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Coastal Virginia Offshore Wind Commercial Project Draft Environmental Impact Statement Volume 1

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ENVIRONMENTAL IMPACT STATEMENT FOR THE COASTAL VIRGINIA OFFSHORE WIND COMMERCIAL PROJECT

DRAFT (X) FINAL ( )

Lead Agency:	U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs
Cooperating Federal Agencies:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service U.S. Department of Defense U.S. Department of Defense, U.S. Army Corps of Engineers U.S. Department of Defense, U.S. Navy U.S. Department of Homeland Security, U.S. Coast Guard U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement U.S. Environmental Protection Agency
Participating Federal Agencies:	Advisory Council on Historic Preservation U.S. Department of the Interior, U.S. Fish and Wildlife Service U.S. Department of the Interior, National Park Service
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Area:	Renewable Energy Lease No. OCS-A-0483 (Lease Area)
Date for Comments:	February 14, 2023

Abstract:

This Draft Environmental Impact Statement (EIS) assesses the reasonably foreseeable impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance (O&M), and conceptual decommissioning of the Coastal Virginia Offshore Wind Commercial Project (Project) proposed by Dominion Energy, in its Construction and Operations Plan (COP). The proposed Project described in the COP and this Draft EIS would construct, operate, maintain, and eventually decommission an up-to 3,000-megawatt (MW) wind energy facility on the Outer Continental Shelf (OCS) offshore Virginia and associated onshore power distribution facilities. This Draft EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321–4370f) and implementing regulations of the Council on Environmental Quality and the Department of the Interior. This Draft EIS will inform the Bureau of Ocean Energy Management's decision on whether to approve, approve with modifications, or disapprove the Project's COP. Publication of the Draft EIS initiates a 60-day public comment period, after which all comments received will be assessed and considered by BOEM in preparation of a Final EIS.

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Acronyms and Abbreviations

μg/L	micrograms per liter
AAQS	ambient air quality standards
AC	alternating current
ACPARS	Atlantic Coast Port Access Route Study
ADLS	Aircraft Detection Lighting System
AIS	Automatic Identification System
AMOC	Atlantic meridional overturning circulation
AMSL	above mean sea level
APE	area of potential effect
APM	applicant-proposed measure
ASLF	ancient submerged landform feature
ASMFC	Atlantic States Marine Fisheries Commission
AWEA	American Wind Energy Association
BA	Biological Assessment
BBC	big bubble curtain
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BRCS	Benthic Resource Characterization Survey
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHIRP	compressed high-intensity radiated pulse
CO	carbon monoxide
CO_2	carbon dioxide
COBRA	CO-Benefits Risk Assessment
COP	Construction and Operations Plan
CSA	CSA Ocean Sciences Inc.
CVOW-C or Project	Coastal Virginia Offshore Wind Commercial Project
CWA	Clean Water Act
dB re 1 μPa	decibel referenced to 1 micropascal
dB	decibels
DC	direct current
DIN	dissolved inorganic nitrogen
DIP	dissolved inorganic phosphorous
DO	dissolved oxygen
DOAv	Virginia Department of Aviation
DOI	U.S. Department of the Interior
Dominion Energy, the lessee	Dominion Virginia Power
DP	dynamic positioning
DPS	distinct population segment

DPST	direct steerable pipe thrusting
DWR	deep-water route
EA	Environmental Assessment
EC	Engineer Circular
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electromagnetic fields
EMFs	electromagnetic forces
ESA	Endangered Species Act
ESC	Erosion and Sediment Control
FAA	Federal Aviation Administration
Fish Haven	Triangle Reef Fish Haven
FONSI	finding of no significant impact
FOV	field of view
FTE	full-time equivalent
G&G	geological and geophysical
GW	gigawatts
HAP	hazardous air pollutant
HAPC	habitat areas of particular concern
hazmat	hazardous materials
HF	high frequency
HFC	high-frequency cetacean
HLV	heavy lift vessel
HMS	Office of Highly Migratory Species
HRG	high-resolution geophysical
HUC	Hydrologic Unit Code
HVDC	high-voltage direct-current
IPF	impact-producing factor
KOP	Key Observation Point
kV	kilovolt
Lease Area	Lease Area OCS-A 0498
LFC	low-frequency cetaceans
LME	Large Marine Ecosystem
LNTMs	local notices to mariners
LP	sound pressure level
Lpk	peak sound pressure level
LPS	Large Pelagics Survey
LWB	Local Wetland Board
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council
MCL	maximum contaminant level
MFC	mid-frequency cetaceans
mg/L	milligrams per liter

mL	milliliter
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSA	Metropolitan Statistical Area
MVA	Minimum Vectoring Altitude
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NALFF	Naval Auxiliary Landing Field Fentress
NARWs	North Atlantic right whales
NAS Oceana	Naval Air Station Oceana
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	notice of availability
NOAA	National Oceanic and Atmospheric Administration
NOI	notice of intent
NO_X	nitrogen oxides
NSRA	Navigation Safety Risk Assessment
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OECC	offshore export cable corridor
OSS	offshore service stations
OW	otariid pinnipeds in water
PAM	passive acoustic monitoring
PDE	Project Design Envelope
PJM	Pennsylvania-New Jersey–Maryland interconnection
PM10	particulate matter smaller than 10 microns in diameter
PM2.5	particulate matter smaller than 2.5 microns in diameter
PMT	Portsmouth Marine Terminal
POI	Point of Interconnection
PPW	phocid pinnipeds in water
PSO	protected species observer
PSU	Practical Salinity Unity
PTS	permanent threshold shift
RAP	Research Activities Plan
RHA	Rivers and Harbors Act of 1899
ROD	Record of Decision

RODA	Responsible Offshore Development Alliance
RSZ	rotor swept zone
SAB	South Atlantic Bight
SAFMC	South Atlantic Fishery Management Council
SAR	search and rescue
SAR	stock assessment report
SCADA	supervisory control and data acquisition
SCC	State Corporation Commission
SEAMAP-SA	Southeast Monitoring and Assessment Program-South Atlantic
SELcum	sound exposure level over 24 hours
SHPO	state historic preservation office
SLIA	seascape, open ocean, and landscape impact assessment
SMR	State Military Reservation
SO_2	sulfur dioxide
SPL	sound pressure level
SPLRMS	root mean-square sound pressure level
T&E	Threatened and Endangered
TCP	traditional cultural property
TMDL	total maximum daily load
TSS	total suspended solids
TTS	temporary threshold shift
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDCR-DNH	Virginia Department of Conservation and Recreation Division of Natural Heritage
VDEQ	Virginia Department of Environmental Quality
VDHR	Virginia Department of Historic Resources
VIA	Visual Impact Assessment
VIMS	Virginia Institute of Marine Science
VMRC	Virginia Marine Resources Commission
VMS	Vessel Monitoring System
VOC	volatile organic compounds
WDA	wind development area
WEA	wind energy area
WNS	white-nose syndrome
WTG	wind turbine generator

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S. Executive Summary

S.1. Introduction

This Draft Environmental Impact Statement (EIS) assesses the reasonably foreseeable impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance (O&M), and conceptual decommissioning of a commercial-scale offshore wind energy facility and transmission cable to shore known as the Coastal Virginia Offshore Wind Commercial Project (CVOW-C or Project). The Bureau of Ocean Energy Management (BOEM) has prepared the Draft EIS under the National Environmental Policy Act (NEPA) (42 U.S. Code [U.S.C.] 4321–4370f). This Draft EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the Project's Construction and Operations Plan (COP).

Cooperating agencies may rely on this EIS to support their decision-making. In conjunction with submitting its COP, Virginia Electric and Power Company doing business as Dominion Virginia Power (Dominion Energy, the lessee) applied to the National Marine Fisheries Service (NMFS) for an incidental take authorization under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.), for incidental take of marine mammals during Project construction. NMFS is required to review applications and, if appropriate, issue an incidental take authorization under the MMPA. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support the authorization. The U.S. Army Corps of Engineers (USACE) similarly intends to adopt the EIS to meet its responsibilities under Section 404 of the Clean Water Act (CWA) and Section 10 and Section 14 of the Rivers and Harbors Act of 1899 (RHA).

S.2. Purpose and Need for the Proposed Action

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

Through a competitive leasing process under 30 Code of Federal Regulations (CFR) 585.211, Dominion Energy was awarded commercial Renewable Energy Lease OCS-A-0483. Dominion Energy has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of an offshore wind energy facility in the Lease Area (the Project) (Figure S-1).

Dominion Energy's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area; to provide between 2,500 and 3,000 megawatts (MW) of energy, making landfall in Virginia Beach, Virginia; and to use the offshore wind power generated from the proposed Project to supply its own customers (see Section 1.3 of the COP). Based on the goals of Dominion Energy, BOEM's authority, and Executive Order 14008, the purpose of BOEM's action is to respond to Dominion Energy's COP proposal and determine whether to approve, approve with modifications, or disapprove Dominion Energy's COP to construct and install, operate, and maintain, and decommission a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action). BOEM's action is needed to further the United States policy, including Executive Order 14008, to make Outer Continental Shelf (OCS) energy resources available for expeditious and orderly development, subject to environmental safeguards (43 U.S.C. 1332(3)), including consideration of natural resources, safety of navigation, and existing ocean uses.

In addition, the National Oceanic and Atmospheric Administration's NMFS received a request for authorization to take marine mammals incidental to construction activities related to the Project under the MMPA on February 16, 2022. NMFS' issuance of an MMPA incidental take authorization is a major federal action, and, in relation to BOEM's action, is considered a connected action (40 CFR 1501.9I(1)). The purpose of the NMFS action—which is a direct outcome of Dominion Energy's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate the lessee's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of the lessee's activities on relevant resources, and, if appropriate, issue the authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS' responsibilities under the MMPA (16 U.S.C. 1371(a)(5)(A and D)) and its implementing regulations. If, after independent review, NMFS makes the findings necessary to issue the requested authorization, NMFS, after independent review, intends to adopt BOEM's EIS to support that decision and fulfill its NEPA requirements.

