energy, OCS-A 0538
- Community Offshore Wind, OCS-A 0539
- Atlantic Shores Offshore Wind Bight, OCS-A 0541
- Invenergy Wind Offshore LLC, OCS-A 0542
- Atlantic Shores North, OCS-A 0549
- Atlantic Shores South, OCS-A 0499
- Ocean Wind LLC, OCS-A 0498
- Ørsted North America, OCS-A 0532

Nearby lease areas and publicly available offshore export cable corridors are shown on Figure 5.8-2.

5.8.1.3 Cables and Pipelines

Known cables and pipelines are mapped on NOAA's Raster Navigational Charts and shown on Figure 5.8-3. The offshore export cables will need to cross existing and proposed submarine cables and pipelines. Depending on the landfall site approach(es) that are used, each Vineyard Mid-Atlantic offshore export cable may cross the offshore export cables proposed for Empire Wind 2 (up to three cables crossed once), the Neptune power cable bundle, the Fiber-Optic Link Around the Globe (FLAG) Atlantic South telecommunication cable (one or two crossings), the WALL-LI fiber optic cable, the Transco natural gas pipeline, several inactive telegraph cables, and multiple cables of unknown type. To account for future cable projects that may be developed as well as unmapped infrastructure that may be identified during offshore surveys, the Proponent conservatively estimates that there will be up to 18–32 cable crossings for each High Voltage Alternating Current (HVAC) cable/High Voltage Direct Current (HVDC) cable bundle, depending on the landfall site approach(es). The cable crossings will be designed to minimize the risk of snagging fishing equipment.

For active, in-service cables and pipelines, the design of each crossing, as well as any survey at the crossing, will be defined, planned, executed, evaluated, and documented in agreement with the cable's or pipeline's owner. More information about cable crossings is provided in Section 3.5.6 of COP Volume I.

If an existing cable is inactive/abandoned, it may alternatively be cut and removed prior to installing the Proponent's cables.

5.8.1.4 Scientific Research

A number of stakeholders conduct scientific research and studies in the vicinity of the Offshore Development Area. These include, but are not limited to, state and federal agencies, non-governmental environmental organizations, and educational institutions.

NOAA's NEFSC collects data during regularly scheduled research vessel trawl surveys. The NEFSC has research facilities in Connecticut, Maine, Massachusetts, New Jersey, and Rhode Island to cover the Northeast Continental Shelf Ecosystem from the Gulf of Maine to Cape Hatteras in North Carolina. The NEFSC conducts over 20 studies regularly and is split into four divisions for research: ecosystems and aquaculture, fishery monitoring and research, population and ecosystems monitoring and analysis, and resource evaluation and assessment.

Further, in the fall of 2017, the New York Department of Environmental Conservation (NYSDEC) and the School of Marine and Atmospheric Sciences (SoMAS) at Stony Brook University began an ocean monitoring project, the NYSDEC Ocean Trawl Survey, to collect physical, chemical, G:\Projects2\NY\6397\2024\MXD\COP_Vol_II\5.8_Other_Marine_Uses\5.8-2_Other_Offshore_Wind_Projects_20241105.mxd

Data Source: U.S. Bureau of Ocean Energy Management (BOEM)

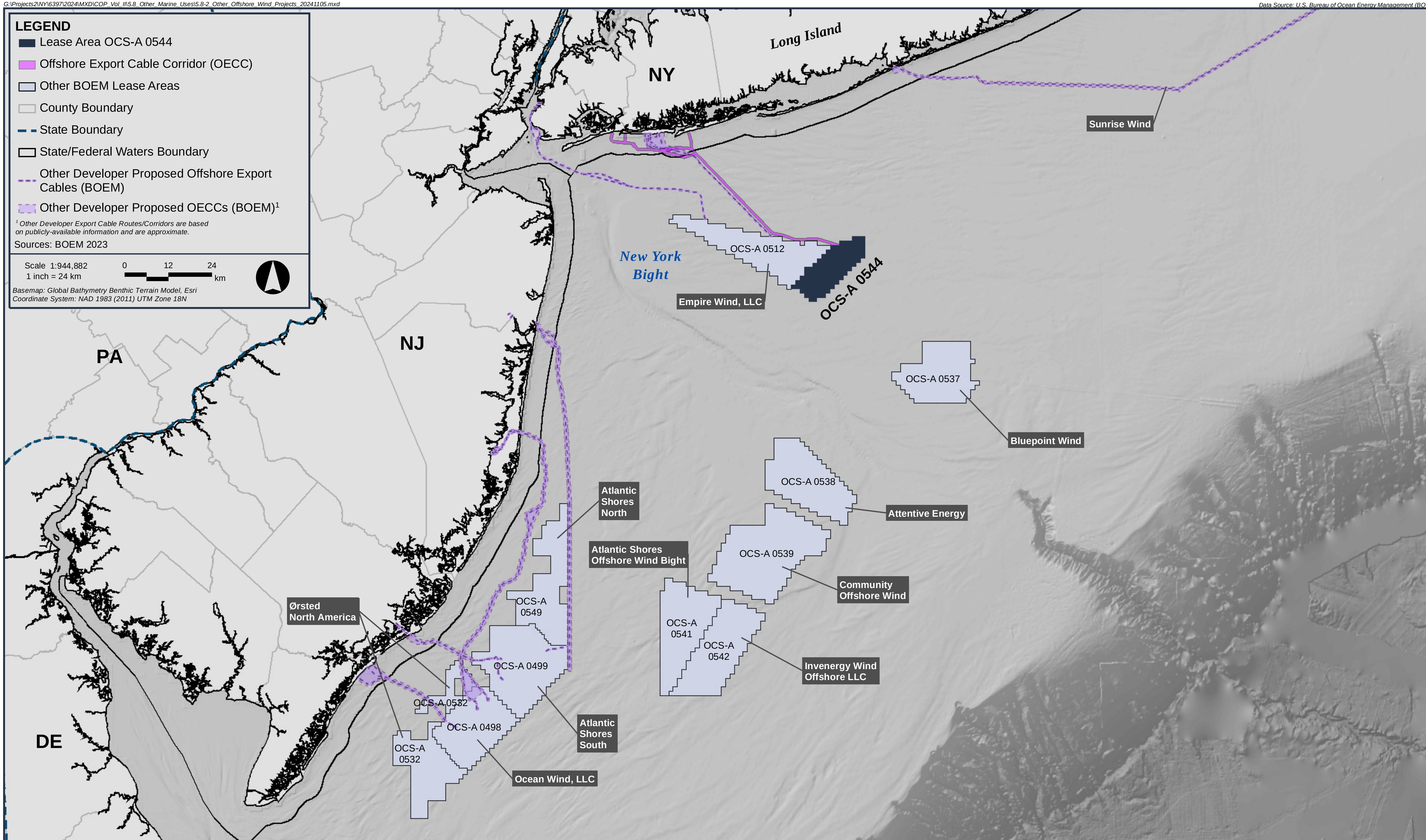

Figure 5.8-2

Other Offshore Wind Energy Projects

VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

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Data Source: U.S. Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA)