USACE Norfolk District anticipates a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, under Section 10 of the RHA (33 U.S.C. 403) and Section 404 of the CWA (33 U.S.C. 1344). In addition, it is anticipated that a Section 408 permission will be required pursuant to Section 14 of the RHA (33 U.S.C. 408) for any proposed alterations that have the potential to alter, occupy, or use any USACE federally authorized Civil Works projects. USACE considers issuance of a permit or permissions under these three delegated authorities a major federal action connected to BOEM's Proposed Action (40 CFR 1501.9(e)(1)). The purpose and need for the Project as provided by the lessee in Section 1.3 of the COP and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project within the area covered by Lease OCS-A-0483 to help states achieve their renewable energy goals. The basic Project purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy project for renewable energy generation and distribution to the PJM Interconnections energy grid. The purpose of the USACE Section 408 action as determined by Engineer Circular 1165-2-220 is to evaluate the lessee's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE project. The USACE Section 408 permission is needed to ensure that Congressionally authorized projects continue to provide their intended benefits to the public. USACE intends to adopt BOEM's EIS to support its decision on any permits or permissions requested under Section 10 of the RHA, Section 404 of the CWA, or Section 14 of the RHA. USACE would adopt the EIS pursuant to 40 CFR 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, USACE would issue a Record of Decision to formally document its decision on the Proposed Action.

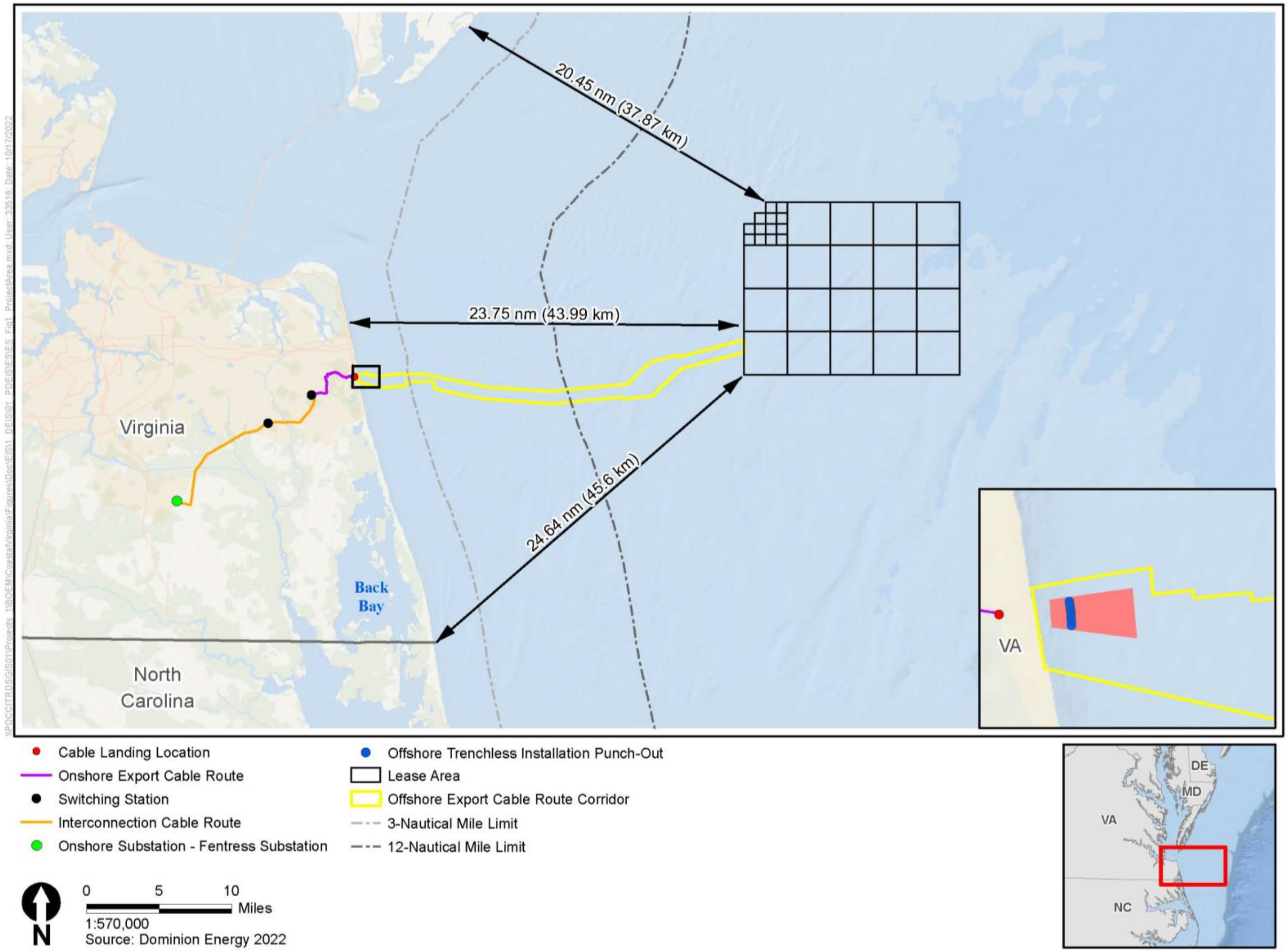

Figure S-1 Coastal Virginia Offshore Wind Commercial Project

S.3. Public Involvement

On July 2, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS, initiating a 30-day public scoping period from July 2 to August 2, 2021 (86 *Federal Register* 35329). The NOI solicited public input on the significant resources and issues, impact-producing factors, reasonable alternatives, and potential mitigation measures to analyze in the EIS. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the National Historic Preservation Act (54 U.S.C. 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), and sought public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the Dominion COP. BOEM held three virtual public scoping meetings on July 12, July 14, and July 20, 2021, to present information on the Project and NEPA process, answer questions from meeting attendees, and to solicit public comments. Scoping comments were received through Regulations.gov on docket number BOEM-2021-0040, via email to a BOEM representative, and through oral testimony at each of the three public scoping meetings. BOEM received total of 52 comment submissions from federal and state agencies, local governments, non-governmental organizations, and the general public during the scoping period. The topics most referenced in the scoping comments included mitigation and monitoring; commercial fisheries and for-hire recreational fishing; finfish, invertebrates, and essential fish habitat; marine mammals; birds; air quality and climate change; employment and job creation; wetlands and Waters of the U.S.; purpose and need; alternatives; and cumulative impacts. BOEM considered all scoping comments while preparing this Draft EIS. Publication of this Draft EIS initiates a 60-day public comment period. BOEM will consider the comments received on the Draft EIS during preparation of the Final EIS.

S.4. Alternatives

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

- No Action Alternative
- Alternative A—Proposed Action
  - Alternative A-1—Revised Layout to Align Substations and Wind Turbine Generators (WTGs)
- Alternative B—Revised Layout to Accommodate the Fish Haven and Navigation
- Alternative C—Sand Ride Impact Minimization Alternative
- Alternative D—Onshore Habitat Impact Minimization Alternative
  - Alternative D-1—Interconnection Cable Route Option 6 (Hybrid Route)
  - Alternative D-2—Interconnection Cable Route Option 1

Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.1.6.

S.4.1 No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP. Project construction and installation, O&M, and decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other existing or other reasonably foreseeable future activities described in Appendix F, *Planned Activities Scenario,* would continue. The ongoing effects of the No Action Alternative serve as the baseline against which all action alternatives are evaluated.

S.4.2 Alternative A—Proposed Action

The Proposed Action would construct, operate, maintain, and eventually decommission an up-to 3,000-MW wind energy facility on the OCS offshore Virginia and associated onshore power distribution facilities within the range of design parameters described in Chapters 1 through 3 of the CVOW-C COP (Dominion Energy 2022) and summarized in Table S-1 and Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Under the Proposed Action, the wind energy facility would consist of up to 205 WTGs ranging from 14 MW to 16 MW each. Refer to Chapter 2 of the CVOW-C COP (Dominion Energy 2022) for additional details on Project design.

- **Alternative A-1 – Revised Layout to Align Substations and WTGs:** Alternative A-1 is the same as Alternative A, except that under Alternative A-1 the three offshore substations (OSSs) would be placed within the rows of the gridded WTG layout, taking the place of three WTG positions (i.e., Alternative A-1 would result in up to 202 WTGs and three OSSs).

Table S-1 Summary of Project Design Envelope Parameters

Project Parameter Details
General (Layout and Project Size)
• 176 to 205 WTGs • Anticipated to begin offshore construction in 2024 (foundations) and 2025 (WTGs) • Construction of the Project is expected to be complete within approximately 3 years
WTGs and Foundations
• Siemens Gamesa Renewable Energy SG 14-222 DD WTG with power-boost technology • 14- to 16-MW WTGs characterized as “minimum” and “maximum” capacity • Rotor diameter ranging from 725 to 761 feet (221 to 232 meters) • Hub height from mean sea level (MSL) ranging from 446 to 489 feet (136 to 149 meters) • Turbine tip height from MSL ranging from 804 to 869 feet (245 to 265 meters) • Installation of monopiles through pile driving • Scour protection is proposed to be installed around WTG monopile foundations. Installation vessels to include jack-up, platform supply, crew transfer, tugs, barges, heavy-lift vessels, fall pipe vessels, walk-to-work, and other support vessel types as necessary.
Inter-Array Cables
• Up to 66-kV cables buried 3.3 to 9.8 feet (1 to 3 meters) beneath the seabed • Up to 300 miles (484 kilometers) total length of inter-array cables (average inter-array cable length of 5,868 feet [1,789 meters] between turbines) • Installation by jet trenching, chain cutting, trench former, or other available technologies • Installation vessels to include deep-draft cable lay, walk-to-work, crew transfer, trenching support, burial tool, survey, multipurpose support vessels, and other support vessel types as necessary

Project Parameter Details
Offshore Export Cables
• Up to nine 230-kV offshore export cables buried 3.3 to 16.4 feet (1 to 5 meters) beneath the seabed; with additional cover in some sections, total burial depth may be up to 24.6 feet (7.5 meters) • Nine offshore export cables (in a single corridor) • Up to 416.9 miles (671 kilometers) total length of offshore export cable • Installation by jet trenching, plowing, chain cutting, trench former, or other available technologies • Installation vessels to include pull-in support barge, tug, multipurpose support, survey, shallow-draft cable lay, hydroplow, crew transfer, deep-draft, walk-to-work, trenching support, burial tool vessels, and other support vessel types as necessary • Cable protection at the cable crossings
Offshore Substations
• Three OSSs • OSSs installed atop piled jacket foundations • Scour protection installed at all foundation locations • Installation vessels to include barge, tug, transport, heavy lift, anchor handling, jack-up vessels, platform support, and other support vessel types as necessary
Onshore Facilities
• Landfall of offshore export cable(s) would be completed via Trenchless Installation • Maximum area of temporary disturbance for cable landing location: 2.8 acres (1.1 hectares maximum temporary workspace at the Nearshore Trenchless Installation Area approximately 8.8 acres [3.6 hectares]) • Construction work area for the switching station: maximum of approximately 45.4 acres (18.4 hectares) • Construction work area for the upgrades at the onshore substation (existing Dominion Energy Fentress substation): maximum of approximately 18.5 acres (7.5 hectares) • Maximum onshore export cable length of approximately 4.41 miles (7.10 kilometers) • Maximum interconnection cable length of approximately 14.2miles (22.9 kilometers) • Maximum area of temporary disturbance for onshore export cable route of approximately 26.6 acres (10.8 hectares) acres (27.6 hectares)[1] • Maximum area of permanent disturbance for onshore export cable route of approximately 1.0 acre (0.4 hectares)[2] • Maximum area of temporary disturbance for Interconnection Cable Route Option 1 of approximately 0 acres (0 hectares)[2] • Maximum area of permanent disturbance for Interconnection Cable Route Option 1 of approximately 1 acre (0.4 hectare)[3] • Maximum area of temporary disturbance for Hybrid Interconnection Cable Route Option 6 of approximately 29.0 acres (11.7 hectares)[4] • Maximum area of permanent disturbance for Hybrid Interconnection Cable Route Option 6 of approximately 4.2 acres (1.7 hectares)[5]

Sources: COP Table 1.2-1; Dominion Energy 2022; BOEM and Dominion Energy 2022..
kV = kilovolt; MSL = mean sea level.

[1] For the purposes of this analysis, the estimated temporary disturbance for the onshore export cable route is associated with the areas of the route that are surface trenched (60-foot-wide [18-meter-wide] trench for ~3.7 miles [6 kilometers]).
[2] For the purposes of this analysis, the estimated permanent disturbance for the onshore export cable route is associated with the permanent structures (i.e., manhole vaults).

[3] For the purposes of this analysis, the total permanent disturbance for Interconnection Cable Route Option 1 is associated with the new permanent structures (i.e., transmission towers) to be installed within the new/proposed right-of-way. For the purposes of this analysis, it is assumed that no other land disturbance will occur within the interconnection cable route.
[4] For the purposes of this analysis, the estimated temporary disturbance for Hybrid Interconnection Cable Route Option 6 is associated with the area of the underground portion of the route that is surface trenched.
[5] For the purposes of this analysis, the estimated permanent disturbance for Hybrid Interconnection Cable Route Option 6 is associated with the permanent structures (i.e., manhole vaults for the underground portion of the route and transmission towers for the overhead portion of the route).

S.4.3 Alternative B—Revised Layout to Accommodate the Fish Haven and Navigation

Under Alternative B, the construction, O&M, and eventual decommissioning of a 2,587-MW wind energy facility on the OCS offshore Virginia would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, the fish haven area along the northern boundary of the Lease Area would be an exclusion zone where eight WTGs and associated inter-array cables and other Project infrastructure would not be sited. Three WTGs and associated inter-array cables would also be excluded from the northwest corner of the Lease Area to avoid conflicts with a proposed vessel traffic fairway. Up to 176 WTGs under Alternative B would each be 14 MW and capable of generating up to 14.7 MW using power-boost capability in a 0.93- by 0.75-nautical-mile (1.72- by 1.39-kilometer) offset grid in an east–west by northwest by southeast gridded layout. The three OSSs would be placed within the rows of the gridded WTG layout to minimize disruptions to surface and aerial navigation through the Wind Turbine Area. This configuration would still allow micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, to avoid sensitive cultural resources and marine habitats. Onshore components would be the same as described under Alternative A.

S.4.4 Alternative C—Sand Ridge Impact Minimization Alternative

Alternative C was developed through the scoping process for the Draft EIS in response to comments received requesting an alternative to minimize impacts on offshore benthic habitats. Under Alternative C, the construction, O&M, and eventual decommissioning of a wind energy facility would include a similar offshore layout and range of design parameters as described under Alternative B. However, in addition to avoiding the fish haven and the proposed vessel traffic fairway, Alternative C would avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, the removal of four WTGs from priority ridge habitat, and the relocation of one WTG to a spare position. Under Alternative C, the removal of four WTGs and relocation of one WTG allows for the reconfiguration of inter-array cabling that would otherwise be developed within priority sand ridge habitats, thus reducing potential seafloor disturbance, including the cross-cutting and trenching of sand ridges. As a result, an up-to 2,528 MW wind energy facility consisting of up to 172 WTGs (inclusive of two spare WTG positions) and three OSSs with associated export cables would be developed under Alternative C. As under Alternative B, Alternative C would use 14 MW WTGs generating up to 14.7 MW each using power-boost capability in a 0.93- by 0.75-nautical-mile (1.72- by 1.38-kilometer) offset grid pattern. Onshore components would be the same as described under the Proposed Action.

S.4.5 Alternative D—Onshore Habitat Minimization Alternative

Alternative D was developed through the scoping process for the Draft EIS in response to public comments regarding the potential impacts on sensitive onshore habitats, including wetlands. Under Alternative D, the construction, O&M, and eventual decommissioning of a wind energy facility would include the same offshore layout and range of design parameters as Alternative A: an up-to 3,000 MW wind energy facility consisting of up to 205 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area, with associated export cables. Unlike Alternative A, the construction of onshore interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid Route). Therefore, under Alternative D BOEM would consider and potentially approve Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6, whereas only Interconnection Cable Route Option 1 is considered under Alternative A. Each of the following sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

- **Alternative D-1:** Interconnection Cable Route Option 1 would be the same as described under the Proposed Action and would be approximately 14.2 miles (22.9 kilometers) long and installed entirely overhead. From the common location north of Harpers Road, Interconnection Cable Route Option 1 would continue to the onshore substation, and the new Harpers Switching Station would be located at Naval Air Station (NAS) Oceana Parcel, pending Navy approval.
- **Alternative D-2:** Interconnection Cable Route Option 6 (Hybrid Route) would be approximately 14.2 miles (22.9 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. Following Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, Interconnection Cable Route Option 6 would transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation. The maximum construction and operational corridor for the underground portion of Interconnection Cable Route Option 6 would be 86.5 feet (26 meters); the overhead portion would be 250 feet (76.2 meters), which is equivalent to the corridor width for Interconnection Cable Route Option 1.

Interconnection Cable Route Option 1 would be an entirely overhead route, while Interconnection Cable Route Option 6 (Hybrid Route) would involve installation of the interconnection cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores when compared to the other interconnection cable routes considered in the Project Design Envelope (Interconnection Cable Route Options 2 through 5).

S.5. Environmental Impacts

This Draft EIS uses a four-level classification scheme to characterize the potential beneficial impacts and adverse impacts of alternatives as either **negligible**, **minor**, **moderate**, or **major**. Resource-specific adverse and beneficial impact level definitions are presented in each Chapter 3 resource section. Table S-2 summarizes the impacts of each alternative and the impacts of each alternative combined with other reasonably foreseeable impacts. Under the No Action Alternative, the environmental and socioeconomic impacts and benefits of the action alternatives would not occur.

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

Appendix L, *Other Impacts*, describes potential unavoidable adverse impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. Appendix L also describes irreversible and irretrievable commitment of resources by resource area. The most notable such commitments could include effects on habitat or individual members of protected species.

Table S-2 Summary and Comparison of Impacts Among Alternatives with No Mitigation Measures

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout to Accommodate the Fish Haven and Navigation	Alternative C Sand Ridge Impact Minimization Alternative	Alternative D Onshore Habitat Impact Minimization Alternative
3.4 Air Quality					
Alternative Impacts	Moderate	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Alternative Combined with Other Foreseeable Impacts	Moderate; moderate beneficial	Minor; moderate beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
3.5 Bats					
Alternative Impacts	Minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Alternative Combined with Other Foreseeable Impacts	Minor	Minor	Minor	Minor	Minor
3.6 Benthic Resources					
Alternative Impacts	Moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial
Alternative Combined with Other Foreseeable Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.7 Birds					
Alternative Impacts	Moderate	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Moderate
Alternative Combined with Other Foreseeable Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout to Accommodate the Fish Haven and Navigation	Alternative C Sand Ridge Impact Minimization Alternative	Alternative D Onshore Habitat Impact Minimization Alternative
3.8 Coastal Habitats					
Alternative Impacts	Moderate	Minor	Minor	Minor	Minor
Alternative Combined with Other Foreseeable Impacts	Negligible	Minor	Minor	Minor	Moderate; minor beneficial
3.9 Commercial Fisheries and For-Hire Recreational Fishing					
Alternative Impacts	Moderate to major on commercial fisheries and moderate on for-hire recreational fishing	Moderate on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Moderate on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Moderate on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Moderate to major on commercial fisheries and moderate on for-hire recreational fishing
Alternative Combined with Other Foreseeable Impacts	Moderate to major on commercial fisheries and moderate on for-hire recreational fishing	Major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Moderate to major on commercial fisheries and moderate on for-hire recreational fishing
3.10 Cultural Resources					
Alternative Impacts	Moderate on individual onshore and offshore cultural resources	Moderate to major on onshore and offshore cultural resources without National Historic Places Act (NHPA) pre-construction requirements	Moderate to major on onshore and offshore cultural resources without NHPA pre-construction requirements	Moderate to major on onshore and offshore cultural resources without NHPA pre-construction requirements	Negligible to major on onshore and offshore cultural resources without NHPA pre-construction requirements