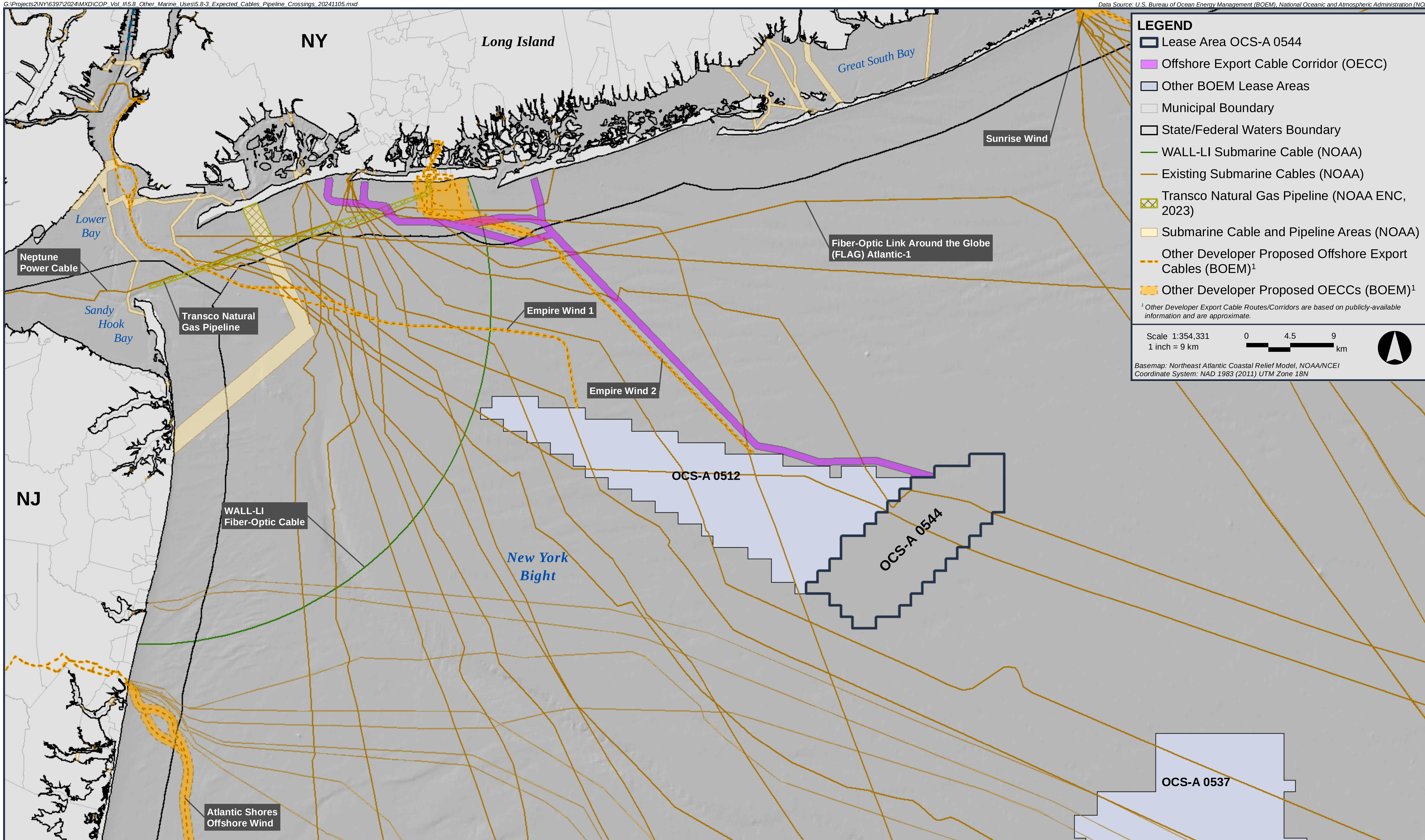

Figure 5.8-3
Expected Cable and Pipeline Crossings

VINEYARD MID-ATLANTIC
VINEYARD OFFSHORE

and biological data from adult and subadult finfish and macroinvertebrates in nearshore waters (up to 30 m [98 ft]). This is a ten-year survey that samples within the Atlantic Ocean from Breezy Point, New York to Block Island Sound year-round and tags adult striped bass in the fall as they migrate through marine waters. These surveys may occur in the same geographical areas as the Lease Area and OECC (NYSDEC and SoMAS 2021).

In addition to these, other surveys that may occur in the Offshore Development Area include, but are not limited to, the following:

- NorthEast Area Monitoring and Assessment Program (NEAMAP) Trawl Survey
- NEFSC Ecological Monitoring (EcoMon) Survey
- Atlantic Marine Assessment Program for Protected Species surveys (Phase II occurred 2015–2019; has been renewed another 5 years)
- NEFSC Surf clam and Ocean Quahog Survey, shellfish surveys, groundfish surveys, and ecosystems surveys
- Surveys associated with and conducted by the Proponent within the Lease Area
- Surveys completed by other offshore wind developers within their respective lease areas

5.8.2 Potential Impacts and Proposed Avoidance, Minimization, and Mitigation Measures

The potential IPFs that may affect other marine uses during the construction, operations and maintenance (O&M), and/or decommissioning of Vineyard Mid-Atlantic are presented in Table 5.8-1.

Table 5.8-1 Impact Producing Factors for Other Marine Uses

Impact Producing Factors	Construction	Operations & Maintenance	Decommissioning
Vessel Activity	•	•	•
Presence of Cables and Structures		•	

Potential effects to other marine uses were assessed using the maximum design scenario for Vineyard Mid-Atlantic's offshore facilities as described in Section 1.5.

5.8.2.1 Vessel and Aircraft Activity

Construction, O&M, and decommissioning activities will cause increased vessel activity within the Offshore Development Area. Vessel activity is discussed in further detail in Section 5.6 Navigation and Vessel Traffic. Vessel activity for decommissioning activities is anticipated to be similar to construction needs. In addition to marine vessels, helicopters may be used for crew transfer and visual inspections of the offshore facilities. Fixed-wing aircraft or drones (autonomous underwater/surface vessels or aerial drones) may be used to support environmental monitoring and mitigation (see Section 3.10.4 of COP Volume I). The Proponent will manage vessel and aircraft activities to minimize disruptions and impacts to the maximum extent practicable.

A Navigation Safety Risk Assessment (NSRA; see Appendix II-G) was conducted and identified potential hazards to navigation as well as measures to mitigate potential risk. Vessels associated with other marine uses could experience localized disruption due to vessel traffic associated with Vineyard Mid-Atlantic activities. Non-regulatory temporary safety buffer zones may be established around work areas during construction, maintenance, or decommissioning activities. Temporary safety buffer zones are used to help ensure safety within the vicinity of active work areas. These zones would only affect discrete portions of the Offshore Development Area at any given time. The Proponent may employ safety vessels to provide guidance to mariners and fishing vessels, explain the ongoing activities, and request that they remain outside the temporary safety buffer zone. Vineyard Mid-Atlantic vessels operating in the Offshore Development Area may temporarily limit other vessel activities within the immediate vicinity or require other vessels to slightly alter their routes to avoid Vineyard Mid-Atlantic activities. Vessel traffic associated with Vineyard Mid-Atlantic is not anticipated to represent a significant increase over the current levels of vessel traffic within the Offshore Development Area (see Appendix II-G).

Lastly, construction, maintenance, and decommissioning activities associated with Vineyard Mid-Atlantic may impact other offshore wind projects in terms of access to port facilities, vessels, and/or construction equipment. As described in Section 3.10.1 of COP Volume I, the Proponent has identified several ports in New York, New Jersey, Connecticut, Rhode Island, Massachusetts, Maryland, South Carolina, and Canada that may be used during construction to state offshore components and/or that be the site of a manufacturing facility. The Proponent plans to coordinate with port facilities and other developers to avoid conflicts.

The Proponent expects to use one or more onshore O&M facilities, which are anticipated to be located at or near any of the ports identified in Section 4.4 of COP Volume I. Port use during O&M would not be exclusive to Vineyard Mid-Atlantic and would allow for other activities. In addition to the O&M facilities, the Proponent may lease space at an airport hangar in reasonable proximity to the Lease Area for aircraft (e.g., helicopters) used to support operations (see Section 4.4.2 of COP Volume I).

5.8.2.2 Presence of Cables and Structures

Within the Offshore Development Area, the presence of installed cables and structures may affect vessel traffic for other marine uses and may influence the siting of future marine infrastructure (navigation impacts are further described in Section 5.6). BOEM considered other marine uses during the siting of the New York Bight Lease Areas and conducted a public process and environmental review prior to designating the New York Bight Lease Areas, which includes Lease Area OCS-A 0544, as suitable for offshore wind energy development. Additionally, recognizing the importance of other marine users in the area, the Proponent has conducted extensive coordination with various agencies and stakeholders to present Vineyard Mid-Atlantic and the various options considered for siting the OECC. As described further in Section 2 of COP Volume I, throughout the OECC routing process, the Proponent consulted with numerous federal and state agencies, including BOEM, National Marine Fisheries Management (NMFS), USACE, USCG, New York State Office of Parks, Recreation and Historical Preservation (NYSOPRHP), and the NYSDOS, as well as stakeholders (including fishermen). Mapped resources published or provided by BOEM, NOAA, USACE, United States Geological Survey (USGS), and NYSDEC, among others, were considered in the routing process. Further, characteristics such as cable route length, water depths and geologic conditions, sensitive habitats, existing and proposed offshore infrastructure, cultural resources, socioeconomic resources, vessel traffic and vessel routing measures, and other constraints were considered. The OECC routing process was designed to minimize any potential conflicts with other marine users and is detailed in Section 2.8 of COP Volume I.