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout to Accommodate the Fish Haven and Navigation	Alternative C Sand Ridge Impact Minimization Alternative	Alternative D Onshore Habitat Impact Minimization Alternative
Alternative Combined with Other Foreseeable Impacts	Moderate on individual onshore and offshore cultural resources	Moderate to major without pre-construction NHPA requirements, considering long-term or permanent and irreversible impacts on cultural resources	Negligible to major assuming implementation of mitigation measures	Negligible to major assuming implementation of mitigation measures	Negligible to major assuming implementation of mitigation measures
3.11 Demographics, Employment, and Economics					
Alternative Impacts	Minor adverse impacts; minor beneficial impacts on demographics, employment, and economics	Negligible to minor adverse; minor beneficial impacts on demographics, employment, and economics	Negligible to minor adverse; negligible to moderate beneficial impacts on demographics, employment, and economics	Negligible to minor adverse; negligible to moderate beneficial impacts on demographics, employment, and economics	Negligible to minor adverse; negligible to minor beneficial impacts on demographics, employment, and economics
Alternative Combined with Other Foreseeable Impacts	Minor on demographics, economics, and employment	Minor adverse; minor to moderate beneficial impacts on demographics, employment, and economics	Negligible to minor adverse; negligible to moderate beneficial impacts on demographics, employment, and economics	Negligible to minor adverse; negligible to moderate beneficial impacts on demographics, employment, and economics	Negligible to minor adverse; negligible to minor beneficial impacts on demographics, employment, and economics
3.12 Environmental Justice					
Alternative Impacts	Minor to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Alternative Combined with Other Foreseeable Impacts	Minor	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout to Accommodate the Fish Haven and Navigation	Alternative C Sand Ridge Impact Minimization Alternative	Alternative D Onshore Habitat Impact Minimization Alternative
3.13 Finfish, Invertebrates, and Essential Fish Habitat					
Alternative Impacts	Minor to moderate	Negligible to moderate; minor beneficial	Negligible to moderate	Negligible to moderate	Negligible to moderate
Alternative Combined with Other Foreseeable Impacts	Minor to moderate; moderate beneficial	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.14 Land Use and Coastal Infrastructure					
Alternative Impacts	Minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
Alternative Combined with Other Foreseeable Impacts	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
3.15 Marine Mammals					
Alternative Impacts	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Alternative Combined with Other Foreseeable Impacts	Moderate to major	Moderate to major	Moderate to major; minor beneficial	Moderate to major; minor beneficial	Moderate to major; minor beneficial
3.16 Navigation and Vessel Traffic					
Alternative Impacts	Moderate	Minor to moderate	Minor to major	Minor to major	Minor to moderate
Alternative Combined with Other Foreseeable Impacts	Minor to moderate	Minor to major	Minor to major	Minor to major	Minor to major

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout to Accommodate the Fish Haven and Navigation	Alternative C Sand Ridge Impact Minimization Alternative	Alternative D Onshore Habitat Impact Minimization Alternative
3.17 Other Uses					
Alternative Impacts	Negligible on Marine Mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems; moderate on scientific research and surveys	Minor on marine mineral extraction; moderate on military and national security uses; negligible on aviation and air traffic with implementation of mitigation measures; negligible on cables and pipelines with implementation of mitigation measures; minor on radar systems; major on scientific research and surveys	Minor on marine mineral extraction; moderate on military and national security uses; negligible on aviation and air traffic with implementation of mitigation measures; negligible on cables and pipelines with implementation of mitigation measures; minor on radar systems; major on scientific research and surveys	Minor on marine mineral extraction; moderate on military and national security uses; negligible on aviation and air traffic with implementation of mitigation measures; negligible on cables and pipelines with implementation of mitigation measures; minor on radar systems; major on scientific research and surveys	Minor on marine mineral extraction; moderate on military and national security uses; negligible on aviation and air traffic with implementation of mitigation measures; negligible on cables and pipelines with implementation of mitigation measures; minor on radar systems; major on scientific research and surveys
Alternative Combined with Other Foreseeable Impacts	Minor on marine mineral extraction and national security and military uses; negligible on aviation and air traffic, cables and pipelines, and radar systems; major on scientific research and surveys	Negligible to minor on aviation and air traffic; negligible to minor on cables and pipelines; negligible to minor for marine mineral extraction; negligible to minor on radar systems; moderate on most military and national security uses; negligible to minor on radar systems; moderate for scientific research and surveys	Negligible to minor on aviation and air traffic; negligible to minor on cables and pipelines; negligible to minor on marine mineral extraction; negligible to minor on radar systems; moderate on most military and national security uses; negligible to minor on radar systems; major on scientific research and surveys	Negligible to minor on aviation and air traffic; negligible to minor on cables and pipelines; negligible to minor on marine mineral extraction; negligible to minor on radar systems; moderate on most military and national security uses; negligible to minor on radar systems; major on scientific research and surveys	Negligible to minor on aviation and air traffic; negligible to minor on cables and pipelines; negligible to minor on marine mineral extraction; negligible to minor on radar systems; moderate on most military and national security uses; negligible to minor on radar systems; major on scientific research and surveys

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout to Accommodate the Fish Haven and Navigation	Alternative C Sand Ridge Impact Minimization Alternative	Alternative D Onshore Habitat Impact Minimization Alternative
3.18 Recreation and Tourism					
Alternative Impacts	Negligible; negligible beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial
Alternative Combined with Other Foreseeable Impacts	Minor; minor beneficial	Minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
3.19 Sea Turtles					
Alternative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate
Alternative Combined with Other Foreseeable Impacts	Moderate; minor beneficial	Moderate	Moderate	Moderate	Moderate
3.20 Scenic and Visual Resources					
Alternative Impacts	Minor	Minor to moderate	Minor to moderate	Minor to moderate	Moderate
Alternative Combined with Other Foreseeable Impacts	Moderate to major	Moderate	Moderate	Moderate	Moderate
3.21 Water Quality					
Alternative Impacts	Minor	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
Alternative Combined with Other Foreseeable Impacts	Minor	Minor	Minor	Minor	Minor
3.22 Wetlands					
Alternative Impacts	Moderate	Moderate to major	Moderate to major	Moderate to major	Moderate to major

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout to Accommodate the Fish Haven and Navigation	Alternative C Sand Ridge Impact Minimization Alternative	Alternative D Onshore Habitat Impact Minimization Alternative
Alternative Combined with Other Foreseeable Impacts	Moderate	Moderate to major	Moderate to major	Moderate to major	Moderate to major

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor; light green = negligible or beneficial to any degree. All impact levels are assumed to be adverse unless otherwise specified as beneficial. Where impacts are presented as multiple levels, the color representing the most adverse level of impact has been applied.
NRHP = National Register of Historic Places.

1. Introduction

This Draft Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, operations and maintenance (O&M), and conceptual decommissioning of the Coastal Virginia Offshore Wind Commercial Project (CVOW-C or Project) proposed by Virginia Electric and Power Company doing business as Dominion Virginia Power (Dominion Energy or lessee), in its Construction and Operations Plan (COP; Dominion Energy 2022).[1] The proposed Project described in the COP and this Draft EIS is a wind farm between 2,500 and 3,000 megawatts (MW) in power capacity that would be sited 27 miles (23.75 nautical miles) off the Virginia Beach, Virginia, coastline within the area covered by Renewable Energy Lease No. OCS-A-0483 (Lease Area). The Project would supply the offshore wind power that it generates to the customers of Dominion Energy. This Draft EIS will inform the Bureau of Ocean Energy Management (BOEM) in deciding whether to approve, approve with modifications, or disapprove the proposed Project. Publication of this Draft EIS initiates a 60-day public comment period; BOEM will use the comments received during the public comment period to inform preparation of the Final EIS.

This Draft EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321–4370f) and NEPA implementing regulations of the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] 1500–1508). CEQ revised these regulations on April 20, 2022, and the current regulations, effective May 20, 2022, contain a presumptive time limit of 2 years for completing EISs and a presumptive page limit of 150 pages or fewer or 300 pages for proposals of unusual scope or complexity. BOEM has followed those limits in preparing this EIS in accordance with the new regulations. Additionally, this Draft EIS was prepared consistent with the U.S. Department of the Interior (DOI) NEPA regulations (43 CFR 46), longstanding federal judicial and regulatory interpretations, and Administration priorities and policies including the Secretary of the Interior's Order No. 3399 requiring bureaus and offices to not apply any of the provisions of the 2020 changes to CEQ regulations (85 *Federal Register* 43304–43376) "in a manner that would change the application or level of NEPA that would have been applied to a proposed action before the 2020 Rule went into effect."

1.1. Background

In 2009, DOI issued final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005. The Energy Policy Act provisions implemented by BOEM provide a framework for issuing renewable energy leases, easements, and rights-of-way for OCS activities (Section 1.3, *Regulatory Framework*). BOEM's renewable energy program has four phases: (1) planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. The history of BOEM's planning and leasing activities offshore Virginia is summarized in Table 1-1.

[1] The Dominion Energy COP and appendices are available on BOEM's website: https://www.boem.gov/renewable-energy/state-activities/cvow-construction-and-operations-plan.

Table 1-1 History of BOEM Planning and Leasing Offshore Virginia

Year	Milestone
2012	On February 3, 2012, BOEM published a Call for Information and Nominations (Call) for Commercial Leasing for Wind Power on the OCS Offshore Virginia in the *Federal Register*. The public comment period for the Call closed on March 19, 2012. In response, BOEM received eight commercial indications of interest.
2012	On February 3, 2012, BOEM published in the *Federal Register* a notice of availability (NOA) of a final Environmental Assessment (EA) and finding of no significant impact (FONSI) for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia.
2012	On December 3, 2012, BOEM published a Proposed Sale Notice requesting public comments on the proposal to auction one lease offshore Virginia for commercial wind energy development.
2013	On July 23, 2013, BOEM published a Final Sale Notice, which stated that a commercial lease sale would be held September 4, 2013, for the wind energy area (WEA) BOEM had designated offshore Virginia. The Virginia WEA was auctioned as one lease, and Virginia Electric and Power Company (doing business as Dominion Virginia Power) was the winner (Renewable Energy Lease OCS-A-0483.
2016–2017	On March 2, 2016, Dominion Energy submitted a Site Assessment Plan (SAP) for Lease OCS-A-0483. BOEM approved the SAP on October 12, 2017.
2020–2021	On October 28, 2020, Dominion Energy submitted a new SAP for Lease OCS-A-0483. BOEM approved the SAP on October 1, 2021.
2020–2022	On December 17, 2020, Dominion Energy submitted a COP for the construction, operations, and conceptual decommissioning of the Project within the Lease Area. Updated versions of the COP were submitted on June 29, 2021; October 29, 2021; December 3, 2021; and May 6, 2022.
2021	On July 2, 2021, BOEM published a notice of intent (NOI) to prepare an EIS for the proposed Project.
2022	On December 16, 2022, BOEM published an NOA of a Draft EIS, initiating a 60-day public comment period for the Draft EIS.

1.2. Purpose and Need of the Proposed Action

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

Through a competitive leasing process under 30 CFR 585.211, Dominion Energy was awarded commercial Renewable Energy Lease OCS-A-0483. Dominion Energy has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of an offshore wind energy facility in the Lease Area (the Project).

Dominion Energy's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area, to provide between 2,500 and 3,000 MW of energy, making landfall in Virginia Beach, Virginia, and use the offshore wind power generated from the proposed Project to supply its own customers (see Section 1.3 of the COP). Dominion Energy's goal of 2,500 to 3,000 MW of offshore wind energy in service by 2028 is mandated for Dominion Energy under the 2020 Virginia Clean Economy Act.[2] Based on the goals of the lessee, BOEM's authority, and Executive Order 14008, the purpose of BOEM's action is to respond to Dominion Energy's COP proposal and determine whether to approve, approve with modifications, or disapprove Dominion Energy's COP to construct and install, operate, and maintain, and decommission a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action). BOEM's action is needed to further the United States policy, including Executive Order 14008, to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards (43 U.S.C. 1332(3)), including consideration of natural resources, safety of navigation, and existing ocean uses.

In addition, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) received a request for authorization to take marine mammals incidental to construction activities related to the Project under the Marine Mammal Protection Act (MMPA) on February 16, 2022. NMFS' issuance of an MMPA incidental take authorization is a major federal action, and, in relation to BOEM's action, it is considered a connected action (40 CFR 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of Dominion Energy's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate the lessee's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of the lessee's activities on relevant resources, and, if appropriate, issue the authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS' responsibilities under the MMPA (16 U.S.C. 1371(a)(5)(A and D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS, after independent review, intends to adopt BOEM's EIS to support that decision and fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (USACE) Norfolk District anticipates a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, under section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 U.S.C. 403) and section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344). In addition, it is anticipated that a section 408 permission will be required pursuant to section 14 of the RHA of 1899 (33 U.S.C. 408) for any proposed alterations that have the potential to alter, occupy, or use any USACE federally authorized Civil Works projects. The USACE considers issuance of a permit or permissions under these three delegated authorities a major federal action connected to BOEM's Proposed Action (40 CFR 1501.9(e)(1)). The purpose and need for the Project as provided by the lessee in Section 1.3 of the COP and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project within the area covered by Lease OCS-A-0483 to help states achieve their renewable energy goals. The basic Project purpose, as determined by USACE for section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose for section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy project for renewable energy generation and distribution to the PJM Interconnections energy grid. The purpose of the USACE section 408 action as determined by Engineer Circular (EC) 1165-2-220 is to evaluate the lessee's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE project. The USACE section 408 permission is needed to ensure that Congressionally authorized projects continue to provide their intended benefits to the public. USACE intends to adopt BOEM's EIS to support its decision on any permits or permissions requested under section 10 of the RHA, section 404 of the CWA, or section 14 of the RHA. The USACE would adopt the EIS pursuant to 40 CFR 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies the USACE's comments

[2] https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526.

and recommendations. Based on its participation as a cooperating agency and its consideration of the final EIS, the USACE would issue a Record of Decision (ROD) to formally document its decision on the proposed action.

1.3. Regulatory Framework

The Energy Policy Act of 2005, Public Law 109-58, added section 8(p)(1)(c) to the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. 1337(p)(1)(c).[3] The new section authorized the Secretary of the Interior to issue leases, easements, and rights-of-way in the OCS for renewable energy development, including wind energy. The Secretary of the Interior delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under the OCSLA (30 CFR 585) were promulgated on April 22, 2009.[4] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove Dominion Energy's COP (30 CFR 585.628).

Consistent with the requirements of the OCSLA and applicable regulations, Section 2 of BOEM's lease form provides the lessee with the right to submit a COP to BOEM for approval. Section 3 provides that BOEM will decide whether to approve a COP in accordance with applicable regulations in 30 CFR 585. BOEM retains the right to disapprove a COP based on its determination that the proposed activities would have unacceptable environmental consequences, would conflict with one or more of the requirements set forth in 43 U.S.C. 1337(p)(4), or for other reasons provided by BOEM pursuant to 30 CFR 585.613(e)(2) or 585.628(f); BOEM reserves the right to approve a COP with modifications; and BOEM reserves the right to authorize other uses within the Lease Area and Project easement that will not unreasonably interfere with activities described in an approved COP pursuant to the lease.

BOEM's evaluation and decision on the COP are also governed by other applicable federal statutes and implementing regulations such as NEPA and the Endangered Species Act (ESA;16 U.S.C. 1531–1544). The analyses in this Draft EIS will inform BOEM's decision under 30 CFR 585.628 for the COP that was initially submitted to BOEM in December 2020 and later updated with new information on June 29, 2021; October 29, 2021; December 3, 2021; and May 6, 2022.

The Environmental Assessment for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia (BOEM 2012) gives a more comprehensive description of BOEM's regulatory authority and decision-making process and is incorporated by reference in this Draft EIS. BOEM is required to coordinate with tribes, federal agencies, and state and local governments to ensure that renewable energy development occurs in a safe and environmentally responsible manner. Appendix A, *Required Environmental Permits and Consultations*, outlines the federal, state, regional, and local permits and authorizations that are required for the Project and the status of each permit and authorization. Appendix A also provides a description of BOEM's consultation efforts during development of the Draft EIS.

1.4. Relevant Existing NEPA and Consulting Documents

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

- *Final Programmatic EIS for Alternative Energy Development and Production and Alternate Use of*

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

Facilities on the Outer Continental Shelf (BOEM 2007). This programmatic EIS examined the potential environmental consequences of implementing the Alternative Energy and Alternate Use Program on the OCS and established initial measures to mitigate environmental consequences. As the program evolves and more is learned, the mitigation measures may be modified or new measures developed.

- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia, (BOEM 2012). BOEM prepared this Environmental Assessment to determine whether issuance of a lease and approval of a Site Assessment Plan within the wind energy area (WEA) offshore New Jersey, Delaware, Maryland, and Virginia would lead to reasonably foreseeable significant impacts on the environment, and, thus, whether an EIS should be prepared before a lease is issued.*

Additional environmental studies conducted to plan for offshore wind energy development are available on BOEM's website: https://www.boem.gov/renewable-energy-research-completed-studies.

1.5. Methodology for Assessing the Project Design Envelope

Dominion Energy would implement a Project Design Envelope (PDE) concept. This concept allows Dominion Energy to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as wind turbine generators, foundations, submarine cables, and offshore substations.

This Draft EIS assesses the impacts of the PDE that is described in the CVOW-C COP and presented in Appendix E, *Project Design Envelope and Maximum-Case Scenario*, by using the "maximum-case scenario" process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Draft EIS evaluates potential impacts of the Proposed Action and each alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource.[5] This Draft EIS considers the interrelationship between aspects of the PDE rather than viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Appendix E explains the PDE approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area.

1.6. Methodology for Assessing Impacts

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

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

1.6.1 Past and Ongoing Activities and Trends (Existing Baseline)

Each resource-specific *Environmental Consequences* section in Chapter 3, *Affected Environment and Environmental Consequences,* of this Draft EIS includes a description of the baseline conditions of the affected environment. The existing baseline considers past and present activities in the geographic analysis area, including those related to offshore wind projects with an approved construction and operations plan (e.g., CVOW-Pilot Project) and approved past and ongoing site assessment surveys, as well as other non-wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources as influenced by past and ongoing activities and trends comprises the existing baseline condition for impact analysis. Other factors currently affecting the resource, including climate change, are also acknowledged for that resource and are included in the impact-level conclusion.

1.6.2 Cumulative Impacts of Ongoing and Planned Activities

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

2 Alternatives Including the Proposed Action

This chapter (1) describes the alternatives carried forward for detailed analysis in this Draft EIS, including the Proposed Action, No Action Alternative, and other action alternatives; (2) describes the non-routine activities and low-probability events that could occur during construction, O&M, and conceptual decommissioning of the proposed Project; and (3) presents a summary and comparison of impacts by alternative and resource affected.[1]

2.1 Alternatives Analyzed in Detail

BOEM considered a range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. To be carried forward for analysis, alternatives were required to meet the screening criteria identified in BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act (NEPA)* (BOEM 2022). The alternatives carried forward for detailed analysis in this Draft EIS are described in this subsection and summarized in Table 2-1. Section 2.1.6, *Alternatives Considered but not Analyzed in Further Detail*, describes the alternatives considered but dismissed from detailed analysis and the rationale for their dismissal. The alternatives listed in Table 2-1 are not mutually exclusive. BOEM may "mix and match" the EIS alternatives to develop the preferred alternative provided that the design parameters are compatible, and the preferred alternative would still meet the purpose of and need for the Proposed Action.