Sand and Mineral Resources

As discussed in Section 2.8 of COP Volume I, while a limited portion of the OECC transverses unverified sand resource areas, it was selected because it follows the proposed Empire Wind 2 submarine export cable route and is farther from the proposed Ambrose Anchorage. Multiple agencies (e.g., USCG, NYSDOS) recommended routing cables as far east from the proposed Ambrose Anchorage as possible to minimize the risk of anchor strikes. Additionally, while the polygon areas currently identified as sand resources by BOEM's Marine Minerals Program are all the potential areas that could be resources on the OCS, it is possible that not all of them will be used for many years with additional work on resource evaluation and delineation still needed. As noted above, BOEM MMP stated that the potential OCS sand resources in the overlap area with the OECC are an undesirable source material for future beach nourishments (BOEM 2024). Finally, it should also be noted that future decommissioning of any cables in sand resources areas would reinstate the areas for use.

Offshore Energy and Cables and Pipelines

As noted in Section 5.8.1.2, a number of offshore wind projects are planned for offshore New York, New Jersey, and Massachusetts with different construction timelines that will likely overlap with Vineyard Mid-Atlantic's timeline. Vineyard Mid-Atlantic's cable routes and interconnection points may impact the planned or future siting of other offshore wind projects.

However, due to coordination with other developers, spatial and/or temporal conflicts are expected to be avoided or minimized. Further, the Proponent has identified a range of port options along the East Coast and Canada that would be suitable to support construction thereby providing flexibility in the event another offshore wind project should require a specific port at a given time. Moreover, the Proponent designed Vineyard Mid-Atlantic in conformance with the Proponent's Commercial Lease of Submerged Lands for Renewable Energy Development, such that no activities are proposed that will unreasonably interfere with or endanger activities or operations carried out under any lease or grant issues or maintained pursuant to the Outer Continental Shelf Lands Act.

As noted in Section 5.8.1.3, Vineyard Mid-Atlantic cables within the OECC may cross cables associated with Empire Wind 2, the Neptune power cable bundle, the FLAG Atlantic South telecommunication cable, the WALL-LI fiber optic cable, the Transco natural gas pipeline, several inactive telegraph cables, and multiple unknown cables. The Proponent is coordinating with other developers on the siting of its OECC and will coordinate on any required cable crossings. If needed, it is expected that any future-installed cables would be able to cross Vineyard Mid-Atlantic's offshore export cables using standard cable crossing techniques.

Scientific Research

Construction of Vineyard Mid-Atlantic may temporarily alter transit routes for research and survey vessels in the Lease Area and along the OECC to avoid installation activities. Low altitude aerial surveys may also need to alter routes to avoid wind turbine generators (WTGs). The Proponent will continue to coordinate with appropriate parties throughout the construction and installation phase and will coordinate with the USCG to provide Notices to Mariners that describe relevant Vineyard Mid-Atlantic-related activities.

As stated above, proposed offshore wind energy development may impact NEFSC surveys. However, this is not unique to Vineyard Mid-Atlantic with any of the other projects proposed from Massachusetts to North Carolina, such as the New York Bight Lease Areas, Empire Wind projects, the lease areas within the MA WEA and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), and the lease areas in the NJ WEA, may impact NEFSC surveys given their scope. Within the Lease Area, the WTGs and electrical service platforms (ESPs) will be in a uniform grid pattern with west-northwest to east-southeast rows, north to south columns, and 0.68 NM (1.3 km) spacing between positions. This 0.68 x 0.68 NM WTG/ESP layout provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512 (where the Empire Wind projects will be installed), in accordance with the stipulations in Lease OCS-A 0544. As described in Empire's Construction and Operations Plan (COP) and in Section 2.3 of COP Volume I, the layout of Lease Area OCS-A 0512 was designed through engagement with regulatory agencies and maritime stakeholders to incorporate west-northwest and east-southeast rows (aligned with bathymetry) that are sympathetic to the dominant trawl directions of most active and potential impacted fisheries.

In December 2022, BOEM and NOAA released their joint Federal Survey Mitigation Strategy for the Northeast US Region (Hare et al. 2022). The Federal Survey Mitigation Strategy describes the approach NOAA Fisheries and BOEM will use to mitigate the impacts of offshore wind energy development on NOAA Fisheries surveys (from Maine to North Carolina) and is intended to guide the implementation of the Northeast Federal Survey Mitigation Program. The Proponent will continue to work with BOEM, NOAA Fisheries, academic institutions, and other fisheries stakeholders to support the implementation of a mitigation strategy.

5.8.2.3 Summary of Avoidance, Minimization, and Mitigation Measures

The majority of potential impacts to other marine uses were considered during the planning and design phase and, as such, the Proponent has taken steps to avoid, minimize, and mitigate impacts during construction, O&M, and decommissioning. The Proponent's proposed measures to avoid, minimize, and mitigate potential impacts to other marine uses during Vineyard Mid-Atlantic are summarized below:

- Offshore structures and cables were sited and designed to avoid or minimize impacts to other marine uses to the maximum extent practicable.
- The Proponent will coordinate with the owner of any cables to be crossed.
- The Proponent will continue to work with BOEM, NOAA Fisheries, and others to support implementation of the Fisheries and Federal Survey Mitigation Implementation Strategy.
- A Marine Coordinator will assist with tasks such as monitoring vessel movements, coordinating and drafting communication protocols with other vessels to avoid conflicts, and supervising temporary safety buffer zones.
- The Proponent will continue to collaborate with other offshore wind developers to minimize potential impacts to other offshore wind energy projects.

6 Visual and Cultural Resources

6.1 Visual Resources (Non-Historic)

This section addresses non-historic resources within the viewshed of Vineyard Mid-Atlantic that may be impacted by the development. Visually sensitive cultural resources and historic properties that may be impacted by Vineyard Mid-Atlantic are discussed in Section 6.2.3.

A detailed Seascape, Landscape, and Visual Impact Assessment (SLVIA) is provided as Appendix II-J.

6.1.1 Affected Environment

Offshore Facilities

The Visual Study Area (VSA) is the outer limit of the visual impact analysis. This limit is established as the maximum distance beyond which any view of an offshore component would be considered negligible. The VSA extends to a radius of 83.7 kilometers (km) (52 miles [mi]) from the proposed wind turbine generator (WTG)/electrical service platform (ESP) positions. The extent of the VSA was determined in consultation with the Bureau of Ocean Energy Management (BOEM). The VSA includes substantial land areas on Long Island, New York including portions of Suffolk County, Nassau County, Queens County (Borough of Queens, New York City) and Kings County (Borough of Brooklyn, New York City). The VSA also includes substantial land areas in New Jersey including portions of Monmouth County and northern Ocean County. The VSA extends as far east as the Mecox Bay inlet in the Town of Southampton, Suffolk County, New York and as far south as Island Beach State Park, Berkeley Township, Ocean County, New Jersey.

Viewshed analysis identifies the maximum geographic area within which some portion of Vineyard Mid-Atlantic's offshore facilities could potentially be visible based on geographic information system (GIS) generated viewshed analysis. The viewshed analysis is limited to the 83.7 km (52.0 mi) radius VSA. Beyond this distance it is assumed that any remaining views of Vineyard Mid-Atlantic components would be negligible due to sheer distance.

At distances greater than 59.7 km (37.1 mi), the top of the nacelle will fall below the visible horizon when viewed from sea level vantage points (assuming an observer with an eye height of 1.8 meters [6 feet] above sea level). From the same viewpoint, the blade tip will fall below the horizon at distances greater than 76.9 km (48.0mi).

For the purpose of the SLVIA, two viewshed conditions are identified:

- Zone of Theoretical Visibility (ZTV) – The ZTV defines the theoretical worst-case area of potential visual effect considering only the screening effect of existing topography and earth's curvature (i.e., "bare earth" condition).

- Zone of Likely Visibility (ZLV) – The ZLV presents the more realistic-case area of potential visual effect including the real-world screening elements of existing intervening vegetation and structures (i.e., "land cover" condition).

Although the possibility of views of Vineyard Mid-Atlantic exists throughout the oceanfront area, 20 key observation points (KOPs) were selected in consultation with BOEM from which more detailed analyses were conducted.

KOPs were selected based on the following criteria:

- Locations which provide clear, unobstructed views toward the Lease Area (as determined through ZLV analysis and field verification);
- Visually sensitive places representative of a larger group of candidate KOPs of the same type or in the same geographic area;
- Vantage points representative of typical views from different Landscape Character Areas;
- Views of the Lease Area commonly available to representative viewer/user groups; and
- Geographic distribution across the VSA illustrating a range of distances to the Lease Area; and
- Locations identified in consultation with BOEM and identified in prior studies.