BOEM considers those measures that Dominion Energy has committed to in its COP to be part of the Proposed Action and action alternatives (COP, Executive Summary, Table ES-1; Dominion Energy 2022). The alternatives listed in Table 2-1 do not include additional mitigation measures that are analyzed separately in this Draft EIS (Appendix H, *Mitigation and Monitoring*). BOEM, in consultation with cooperating agencies, may select any of the mitigation measures identified in Appendix H in addition to its preferred alternative, as long as the design parameters are compatible, and the preferred alternative and mitigation measures would still meet the purpose and need. Additionally, compliance with applicable laws and regulations by Dominion Energy and BOEM may require additional measures or changes to the measures described in this Draft EIS. The completion of consultations under the MMPA, Section 7 of the Endangered Species Act (ESA), the Magnuson-Stevens Fishery Conservation and Management Act, and Section 106 of the National Historic Preservation Act (NHPA) may result in additional measures or changes to the measures described in this Draft EIS.

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

BOEM decided to use the NEPA substitution process for NHPA Section 106 purposes, pursuant to 36 CFR 800.8(c), during its review of the Project. Section 106 of the NHPA regulations, "Protection of

[1] *Decommissioning* as described in this analysis is considered conceptual because the lessee would submit a second application for formal review and approval at the end of the project life.

Historic Properties" (36 CFR 800), provides for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. Please note that the substitution process does not lessen compliance with the fundamental policies of Section 106; it is designed to allow greater procedural efficiency without lessening substantive requirements. Draft avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties are presented in Appendix H. Ongoing consultation with consulting parties and government-to-government consultation with tribal nations may result in additional measures or changes to these measures.

All elements of the Proposed Action are included in BOEM's analysis in this Draft EIS; however, BOEM's authority under the OCSLA only extends to the activities on the OCS.

Table 2-1 Alternatives Considered for Analysis

Alternative	Description
Alternative A — Proposed Action	Under **Alternative A**, the Proposed Action, the construction, operation, maintenance, and eventual decommissioning of an up-to 3,000 MW wind energy facility consisting of up to 205 WTGs ranging from 14 MW to 16 MW each and three offshore substations (OSSs) in the Lease Area and associated export cables would occur offshore Virginia and within the range of the design parameters outlined in the COP (Dominion Energy 2022), subject to applicable mitigation measures (Figure 2-1). Dominion would space WTGs in a 0.93- by 0.75-nautical-mile offset grid pattern (east–west by northwest by southeast gridded layout). The three OSSs would be placed in offset positions between the gridded WTG layout. This configuration would still allow micrositing of WTGs (up to 500 feet) to avoid sensitive cultural resources and marine habitats. Onshore components include a cable landing location in Virginia Beach, Virginia.[2] Onshore export cables would transfer electricity from the cable landing location to a switching station constructed either north of Harpers Road or north of Princess Anne Road in Virginia Beach, Virginia. An overhead interconnection cable route would then connect the new Harpers Switching Station to the Fentress Substation located in Chesapeake, Virginia. **Alternative A-1**: Revised Layout to Align Substations and WTGs: The three OSSs would be placed within the rows of the gridded WTG layout. The realigned OSSs would take the place of three WTG positions resulting in an up-to 3,000 MW wind energy facility consisting of up to 202 WTGs ranging from 14 MW to 16 MW each (Figure 2-2).

[2] The cable landing location would be adjacent to the existing CVOW-Pilot Project landing location and at a proposed parking lot west of the State Military Reservation (SMR) firing range (formerly known as Camp Pendleton). This is the only cable landing location carried forward in the PDE and would be the same under all alternatives (COP, Section 2.1.2.1; Dominion Energy 2022).

Alternative	Description
Alternative B — Revised Layout to Accommodate the Fish Haven and Navigation	Under **Alternative B**, the Revised Layout to Accommodate the Fish Haven[3] and Navigation Alternative, the construction, operation, maintenance, and eventual decommissioning of a 2,587 MW wind energy facility consisting of 176 WTGs (inclusive of three spare WTG positions) and three OSSs in the Lease Area and associated export cables would occur offshore Virginia within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Dominion Energy would use only 14 MW WTGs, each capable of generating up to 14.7 MW using power boost capability, to avoid impacts due to construction and operation of WTGs. Similar to Alternative A, Dominion would utilize WTGs in a 0.93- by 0.75-nautical-mile offset grid pattern (east–west by northwest by southeast gridded layout). However, under Alternative B, the Fish Haven area located along the northern boundary of the Lease Area would be an exclusion zone (e.g., eight WTGs and associated infrastructure would not be developed or placed in the Fish Haven area). Additionally, three WTGs and associated inter-array cables would be excluded from the northwest corner of the Lease Area to avoid a proposed vessel traffic fairway (Figure 2-3). As under Alternative A-1, the three OSSs would be placed within the rows of the gridded WTG layout. This configuration would still allow micrositing of WTGs (up to 500 feet) to avoid sensitive cultural resources and marine habitats. Onshore components are the same as under Alternative A.
Alternative C — Sand Ridge Impact Minimization Alternative	Under **Alternative C**, the Sand Ridge Impact Minimization Alternative, the construction, operation, maintenance, and eventual decommissioning of a wind energy facility would include a similar offshore layout of Project components as Alternative B. However, in addition to avoiding the Fish Haven area and proposed vessel traffic fairway, Alternative C would also avoid sand ridge habitat by a combination of: micrositing WTGs, inter-array cables or OSSs (or both) (up to 500 feet); the removal of four WTGs within priority sand ridge habitat, and the relocation of one WTG. The removal and relocation of these WTGs would allow for a reconfiguration of inter-array cabling to minimize potential linear seafloor impacts and the potential cross-cutting impacts to priority sand ridge habitat. As a result, an up-to 2,528 MW wind energy facility consisting of up to 172 WTGs (inclusive of two spare WTG positions), and three OSSs and associated export cables would be developed under Alternative C (Figure 2-4). The generation capacity under Alternative C would allow Dominion Energy to meet its minimum 2,500-MW need for the project under the 2020 Virginia Clean Economy Act. As under Alternative B, Alternative C would utilize 14 MW WTGs generating up to 14.7 MW each using power boost capability in a 0.93- by 0.75-nautical mile offset grid pattern. Onshore components are the same as under Alternative A.

[3] The Fish Haven is an area of documented recreational fisheries uses within the northern border of the Lease Area known as the *Triangle Wrecks* and *Triangle Reef*. The area consists of several large, scuttled World War II-era ships, tires, cable spools, and other materials deposited since the 1970s to facilitate an artificial reef development (COP Sections 2.1.1 and 4.2.4.2; Dominion Energy 2022).

Alternative	Description
Alternative D — Onshore Habitat Impact Minimization Alternative	Under **Alternative D**, the Onshore Habitat Impact Minimization Alternative, the construction, operation, maintenance, and eventual decommissioning of a wind energy facility would include the same offshore layout of Project components as described under Alternative A: an up-to 3,000 MW wind energy facility consisting of up to 205 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area and associated export cables. Unlike Alternatives A, B, and C, the construction of interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid Route), as described in the COP (Dominion Energy 2022).[4] For purposes of comparative analyses, Interconnection Cable Route Option 1 will be evaluated in all action alternatives. However, under Alternative D, BOEM would approve either Interconnection Cable Route Option 1 or 6 (Hybrid Route) to minimize impacts of the proposed Project on onshore sensitive habitats (Figure 2-5). Interconnection Cable Route Option 1 would be an entirely overhead route, while Interconnection Cable Route Option 6 (Hybrid Route) would involve installation of the Interconnection Cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. Each of the following sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the Project's purpose and need. **Alternative D-1 (**Figure 2-6)**:** Interconnection Cable Route Option 1 would be approximately 14.2 miles (22.9 kilometers) long and installed entirely overhead. From the common location north of Harpers Road, Interconnection Cable Route Option 1 would continue to the onshore substation and the new Harpers Switching Station would be located at Naval Air Station (NAS) Oceana Parcel, pending Navy approval. **Alternative D-2 (**Figure 2-7**):** Interconnection Cable Route Option 6 (Hybrid Route) would be approximately 14.2 miles (22.9 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. Following Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, Interconnection Cable Route Option 6 would transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be bult at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation.

[4] The CVOW-C COP (Dominion Energy 2022) identifies six different interconnection cable route options and refers to them as Interconnection Cable Route Alternatives. The use of the word *alternative* in this context is not to

Alternative	Description
Alternative E — No Action Alternative	Under **Alternative E,** the No Action Alternative, BOEM would not approve the COP, and the Project construction and installation, operation and maintenance, and conceptual decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other existing or other reasonably foreseeable future impact-producing activities would continue. The impact of the No Action Alternative serves as the baseline against which all action alternatives are evaluated.

Note: Components of alternatives may be individually selected and combined with any or all other alternatives, subject to the combination meeting the purpose and need.

2.1.1 No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP. Project construction and installation, O&M, and decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other existing or other reasonably foreseeable future activities described in Appendix F, *Planned Activities Scenario,* would continue. The ongoing effects of the No Action Alternative serve as the baseline against which all action alternatives are evaluated.

2.1.2 Alternative A—Proposed Action and Alternative A-1

The Proposed Action would construct, operate, maintain, and eventually decommission an up-to 3,000 MW wind energy facility on the OCS offshore Virginia and associated onshore power distribution facilities (Figure 2-1). The boundary of the Lease Area is located 20.45 nautical miles (37.87 kilometers) from the northwest corner to the Eastern Shore Peninsula and 23.75 nautical miles (43.99 kilometers) from Virginia Beach, Virginia. Water depths in the Lease Area range from 57 feet (18 meters) to 139 feet (42 meters). The Proposed Action is based on Dominion Energy's maximum-case design parameters, which is described in the COP and summarized in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. This subsection describes the construction and installation, O&M, and decommissioning activities to be undertaken for the Proposed Action; COP Sections 1, 2, and 3 (Dominion Energy 2022) provide additional details on Project design.

Alternative A-1 is the same as Alternative A, except that under Alternative A-1 the three OSSs would be placed within the rows of the gridded WTG layout, taking the place of three WTG positions (i.e., Alternative A-1 would result in up to 202 WTGs and three OSSs) (Figure 2-2).

2.1.2.1 Construction and Installation

The Proposed Action would include the construction and installation of both onshore and offshore facilities. Construction and installation would begin in 2023 and be completed in 2027. Dominion Energy anticipates beginning with land-based construction (onshore export and interconnection cable installation, switching station construction, and existing onshore substation upgrades) in the third quarter of 2023 and finishing in 2025. Construction of the offshore components would begin in the fourth quarter of 2023

indicate a BOEM-developed alternative for the purposes of the EIS; therefore, BOEM uses *Interconnection Cable Route Option* throughout this document.

with scour protection pre-installation (ending in 2025), offshore export cable installation (ending in 2026), and monopile and transition piece transport and onshore staging (ending in 2026). Monopile installation and offshore substation installation would occur from May 2024 through October 2025. Transition piece installation and scour protection post-installation would occur in 2024 through 2026. Inter-array cable installation and WTG pre-assembly and installation are planned to start in 2025 and end in 2026 and 2027, respectively. Commissioning is planned for 2024 through 2027. As per Dominion Energy's commitment to seasonal restrictions from November through April, no WTG or OSS foundation installation activities are planned for winter. Monopile and OSS pin pile installation is planned for part of spring (May), summer (June, July, and August), and part of fall (September through October) annually. Inter-array and offshore export cable emplacement associated with construction of the WTGs and OSSs would occur during two separate construction seasons, which would provide a recovery period for sand ridge habitats between the installation of the inter-array and offshore export cables. Additionally, there would be an approximate 1- to 2.5-month period between installation of each offshore export cable installation, with the potential for a longer period dependent on weather conditions and operational needs for cable resupply. There would be several months of seafloor rest following the completion of offshore export cable installation at one OSS prior to commencement of inter-array cable emplacement associated with the next OSS (BOEM and Dominion Energy 2022). An indicative Project schedule is included in COP Section 1, Table 1.1-3 (Dominion Energy 2022).

2.1.2.1.1 Onshore Activities and Facilities

Proposed Onshore Project elements include the cable landing location, the onshore export cable route, the switching station, the onshore interconnection cable route(s), and expansions/upgrades to the onshore substation that connects to the existing grid (these elements collectively compose the Onshore Project area). Interconnection Cable Route Option 1 would be the selected onshore interconnection cable route for the Project (Figure 2-1 and Figure 2-2). Appendix E describes the PDE for onshore activities and facilities, and COP Section 3 (Dominion Energy 2022) provides additional details on construction and installation methods.