Section 6.2 of the SLVIA provides information about each of the 20 KOPs analyzed and includes figures illustrating the location of the selected KOPs. A photo log and supplemental information is provided for each KOP in Appendix D of Appendix II-J.

Of the 20 KOPs, 11 have associated photo simulations: eight in New York and three in New Jersey. The KOPs selected for photo simulations represent a variety of viewing distances, viewer elevations, Seascape, Landscape, and Ocean Character Areas, and viewer types as well as overall geographic distribution and general intensity of use. Simulated KOPs were selected in consultation with BOEM. The photo simulations are provided in Appendix E of Appendix II- J.

Onshore Facilities

For Vineyard Mid-Atlantic's onshore facilities, the ZLV is determined using GIS-generated viewshed analysis of a representative substation design within each onshore substation site envelope. Study Points are identified and photo simulations are provided for the four identified onshore substation sites: Onshore Substation Site Envelopes A, B, C, and D. The onshore photo simulations are provided in Appendix F of Appendix II-J.

6.1.2 Potential Effects and Proposed Avoidance, Minimization, and Mitigation Measures

Offshore Facilities

The potential visual impacts of Vineyard Mid-Atlantic on Character Areas and viewer experience within the VSA are assessed in detail in the SLVIA (see Appendix II-J). The sheer distance of Vineyard Mid-Atlantic from the nearest coastal vantage point—greater than 38 km (24 mi) from the closest WTG to Fire Island, New York and 66 km (41 mi) east of Long Branch, New Jersey—serves to minimize visibility of the offshore facilities from sensitive visual resources.

Overall, Vineyard Mid-Atlantic's offshore facilities will result in small change to landscape conditions for viewers along the New York and New Jersey coastlines. Land based viewers will have limited visibility of the WTGs when weather conditions allow; however, Vineyard Mid-Atlantic would likely be considered visually subordinate to the wider landscape. Vineyard Mid-Atlantic will be virtually undetectable from the eastern and southern portions of the VSA.

The WTGs (blades, nacelle, and tower) will be no lighter than pure white (RAL 9010) and no darker than light grey (RAL 7035) in color; the Proponent expects that the WTGs will be off-white/light grey. When viewed from ground level vantage points, the expected off-white/light grey color of the WTGs generally blends well with the sky at the horizon. The ESP topsides are expected to be light grey in color, which would appear muted and indistinct. However, as described in Appendix II-J, the apparent color of the WTGs and ESPs will not be constant and will vary depending on time of day and sun angle, backdrop sky color, and lighting conditions (sunny, partly cloudy, or overcast conditions). The level of noticeability will be directly proportional to the degree of visual contrast and scale of change between the WTGs and ESPs and the corresponding backdrop.

All offshore cables will be submerged and will not be visible. The onshore export cables and grid interconnection cables will be installed entirely underground and will not be visible. The onshore substation sites will have a perimeter access fence. Vegetative buffers for visual screening and sound attenuation walls may also be installed, if needed.

For a development of this type, mitigation options are limited due to the size and structural requirements of WTGs, the number of WTGs necessary to meet energy production requirements, and their location on an unscreened seascape. However, Vineyard Mid-Atlantic is applying important mitigation techniques to minimize potential visual impacts to the maximum extent practicable, which include:

- Vineyard Mid-Atlantic is located in an area identified by BOEM as suitable for offshore wind development, sited far from shore to minimize visual impacts.

- The location of the nearest WTG (more than 38 km [24 mi] offshore) eliminates all foreground, mid-ground, and even near background views from visually sensitive public resources and population centers.
- The Proponent will use an Aircraft Detection Lighting System (ADLS) or similar system that automatically turns on and off aviation obstruction lights in response to the detection of aircraft. The ADLS is estimated to be activated less than 2 hours and 42 minutes per year (see Appendix II-I). Thus, the effect of nighttime lighting is substantially minimized through the use of ADLS.
- Based on current United States Coast Guard (USCG) guidance, marine navigation lights mounted on each foundation (or near the bottom of the ESP topsides) will be visible in all directions at a distance of 3.7 to 9.5 km (2 to 5 nautical miles), depending on the structure's location. Due to sheer distance, marine navigation lights on the WTGs and ESP(s) will not be visible from any coastal vantage point.

More detail on these measures is provided in Appendix II-J. An assessment of the activation frequency of an ADLS is included in Appendix II-I.

Onshore Facilities

There are several mitigation measures that may be implemented to reduce visual impacts as the siting and design of the onshore substations progress:

- The design of the onshore substations will consider the color of materials used for buildings, fences, and specular steel structures to minimize visual contrast.
- Vegetative buffers may be installed to provide visual screening at the onshore substation sites, if needed.
- Outdoor lighting at the onshore substation sites will typically be equipped with light shields to prevent light from encroaching into adjacent areas. The Proponent will ensure that the lighting scheme complies with local requirements.

Additional details on these measures are provided in Appendix F of Appendix II-J.

6.2 Cultural Resources

This section provides information regarding cultural resources that may be affected by Vineyard Mid-Atlantic to assist the Bureau of Ocean Energy Management (BOEM) in meeting its obligations under Section 106 of the National Historic Preservation Act (NHPA). BOEM is the lead federal agency for Vineyard Mid-Atlantic and will initiate the Section 106 consultation with the State Historic Preservation Officer(s) (SHPO[s]), Tribal Historic Preservation Officer(s) (THPO[s]), and/or other interested parties. This summary section, along with the Terrestrial Archaeological Resources Assessment (TARA) (see Appendix II-L), the Marine Archaeological

Resources Assessment (MARA) (see Appendix II-Q), the Offshore Historic Resources Visual Effects Assessment (HRVEA) (see Appendix II-K1), and the Onshore Historic Resources Effects Assessment (HREA) (see Appendix II-K2) was prepared to support BOEM's National Environmental Policy Act (NEPA) and NHPA review, in accordance with 30 CFR Part 585.627(a)(6). BOEM provides recommended approaches for assessing impacts to historic properties during the offshore wind energy permitting process in "Guidelines for Providing Archaeological and Historical Property Information Pursuant to 30 CFR Part 585" (BOEM 2020a). The identification of historic properties was based on standard practices within each discipline.

Cultural resources include:

- aboveground buildings, structures, districts, and other properties of historic significance;

- archaeological resources, which are areas where human alterations to the earth, artifacts, or other signs of past human activity are found; and

- traditional cultural properties (TCPs), which are places, landscape features, or locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community.

Cultural resources with historic significance and integrity under NHPA criteria are called "historic properties" and are eligible for listing or listed in the National Register of Historic Places (NRHP). As defined in the regulations implementing Section 106 of the NHPA, historic property means:

> *…any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. This term also includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.*

The Area of Potential Effects (APE) is defined in 36 CFR § 800.16 as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist."

BOEM's "Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585" (dated May 27, 2020) state that "[t]he scope of these geographic areas should include the following:

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities;

- The depth and breadth of terrestrial areas potentially impacted by any ground disturbing activities;
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible; and
- Any temporary or permanent construction or staging areas, both onshore and offshore" (BOEM 2020a).

The Proponent has identified a Preliminary Area of Potential Effects (PAPE) to assist BOEM with the development of the APE. The PAPE is based on the maximum Project Design Envelope (PDE) for Vineyard Mid-Atlantic. The PAPE for Vineyard Mid-Atlantic is subdivided into three geographic elements:

1. PAPE for physical impacts to marine cultural resources;
2. PAPE for physical impacts to terrestrial cultural resources; and
3. PAPE for visual impacts to visually sensitive cultural resources (onshore and offshore).

Each of these elements of the PAPE are described separately below, followed by a discussion of Vineyard Mid-Atlantic's potential effects to cultural resources within each element of the PAPE and the Proponent's proposed measures to avoid, minimize, and mitigate those effects.

6.2.1 Marine Cultural Resources

This summary section discusses marine cultural resources, including archaeological resources and TCPs located offshore, that may be physically impacted by Vineyard Mid-Atlantic. Marine cultural resources include shipwrecks, ancient submerged landforms, sunken aircraft, and other maritime infrastructure. This section, along with the MARA (see Appendix II-Q), was prepared in accordance with 30 CFR Part 585.627(a)(6) to support BOEM's NEPA and NHPA review.

The PAPE for marine archaeological resources was analyzed pursuant to 30 CFR § 585 and BOEM guidelines under the supervision of the Qualified Marine Archaeologist (QMA). The high-resolution geophysical (HRG) surveys were conducted primarily in 2023 and performed in accordance with guidelines issued by BOEM (2020a and 2020b), and the New York State Historic Preservation Office (NYSHPO). A detailed MARA is provided as Appendix II-Q.

6.2.1.1 Preliminary Area of Potential Effects

The PAPE for marine archaeological resources is comprised of the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities associated with Vineyard Mid-Atlantic's offshore facilities. The PAPE (including maps and a description of potential impacts associated with Vineyard Mid-Atlantic) is fully described in the MARA (Appendix II-Q) and includes the Lease Area and the Offshore Export Cable Corridor (OECC).

6.2.1.2 Summary of Potential Avoidance, Minimization, and Mitigation Measures

The MARA identifies recommended avoidance buffers for shipwrecks within and adjacent to the PAPE based on the visible extent of each resource gleaned from geophysical survey data. The MARA also identifies Ancient Submerged Landform Features (ASLFs) with the potential to contain intact cultural resources within the PAPE and provides recommended avoidance areas. The Proponent commits to avoid the shipwreck sites and ASLFs by the recommended avoidance buffer. If needed, the Proponent will develop and adhere to a Historic Properties Treatment Plan (HPTP), which will define proposed mitigation measures that will be implemented to avoid and minimize potential effects to historic properties and ASLFs within the PAPE. The Proponent also expects to develop an Unanticipated Discoveries Plan to address the possibility of encountering an unidentified and unanticipated submerged cultural resource during offshore activities. These measures will be finalized in consultation with BOEM, NYSHPO, Tribes/Tribal Nations, and other relevant consulting parties through the Section 106 and NEPA processes.

6.2.2 Terrestrial Cultural Resources

This summary section addresses terrestrial cultural resources, including archaeological resources, historic buildings, and historic districts located onshore, that may be physically impacted by Vineyard Mid-Atlantic.

BOEM recommends that efforts to identify historic properties "within onshore terrestrial areas" be "conducted and reported following the guidance published by the affected SHPO and provided through consultation with the affected SHPO" (BOEM 2020a). The Proponent's consultant, Environmental Design & Research (EDR), is conducting the Phase IA (i.e., "assessment") survey for Vineyard Mid-Atlantic in accordance with applicable federal and state guidance. Key personnel involved in the archaeological surveys meet the Secretary of the Interior's (SOIs) Professional Qualification Standards (36 CFR 61, Appendix A). All tasks associated with the surveys are being undertaken in accordance with the SOI's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716–44742, NPS 1983), the New York Archaeological Council's (NYAC's) "Standards for Cultural resources Investigations and the Curation of Archaeological Collections in New York State" (the NYAC Standards; NYAC 1994) and the NYSHPO's "Phase 1 Archaeological Report Format Requirements" (NYSHPO 2005). The TARA (see Appendix II-L) will follow the guidelines established by the National Park Service (NPS) in Recovery of Scientific, Prehistoric, Historic, and Archaeological Data (36 CFR 66, Appendix A).

This summary section, along with the TARA (see Appendix II-L), is being prepared in accordance with 30 CFR Part 585.627(a)(6) to support BOEM's NEPA and NHPA review.

6.2.2.1 Preliminary Area of Potential Effects

The PAPE for terrestrial cultural resources is comprised of the depth and breadth of terrestrial areas potentially impacted by any ground-disturbing activities within the footprint of Vineyard Mid-Atlantic's onshore facilities and construction staging areas. This includes both below ground archaeological resources and aboveground historic properties that are within or intersect with the footprint of the onshore facilities and construction staging areas. The PAPE (including maps and a description of potential impacts associated with Vineyard Mid-Atlantic) will be fully described in the TARA (see Appendix II-L), Offshore HRVEA (Appendix II-K1), and Onshore HREA (Appendix II-K2).

Appendix II-L will provide information on the types and distribution of archaeological cultural resources in or near the potential landfall sites, points of interconnection (POIs), onshore cable routes, and onshore substation sites (which could also be used for an onshore reactive compensation station [RCS]). The study area will encompass areas within 0.4 kilometers (km) (0.25 miles [mi]) of the onshore components. The study area will be located in the Borough of Queens, Queens County, New York; Towns of Hempstead and Oyster Bay and City of Long Beach, Nassau County, New York; and Towns of Babylon and Huntington, Suffolk County, New York. The TARA, including detailed maps of archaeological sensitivity, will be provided in Appendix II-L.

As further described in the Onshore HREA (see Appendix II-K2), no adverse effects to aboveground historic properties are anticipated from the direct physical effects of Vineyard Mid-Atlantic. Construction impacts will be temporary, the onshore cable routes will be underground, and disturbed areas will be restored. More detail is provided in Appendix II-K2.

6.2.2.2 Summary of Potential Avoidance, Minimization, and Mitigation Measures

The Proponent will consult with the NYSHPO regarding the potential for Vineyard Mid-Atlantic to affect both known and un-recorded cultural resources that may be present within the study area. The Proponent intends to prioritize avoiding known cultural resources. Potential avoidance, minimization, and mitigation measures include the following:

- The Proponent intends to prioritize avoiding known cultural resources. The onshore cable routes are sited primarily within public roadway layouts (or immediately adjacent areas)[91] (i.e., within previously disturbed areas) to minimize disturbance to cultural resources.

- The Proponent anticipates completing additional Phase 1A and/or Phase 1B studies as appropriate.

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[91] In limited areas, the onshore cable routes may follow utility rights-of-way (ROWs) or depart from public roadway layouts, particularly at complex crossings.

- The Proponent may develop an Onshore Archaeological Monitoring Plan as part of the Section 106 consultation process and conduct monitoring of archaeologically sensitive areas during construction. Alternatively, the Proponent may conduct additional intensive testing prior to construction.

- The Proponent anticipates developing and implementing an Onshore Unanticipated Discoveries Plan as part of the Section 106 consultation process.

The Proponent will continue to develop appropriate avoidance, minimization, and mitigation measures (as needed) in consultation with BOEM, NYSHPO, federally recognized Tribes/Tribal Nations, and other relevant consulting parties.

6.2.3 Visually Sensitive Cultural Resources (Aboveground Historic Properties)

This summary section addresses visually sensitive cultural resources located within the viewshed of Vineyard Mid-Atlantic's onshore and offshore facilities. Visual impacts to non-historic resources are addressed in Section 6.1.

BOEM provides recommended approaches for assessing impacts to historic properties during the offshore wind energy permitting process in Guidelines for Providing Archaeological and Historical Property Information Pursuant to 30 CFR Part 585 (BOEM 2020a). These guidelines state that a HRVEA should be conducted in a manner acceptable to the relevant SHPO for the state(s) within the areas that will have a view of Vineyard Mid-Atlantic's onshore or offshore components (see Appendices II-K1 and II-K2). This summary section, along with the Offshore HRVEA (Appendix II-K1) and Onshore HREA (Appendix II-K2) was prepared in accordance with 30 CFR Part 585.627(a)(6) to support BOEM's NEPA and NHPA review.

6.2.3.1 Preliminary Area of Potential Effects

The PAPE for direct visual effects includes "the viewshed from which renewable energy structures, whether located offshore or onshore, would be visible" (BOEM 2020a). To delineate the PAPE for direct visual effects, the Proponent identified areas from which Vineyard Mid-Atlantic would, with some certainty, be visible and recognizable under a reasonable range of meteorological conditions. Then, the Proponent identified historic properties included in, or eligible for inclusion in the NRHP, that are within the PAPE and assessed the potential effects of Vineyard Mid-Atlantic on those properties. Baseline photography and fieldwork that supported the development of the PAPE was conducted in Spring 2023.

Offshore

For Vineyard Mid-Atlantic's offshore components, the PAPE for direct visual effects includes areas where the wind turbine generators (WTGs) and electrical service platforms (ESP[s]) would be visible. Since the maximum height of the ESP topside(s) (70 meters (m) [230 feet {ft}]) is much less than the maximum nacelle height of the WTGs (203.5 m [668 ft]), the PAPE for the

WTGs encompasses the PAPE for the ESP(s). The offshore export cables from the ESP(s) to the mainland landfall sites as well as the inter-array and inter-link cables within the Lease Area are underwater and will not have a visual impact. Delineating the offshore PAPE for direct visual effects involved the following process:

- First, the visual study area (VSA) was determined, which is the maximum distance beyond which any view of an offshore component would be considered negligible. For Vineyard Mid-Atlantic, the VSA is an area within 83.7 km (52 mi) of the WTGs/ESPs.
- Next, within the limits of the VSA, viewshed analysis identified the areas where Vineyard Mid-Atlantic could potentially be visible, taking into account intervening topography, built structures, and vegetation. The viewshed was generated using a Geographic Information System (GIS) viewshed calculation utilizing Light Detection and Ranging (LiDAR) data.
- Additionally, field verification, review of historic resources surveys, and photo simulations, as well as guidance provided by BOEM, were used to identify those areas within the viewshed where Vineyard Mid-Atlantic "would be visible."

The PAPE (including maps and a description of potential impacts associated with Vineyard Mid-Atlantic) is fully described in the Offshore HRVEA (see Appendix II-K1). The PAPE for direct visual effects includes portions of the south shore of Long Island (i.e., portions of Suffolk County, Nassau County, Queens County and Kings County) as well as portions of coastal New Jersey (i.e., portions of Monmouth County and Ocean County).

Onshore

For the onshore portions of Vineyard Mid-Atlantic, the PAPE for direct visual effects is primarily related to the new onshore substation sites and onshore RCSs (if used), as the onshore cables will be underground. Four potential onshore substation site envelopes have been identified.

The onshore substation site envelopes could also be used for an RCS, however both an RCS and an onshore substation site would not be located in the same onshore substation site envelope. If used, the RCS would be much smaller in size than an onshore substation.

The PAPE for Vineyard Mid-Atlantic's onshore facilities is based on the identification of a ZLV, which is determined using GIS-generated viewshed analysis of a representative substation design within each onshore substation site envelope. Next, a 1.6 km (1 mi) radius was identified around each of the proposed onshore substations to assess potential visual effects. Photo simulations for the onshore substations and, where available, field observations were also used to identify those areas within the ZLV where Vineyard Mid-Atlantic's onshore facilities "would be visible." The PAPE (including maps and a description of potential impacts associated with Vineyard Mid-Atlantic) is fully described in the Onshore HREA (see Appendix II-K2).

For the potential onshore substation sites and onshore RCSs (if used), the site will have a perimeter access fence and may include sound attenuation walls, if necessary. Substation construction may require initial clearing and grading of the site, but the periphery of the site (outside the security fencing) will be restored and revegetated (if required). Vegetative buffers for visual screening may be installed, if needed.

As further described in the Onshore HREA (see Appendix II-K2), two aboveground historic properties have the potential to be adversely affected by the proposed onshore facilities.

6.2.3.2 Summary of Potential Avoidance, Minimization, and Mitigation Measures

The Proponent is avoiding and minimizing visual impacts to the maximum extent practicable.

The WTGs will have uniform shape, design, and color and will be aligned and spaced consistently, thereby reducing potential for visual clutter. Additionally, the WTGs will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color in accordance with BOEM and Federal Aviation Administration (FAA) guidance; the Proponent anticipates painting the WTGs off-white/light grey to reduce contrast with the sea and sky and thus, minimize daytime visibility of the WTGs. This lack of contrast between the WTGs and the background means that the percentage of the time the structures might be visible is greatly reduced. Additionally, the upper portion of the ESP(s) will be a grey color, which would appear muted and indistinct. Color contrast decreases as distance increases. Color contrast will diminish or disappear completely during periods of haze, fog, or precipitation.

Lighting will be kept to the minimum necessary to comply with navigation safety requirements and safe operating conditions. For each WTG and ESP, marine navigation lighting will include yellow flashing lights that are visible in all directions at a distance of 3.7 to 9.5 km (2 to 5 nautical miles [NM]), in accordance with current United Stated Coast Guard (USCG) guidance.

The Proponent will use an Aircraft Detection Lighting System (ADLS) or similar system that automatically turns on and off aviation obstruction lights in response to the detection of aircraft. The ADLS is estimated to be activated less than 2 hours and 42 minutes per year (see Appendix II-I). Thus, the effect of nighttime lighting is substantially minimized through the use of ADLS.

The onshore cables are expected to be installed primarily underground within public roadway layouts (or immediately adjacent areas), thus minimizing potential visual effects to adjacent properties. The design of the onshore facilities will consider the color of materials used to minimize impacts. Lastly, vegetative buffers for visual screening of the onshore substations may be installed, if needed. Specific to the potential for adverse effects to two aboveground historic properties, the Proponent anticipates consultation with the appropriate federal agencies, federally recognized Tribal Nations, NYSHPO, and other consulting parties in connection with Vineyard Mid-Atlantic to develop meaningful measures to mitigate any adverse effects caused by Vineyard Mid-Atlantic as required by 30 CFR § 585.626(b)(15).

7 Low Probability Events

Low probability events that could occur during construction, operation, and/or decommissioning of Vineyard Mid-Atlantic include: collisions and allisions, severe weather and natural events, corrective maintenance activities or significant infrastructure failure, cable displacement or damage, offshore spills and inadvertent releases, coastal and onshore spills and inadvertent releases, or terrorist attacks.

The Offshore Development Area is comprised of Lease Area OCS-A 0544 (the "Lease Area"), the Offshore Export Cable Corridor (OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Mid-Atlantic activities. The Onshore Development Area consists of the landfall site(s), onshore cable routes, onshore substation sites, potentially onshore reactive compensation stations (RCSs), and points of interconnection (POIs) on Long Island, New York as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Mid-Atlantic activities. The following sections discuss these low probability events in the Offshore Development Area and Onshore Development Area.

7.1 Collisions, Allisions, and Grounding

Generally, collisions involve vessels colliding with other vessels or with marine life, while allisions involve vessels colliding with fixed objects, such as wind turbine generators (WTGs) or electrical service platforms (ESPs). Grounding occurs when a vessel runs aground or makes contact with the seafloor in shallow water. As described further in the Navigation Safety Risk Assessment (NSRA) provided as Appendix II-G, collisions and allisions are considered low probability events within the Offshore Development Area. Each event could result in spills (as described below in Sections 7.5 and 7.6); damage to infrastructure or vessels; human injuries or fatalities; or, in the case of a collision with marine life, injury or fatalities of marine life (see Sections 4.7 and 4.8).

However, the risk of vessel collisions is considered low due to the use of a uniform grid pattern for the WTG/ESP layout, the planned marine navigation lighting and marking of the offshore facilities, and mariners' adherence to United States Coast Guard (USCG) and international maritime regulations designed to promote safety. First and foremost, as described in Section 2.3 COP Volume I, Vineyard Mid-Atlantic's WTGs and ESP(s) will be arranged in a uniform grid pattern with west-northwest to east-southeast rows, north to south columns, and 0.68 nautical mile (NM) (1.3 kilometer [km]) spacing between positions (see Figure 2.3-1 of COP Volume I).[92]

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[92] Where necessary, WTGs and ESP(s) may be micro-sited by a maximum of 152 m (500 ft) to avoid unfavorable seabed conditions, maintain facilities within the Lease Area boundaries, and/or for other unexpected circumstances.

This 0.68 x 0.68 NM WTG/ESP layout provides two common lines of orientation with the layout proposed for neighboring Lease Area OCS-A 0512 (where the Empire Wind projects will be installed), in accordance with the stipulations in Lease OCS-A 0544.

Accordingly, the Proponent has designed a surface structure layout for Vineyard Mid-Atlantic that shares two common lines of orientation with Lease Area OCS-A 0512. Since Vineyard Mid-Atlantic's 0.68 x 0.68 NM WTG/ESP layout aligns with the layout of Lease Area OCS-A 0512, in accordance with Section 8 of the Lease, a 3.7 km (2 NM) setback between Lease Areas OCS-A 0512 and OCS-A 0544 is not required.

Vineyard Mid-Atlantic's WTG/ESP layout includes six positions that are contingent upon the final layout of Empire Wind 2. As shown on Figure 2.3-1, Empire's proposed layout includes six "off-grid" positions along its boundary with Lease Area OCS-A 0544 that do not follow the west-northwest to east-southeast common line of orientation. Given that Empire Wind will only install up to 149 WTGs and ESPs, but has proposed 176 positions, there is a possibility that the Empire Wind 2 project will not use one or more of these six off-grid positions. However, if the final Empire Wind 2 layout includes WTGs at those positions, Vineyard Mid-Atlantic would not use the immediately adjacent "on-grid" positions shown in Figure 2.3-1. These six Vineyard Mid-Atlantic positions are denoted throughout this Construction and Operations Plan (COP) as "contingent WTG/ESP positions."

Further, vessels and mariners are expected to follow the International Regulations for Preventing Collisions at Sea. To enhance marine navigation safety, Vineyard Mid-Atlantic's offshore facilities will be equipped with marine navigation lighting and marking in accordance with USCG, Bureau of Ocean Energy Management (BOEM), and Bureau of Safety and Environmental Enforcement (BSEE) guidance. The risk of allision is expected to be further reduced due to the inclusion of Mariner Radio Activated Sound Signals (MRASS) and Automatic Identification System (AIS) transponders in the design of Vineyard Mid-Atlantic's offshore facilities. The Proponent expects to provide a lighting, marking, and signaling plan to BOEM, BSEE, and USCG prior to construction of the offshore facilities. Additional information on marine navigation lighting, marking, and signaling can be found in the NSRA in Appendix II-G. Furthermore, the specific location of Vineyard Mid-Atlantic's offshore facilities (e.g., WTGs and ESP[s]) will be provided to USCG and the National Oceanic and Atmospheric Administration (NOAA) for inclusion on nautical charts.

7.2 Severe Weather and Natural Events

Severe weather events such as winter nor'easters, hurricanes (albeit less frequently), and major storms may occur within the Offshore Development Area. Nor'easters typically form between October and April. While their frequency and strength are correlated to the southerly jet stream along the eastern United States (US), over the last 20 years, an average of 1.6 significant nor'easters with wave heights over 2 meters [m] (6.6 feet [ft]) occurred each year in the southern New England continental shelf and New York Bight region. Based on future climate predictions, nor'easters along the US East Coast are expected to decrease in frequency but increase in severity (Colle et al. 2015). Historical data reveal that 25 hurricanes (15 category 1, six category 2, and four category 3) have occurred in the region since 1851 (see the Metocean Characterization Report to be included in the Marine Site Investigation Report [Appendix II-B to the COP]). Further examination of the NOAA Historical Hurricane Track database shows that approximately 67 storms have passed within a 111 km (60 NM) radius centered around the Lease Area between the years of 1851 to 2021 (NOAA 2024). Based on the highest intensity (category) reached for each storm track within the study region, most of these storms (79%) had winds equal to or less than 117.4 kilometers per hour [km/hr] (63.4 knots [kts]) and were categorized as either extratropical, tropical depression, or tropical storm. Fifteen percent of the observations were considered category 1 and 2 hurricanes, which translates to an average frequency of a category 1 or 2 hurricane occurring every 17 years. Only 6% of the observed hurricanes were classified as category 3 (a major hurricane with winds of 178 to 207 km/hr [96 to 112 kts]), resulting in an average of one category 3 hurricane every 42 years. No category 4 or category 5 hurricanes have been recorded in the New York Bight region.

Vineyard Mid-Atlantic's offshore facilities will be designed to withstand severe weather events and extreme environmental conditions (including wind speed and wave height) based on site-specific conditions and in accordance with applicable US and international standards. As described in Section 3.12.2 of COP Volume I, a Certified Verification Agent (CVA) will conduct an independent assessment of the offshore facilities' proposed design. The WTG design will be reviewed by the third-party CVA to verify that the design is able to withstand the site-specific conditions (e.g., sustained wind speeds and gusts) anticipated at the Lease Area. The WTGs will be designed to automatically stop power production when wind speeds exceed a maximum value, after which the rotor will normally idle. The exact speed at which power production will cease depends on the manufacturer's specifications.

Under certain meteorological conditions, ice may accumulate on WTG blades, presenting a possible falling ice risk if dislodged or ejected. Ice accumulation risk is greatest when air temperatures are less than 0 degrees Celsius [°C] (32 degrees Fahrenheit [°F]), relative humidity is greater than 95%, and when wind speeds are relatively low (<5 meters per second [m/s] [10 kts]). Based on an analysis of meteorological data from John F. Kennedy Airport and National Data Buoy Centre (NDBC) ocean buoy located near the Lease Area, these potential icing conditions occurred for only one hour over the analysis period from January 1, 2010 to July 27, 2018, which is 0.0016% of the observations.[93] Therefore, the risk of ice formation on the WTG blades is very low. See the NSRA provided as Appendix II-G for additional details.

Vineyard Mid-Atlantic is sited in an area with relatively low seismic activity. An analysis of the history of earthquake activity in the area is provided in Appendix II-B. Overall, the potential for catastrophic damage to the onshore and offshore facilities from an earthquake is extremely

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93 Periods of missing data were excluded, and these periods represent 19.1% of the entire analysis period.

low. Vineyard Mid-Atlantic's foundations will be designed for the relevant seismic accelerations for the region. Additional discussion of seismic activity in the region and how the offshore facilities are designed to withstand seismic inertial loads is included in the Marine Site Investigation Report (see Appendix II-B).

Catastrophic damage to Vineyard Mid-Atlantic's onshore facilities, such as the transition vaults, splice vaults, or buried concrete duct bank, is not anticipated. Although unlikely, damage could occur as a result of a natural disaster, severe weather, or other event. Any damage to, or breakage of, these underground components would require excavation to uncover and repair the damaged section. Repair work impacts would be localized and temporary and similar to those from initial transition vault, splice vault, and duct bank installation (see Sections 3.7.2 and 3.8.4.2 of COP Volume I). Any required repair work will incorporate mitigation for construction activities as described in Section 5.5.

7.3 Corrective Maintenance Activities or Significant Infrastructure Failure

Although highly improbable, as with any major infrastructure, it is possible that a component of Vineyard Mid-Atlantic could experience a significant structural, electrical, or hydraulic failure. Vineyard Mid-Atlantic will undergo an extensive and well-vetted structural design process to minimize the possibility of component failure. As noted in Section 7.2, a third-party CVA will conduct an independent assessment of the offshore facilities' design as well as fabrication, installation, and commissioning methods. The CVA's assessment will be based on site-specific conditions and applicable international and US standards (see Section 3.12.2 of COP Volume I). The Proponent will develop one or more Facility Design Reports (FDRs) containing the specific details of the offshore facilities' design and one or more Fabrication and Installation Reports (FIRs) that describe how the components will be fabricated, transported, installed, and commissioned. The FDRs and FIRs will be reviewed by the CVA and the BSEE.

The potential risk of significant infrastructure failure or corrective maintenance activities will be further reduced by the Proponent's rigorous inspection and maintenance program. To minimize equipment downtime, maximize energy production, and verify that the facilities remain in a safe condition, the Proponent will conduct regular inspections and preventative maintenance (see Section 4 of COP Volume I). The Proponent's operations and maintenance (O&M) plan and maintenance schedule for each primary component (i.e., WTG, ESP, etc.) will be developed based on original equipment manufacturers' (OEMs') recommendations and experience gained from similar projects operating globally. This inspection and preventive maintenance strategy will be reviewed regularly and continuously improved. Data collected from the continuous monitoring of the facilities will be analyzed to identify and correct potential equipment failures in advance. The Proponent will ensure that Vineyard Mid-Atlantic's preventive maintenance strategy aligns with best industry practice.

7.4 Cable Displacement or Damage

The target burial depth of the offshore export, inter-array, and inter-link cables is designed to substantially reduce the risk of displacement or damage to the cables by anchors or fishing gear. The Proponent's engineers have determined that a target burial depth of 1.2 meters (4 feet) in federal waters and 1.8 m (6 ft) in state waters, is at least twice the required burial depth to protect the cables from fishing activities. Likewise, the target burial depth generally provides a maximum of 1 in 100,000 year probability of anchor strike,[94] which is considered a negligible risk. In the event that sufficient cable burial cannot be achieved, cable protection will be installed as described in Sections 3.5.5 and 3.6.5 of COP Volume I. Additionally, the OECC was designed to avoid areas of higher risk for anchor strikes (e.g., traffic separation schemes [TSSs], anchorage areas, safety fairways), to the extent possible. Furthermore, the cables will be continuously monitored as described in Section 4.2.3 of COP Volume I. Accordingly, cable displacement or damage is not expected.

7.5 Offshore Spills/Inadvertent Releases

Offshore spills are not anticipated and would be accidental in nature. Some scenarios in which inadvertent releases could occur include:

- inadvertent releases resulting from vessel refueling during construction or operation;
- inadvertent releases resulting from routine maintenance activities required during operation of Vineyard Mid-Atlantic;
- inadvertent releases due to equipment malfunction or breakage; or
- inadvertent releases resulting from a catastrophic event occurring at, or in proximity to, Vineyard Mid-Atlantic.

Other types of inadvertent releases discussed in this section include ballast/ bilge water and marine trash and debris.

Section 6 of COP Volume I describes the Proponent's Health, Safety, and Environmental (HSE) Management System, spill response plans and spill prevention measures, and guidelines for chemical use, waste generation, and disposal. All solid and liquid discharges will be treated in

[94] Based on a preliminary Cable Burial Risk Assessment (CBRA) (see Appendix II-T), in a limited portion of the OECC within the Nantucket to Ambrose Traffic Lane, the offshore export cables will have a greater target burial depth of 2.9 m (9.5 ft) beneath the stable seafloor. The target burial depths are subject to change if the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

accordance with all applicable federal, state, and local regulations. If grout is used during foundation installation, the grout level will be monitored using underwater cameras. When grout reaches the top of the sleeve, grouting will be halted, thus minimizing the risk of a grout release.

The Proponent's draft Oil Spill Response Plan (OSRP), provided as Appendix I-F, describes spill prevention measures for the offshore facilities as well communication, containment, removal, and mitigation procedures in the unforeseen event of an offshore spill. Annex 5 of the draft OSRP provides an oil spill modeling study that assesses the trajectory and weathering of oil following a catastrophic release of all oil contents from the toppling of an ESP (the largest oil-containing component). As described in the draft OSRP, the WTGs and ESP(s) will be equipped with secondary containment around oil-filled equipment to prevent a discharge of oil into the environment. The ESP(s) will also likely include an oil/water separator.

The Proponent will require all vessels to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental spills. Vessel fuel spills are not expected, and, if one occurred, it is likely to be limited in quantity. According to the Bureau of Transportation statistics (2021), between 2000 and 2021, the average oil spill size for vessels other than tank ships and tank barges in all US waters was approximately 341 liters (90 gallons). A spill of this size is anticipated to dissipate at a rapid pace and evaporate within days of the initial spill. The risk of spills will be further minimized because vessels will be expected to comply with USCG regulations at 33 CFR § 151 relating to the prevention and control of oil spills.

In the unlikely event of an inadvertent release of oil, fuel, or other chemicals, potential impacts could occur to water quality and marine resources such as benthic organisms, finfish and invertebrates (including Essential Fish Habitat [EFH]), marine mammals, and sea turtles. In addition to the Proponent's efforts to contain and remove an offshore spill, it is anticipated that dispersion, evaporation, and weathering of fuel or oil would occur, all of which would limit the amount and duration of exposure of marine organisms to hydrocarbons. Therefore, while limited mortality of marine organisms (such as finfish and benthic organisms) or impacts to habitat are possible, overall impacts to marine organisms would be short-term, localized, and unlikely to cause population level effects. Similarly, any impacts to water quality would be temporary and localized.

All Vineyard Mid-Atlantic vessels will comply with the United States Coast Guard (USCG) waste and ballast water management regulations (at 33 CFR Part 151 and 46 CFR Part 162), among other applicable federal regulations and International Convention for the Prevention of Pollution from Ships (MARPOL) requirements. Additionally, all Vineyard Mid-Atlantic vessels will meet USCG bilge water regulations in 33 CFR Part 151. Vessels covered under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) are also subject to the effluent limits contained in the VGP.

Invasive species may be accidentally released during ballast and bilge water discharges from marine vessels (Pederson et al. 2021); however, utilizing best management practices (BMPs) for ballast and bilge water discharges (particularly for vessels transiting from foreign ports) would reduce the likelihood of accidental release of invasive species (BOEM 2024). Further, any potential introduction of invasive species from the offshore wind industry would be far less than existing activities like trans-oceanic shipping. Additionally, these infrequent releases would be spatially and temporally dispersed. Accordingly, ballast and bilge water releases are only anticipated to result in localized and short-term impacts to water quality and marine organisms such as benthic, finfish and invertebrates, and EFH resources.

Accidental releases of trash and debris may occur from vessels or other activities during construction, O&M, and decommissioning. All Vineyard Mid-Atlantic vessel personnel, construction personnel, survey personnel, or other contractors will receive Marine Trash and Debris Prevention training and will follow all BOEM and BSEE guidelines for marine trash and debris prevention. Further, vessel operators will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements. Since all vessels would be required to comply with laws and regulations to properly dispose of marine debris as well as BOEM guidelines, accidental releases of trash and debris are unlikely. Any marine debris accidentally released would be promptly recovered to the extent feasible. Accordingly, any inadvertent release of trash or debris is only anticipated to result in temporary and localized impacts to water quality, benthic resources, finfish and invertebrates, marine mammals, and sea turtles.

7.6 Coastal and Onshore Spills and Accidental Releases

While not expected, spills or accidental releases related to coastal or onshore infrastructure and activities could come from lubricating or hydraulic oils in construction equipment, refueling activities, waste and/or chemicals stored onshore, releases associated with horizontal directional drilling (HDD) activities, or trash and debris.

Refueling and lubrication of construction equipment will be conducted in a manner that protects coastal habitats, wetlands, and resources such as local drinking water supplies, from accidental spills. Where practicable, onshore vehicle fueling and all major equipment maintenance will be performed offsite at commercial service stations or a contractor's yard. Larger, less mobile equipment (e.g., excavators, paving equipment) will be refueled as necessary onsite. Any such field refueling will be performed in accordance with applicable on-site construction refueling regulations. Procedures for onshore refueling of construction equipment will be finalized during consultations with the appropriate state, regional, and local authorities. The fuel transfer operation will be performed by well-trained personnel knowledgeable about the equipment, the location, and the use of the work zone spill kit. For all fuel transfer operations or other appropriate activities, proper spill containment gear and absorption materials will be maintained for immediate use in the event of inadvertent spills or leaks, thereby minimizing the risk of potential impacts.

Further, any solid waste, trash, and/or debris associated with Vineyard Mid-Atlantic will be stored and properly disposed of in accordance with all applicable federal, state, and local regulations. While unlikely, accidental releases of trash and debris could potentially occur during nearshore project activities and onshore construction (e.g., onshore or nearshore cable installation, transport of equipment and personnel from ports). All Vineyard Mid-Atlantic vessel personnel, construction personnel, survey personnel, or other contractors will receive Marine Trash and Debris Prevention training and will follow all BOEM and BSEE guidelines for marine trash and debris prevention. Additionally, any marine debris or other trash accidentally released would be promptly recovered to the extent feasible. Accordingly, impacts to water quality, nearshore resources, and onshore resources are not expected.

In addition to this, the Proponent will develop a Spill Prevention, Control, and Countermeasure (SPCC) Plan for each onshore substation site, and onshore RCS (if required), in accordance with 40 CFR Part 112 and applicable state regulations during the state permitting process, which will describe onshore spill prevention and response procedures.

Lastly, HDD activities could result in temporary impacts to coastal habitats at the landfall sites. HDD operations will use bentonite or another non-hazardous drilling fluid beneath the coastal and nearshore habitats that are seaward of the HDD entry point. Crews are trained to closely monitor both the position of the drill head and the drilling fluid pressure to reduce the risk of inadvertent releases of pressurized drilling fluid to the surface (i.e., drilling fluid seepage). The Proponent will develop an HDD Inadvertent Release Response Plan, which will describe measures to reduce the risk of an inadvertent release and the immediate corrective actions that will be taken in the unlikely event of an inadvertent release. In the unlikely event of an inadvertent release, turbidity could occur. However, the impact of such an event is expected to be minor and temporary in nature. This is due to the fact that drilling fluid is a natural and inert substance and the amount of fluid used is typically low. Therefore, any released material is expected to pose little to no threat to water quality or ecological resources.

7.7 Terrorist Attacks

Although highly unlikely, Vineyard Mid-Atlantic could be a target for terrorism. Impacts associated with a terrorist attack would depend on the magnitude and location of the attack. Potential impacts from this type of event would be similar to the potential outcomes listed in the above sections and the same mitigation measures would apply, as appropriate. Measures described above to contain offshore spills and releases would be followed and are expected to minimize the environmental impacts from a terrorist attack.

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