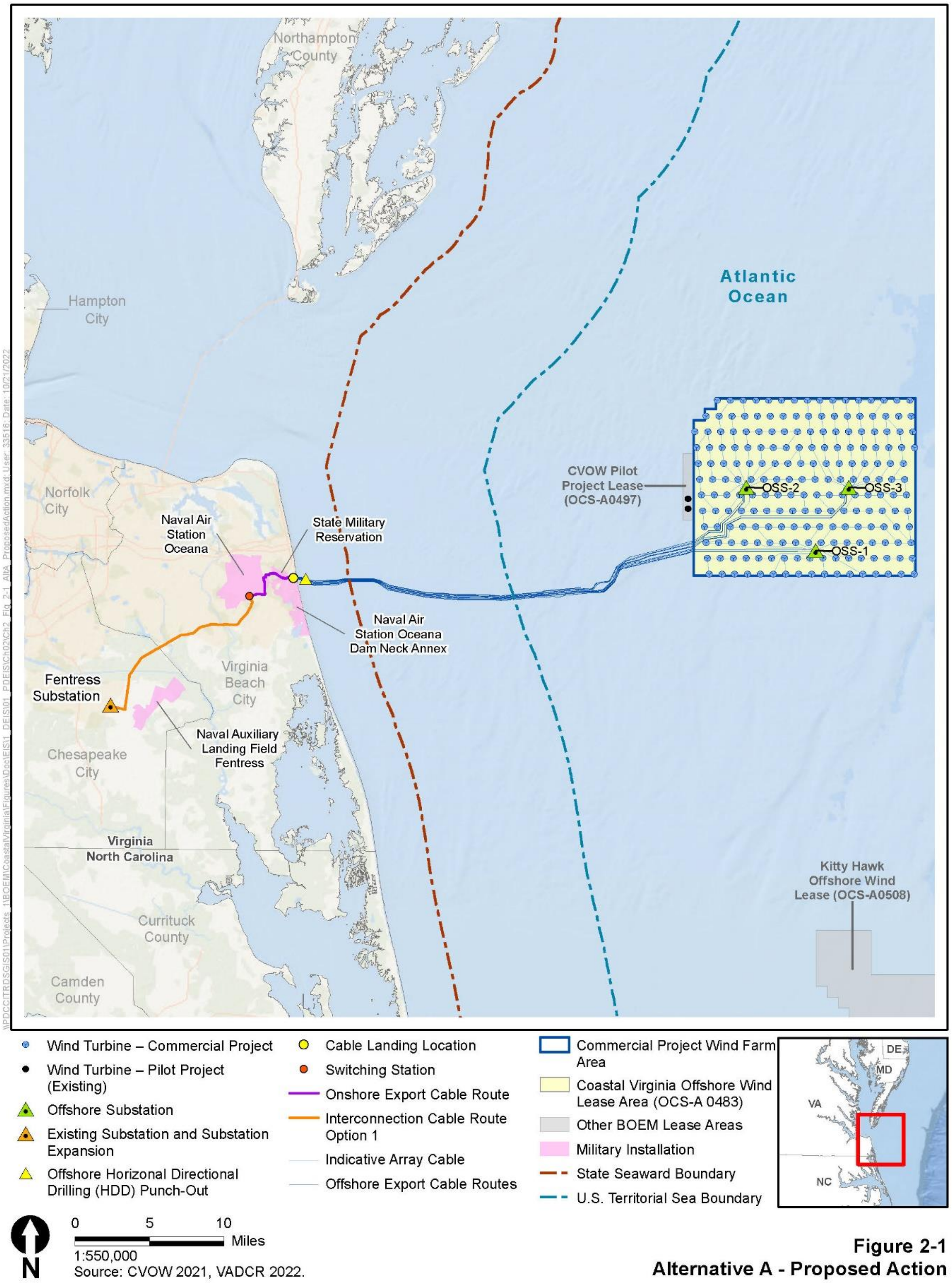

Figure 2-1 Alternative A: Proposed Action

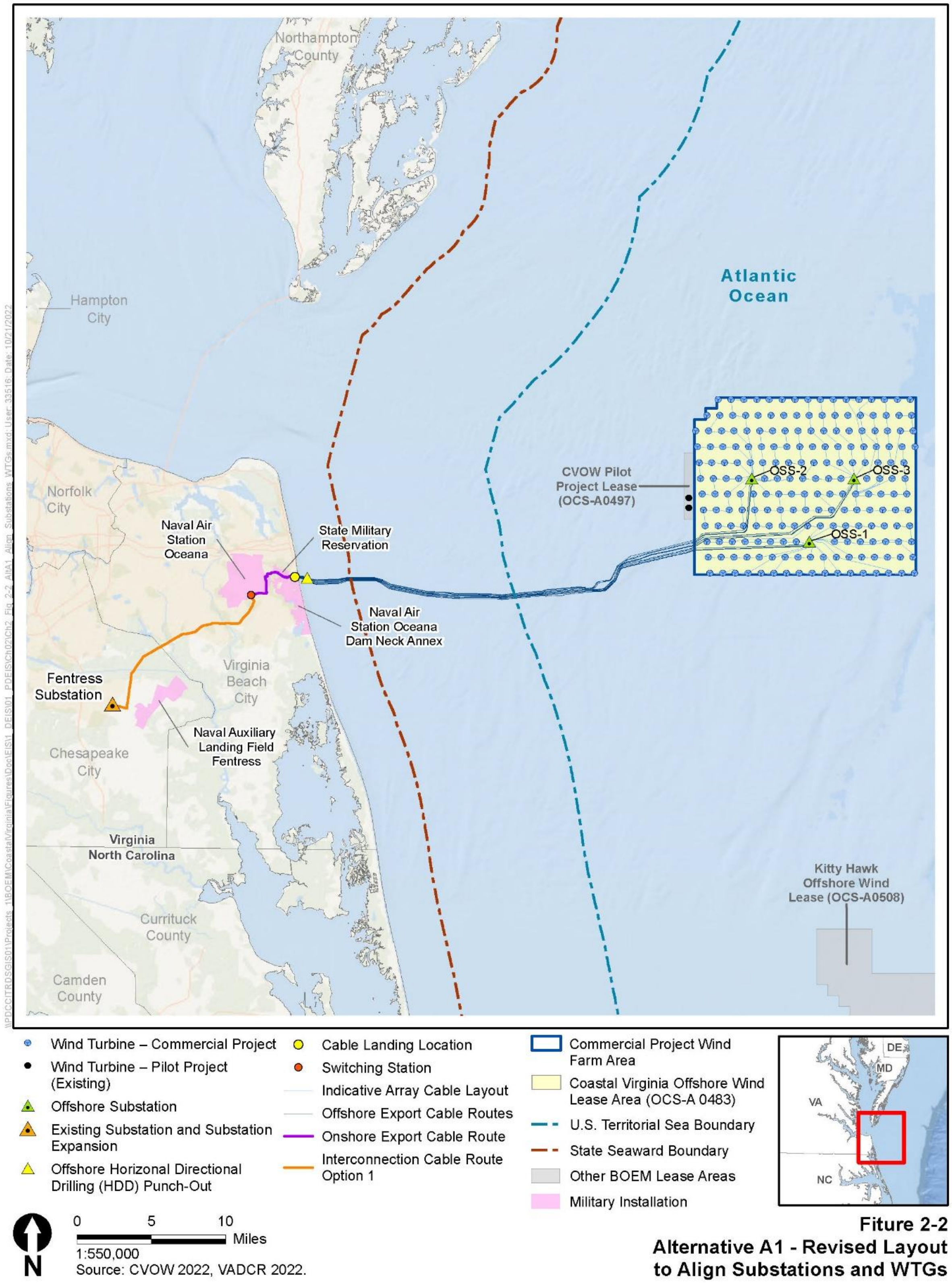

Figure 2-2 Alternative A-1: Revised Layout to Align Substations and WTGs

The proposed Project would include a cable landing location in Virginia Beach, Virginia, as shown in COP Section 3, Figure 3.3-14 (Dominion Energy 2022). The cable landing would be located at the proposed parking lot west of the firing range at the SMR. Dominion Energy plans to use trenchless installation—direct steerable pipe thrusting (DSPT)—to install the offshore export cables under the beach and dune and bring them to shore through a series of conduits. DSPT involves using a direct steerable tunnel boring machine (DSTBM) to excavate ground along the design alignment while simultaneously pushing steel casing pipes behind the DSTBM using a pipe thrusting machine. The pipe thrusting machine is situated on the ground surface or (typically) in a shallow pit and uses pipe clamps to grip the outside circumference of the pipe and thrust the steel casing pipe behind the DSTBM in compression. This provides the force required to progress the DSTBM forward, which excavates the ground at the leading edge of the casing pipe. Upon exiting the conduits, the nine 230-kilovolt (kV) offshore export cables would be spliced to a series of nine separate single circuit horizontal directional drilling (HDD) vaults laid in a single right-of-way and transition to the onshore export cables at the cable landing location. The operational footprint for the cable landing location is anticipated to be approximately 2.8 acres (1.1 hectares).

Onshore export cables would transfer the electricity from the cable landing location to a common location north of Harpers Road and would comprise 27 single-phase 230-kV onshore export cables installed underground within the onshore export cable route corridor. The proposed Project currently includes a single onshore export cable route that plans to use HDD below Lake Christine. HDD would create a pilot bore along the cable corridor, expand the bore to a diameter necessary for the cables, then pull the cables into the prepared borehole. The onshore export cable route (COP, Section 3, Figure 3.3-15; Dominion Energy 2022) would be 4.41 miles (7.10 kilometers) long, and the operational corridor would be approximately 51 acres (20.5 hectares).

The switching station would be constructed north of Harpers Road (Harpers Switching Station) in Virginia Beach, Virginia (COP, Section 3, Figure 3.3-16; Dominion Energy 2022). The switching station would collect power and convert an underground cable configuration to an overhead configuration. The power would then be transmitted to the existing onshore substation for distribution to the grid. The switching station would be an aboveground, fenced facility and would generally have the appearance of a typical larger Dominion Energy substation. The operational footprint of Harpers Switching Station would be approximately 21 acres (8.5 hectares). The switching station would serve as a transition point where the power transmitted through twenty-seven 230-kV onshore export cables would be collected to three 230-kV interconnection cables.

Dominion Energy evaluated five overhead interconnection cable route options and one hybrid interconnection cable route option from Harpers Road to the onshore substation (COP, Section 3, Table 3.3-9 and Figure 3.3-15; Dominion Energy 2022). The CVOW-C COP identifies the six interconnection cable route options within the PDE as Interconnection Cable Route Alternatives (COP, Section 2.1.2.4; Dominion Energy 2022); the use of the word *alternative* in this context is not to indicate a BOEM-developed alternative for the purposes of the EIS, but instead an interconnection cable routing option developed by Dominion Energy. For all interconnection cable route options considered, a maximum construction and operational corridor width of 250 feet (76.2 meters) would be needed for overhead cables. Existing ROWs would be used to the extent practical. The height of the overhead interconnection cable would vary from 75 feet (22.9 meters) to 170 feet (51.8 meters), depending on the terrain within the route.

Dominion Energy selected Interconnection Cable Route Option 1 (overhead) as their preferred cable route, and on August 5, 2022, the Virginia State Corporation Commission (VA SCC) approved, by issuance of a certificate of public convenience and need (CPCN), Interconnection Cable Route Option 1. The approved CPCN includes all of the transmission interconnection lines and stations starting 3 miles

(4.8 kilometers) offshore, the single proposed underground lines and route from the State Military Reservation to the Harpers Switching Station, and Interconnection Cable Route Option 1 for the overhead lines from Harpers Switching Station to Fentress Substation. As a result, the Proposed Action includes only Interconnection Cable Route Option 1 and associated transmission interconnection lines and stations. On October 7, 2022, Dominion Energy requested that BOEM remove from consideration Interconnection Cable Route Options 2, 3, 4, and 5; Interconnection Cable Route Option 6 (the hybrid interconnection cable route option) is considered under Alternative D.

The existing onshore substation (Fentress Substation) that would be expanded and upgraded to accommodate the electricity from the Project is located in Chesapeake, Virginia. The Fentress Substation would serve as the final Point of Interconnection (POI) for power distribution to the Pennsylvania–New Jersey–Maryland interconnection (PJM) grid. The current footprint of the onshore substation is approximately 11.7 acres (4.7 hectares). The expansion/upgrades to the onshore substation footprint are anticipated to require approximately an additional 6.8 acres (2.8 hectares), for a total of 18.5 acres (7.5 hectares). The onshore substation expansions/upgrades would serve as the POI for the three 230/500-kV auto-transformers for connection into the grid. The existing equipment at the onshore substation affected by this Project would include one 500-kV transmission line, two 230/500-kV transformer banks, and a security fence. The onshore substation expansion/upgrades would include the addition of three 230/500-kV transformer banks, a 500-kV gas-insulated switchgear building, static poles, and other ancillary equipment. The facility is planned to be surrounded by a security fence approximately 20 feet (6.1 meters) high.

2.1.2.1.2 Offshore Activities and Facilities

Proposed Offshore Project components include WTGs and their foundations, OSSs and their foundations, scour protection for foundations, inter-array cables, and offshore export cables (these elements collectively compose the Offshore Project area). The proposed Offshore Project elements would be on the OCS as defined in the OCSLA, with the exception of a portion of the offshore export cables, which would be within state waters (COP, Executive Summary, Figure ES-1; Dominion Energy 2022). Appendix E describes the PDE for offshore activities and facilities, and COP Section 3 provides additional details on construction and installation methods.

Dominion Energy proposes the installation of 205 14 MW to 16 MW WTGs (COP, Section 3, Figure 3.3-4). The preferred WTG layout would be arranged in a grid pattern oriented at 35 degrees to minimize wake losses within the Wind Turbine Area (COP, Section 3, Figure 3.3-4; Dominion Energy 2022). WTGs would be spaced approximately 0.75 nautical mile (1.39 kilometers) in an east–west direction and 0.93 nautical mile (1.72 kilometers) in a north–south direction. However, the distances between some turbines in the final WTG layout may be slightly larger or smaller, subject to micrositing; some WTG foundation installation locations may shift up to 500 feet (152 meters) to avoid obstructions, and sensitive cultural and natural resources, and due to local site condition variations. Turbine tip height as measured from mean sea level would be between 804 feet (245 meters) and 869 feet (265 meters). The distance from the bottom of the turbine tip to the highest astronomical tide would be between 82 feet (25 meters) and 115 feet (35 meters). Dominion Energy would mount the WTGs on monopile foundations consisting of two parts: a lower foundation pile (monopile) driven into the seabed and an upper transition piece mounted on top of the monopile (together referred to as the WTG foundation). Monopiles would be installed to the target penetration depth via impact and vibratory pile driving. Dominion Energy proposes using secondary noise mitigation systems such as the Hydro Sound Damper, the Noise Mitigation Sleeve, the AdBm Noise Mitigation System, or double big bubble curtains, to reflect and dampen underwater sound waves. The WTG foundations would have scour protection installed around the base of the monopile.

Dominion Energy proposes to construct three OSSs in offset positions between the gridded WTG layout (COP, Section 3, Figure 3.3-5; Dominion Energy 2022); however, under Alternative A-1, the three OSSs would be placed within the rows of the gridded WTG layout, taking the place of three WTG positions. The offshore substation would comprise two main components: a foundation attached to the seafloor and a topside to contain the decks holding the main electrical and support equipment. Dominion Energy is also considering adding a helideck to support monitoring and maintenance to each of the OSSs for normal and emergency access by helicopters. Dominion Energy is proposing to use pre- or post-installed, piled, jacket foundations to support the OSSs. The OSS foundations are foreseen to have scour protection installed around the base of the piled jackets. The need, type, and method for installing scour protection for the WTG foundations and the OSS foundations would be determined in consultation and coordination with relevant jurisdictional agencies prior to construction and installation. Dominion Energy believes that it is possible to design and install the size and type of piled jacket foundations included in the PDE to the desired target penetration depth of 229.7 feet (70 meters) to 269 feet (82 meters). The distance of the OSS topside substructure base above the highest astronomical tide would be between 56 feet (17 meters) and 151 feet (46 meters).

The inter-array cable system would be composed of a series of cable “strings” that interconnect a small grouping of WTGs to the OSSs. The inter-array cables would consist of strings of three-core copper and/or aluminum conductor, with a rated voltage of 72.5 kV and an operating voltage of 66 kV, connecting up to six WTGs per string. The WTG strings would be connected to each other via link/switch, and each offshore substation would be tied to a WTG string. Dominion Energy anticipates approximately 12 WTG strings would be connected to each offshore substation, for a total of 36 WTG strings (COP, Section 3, Figure 3.3-7; Dominion Energy 2022). However, the number of WTGs per string and/or the number of WTG strings connecting to each offshore substation may be modified given the final layout of WTGs.

The offshore export cables would transfer the electricity from the offshore substation to the cable landing location in Virginia Beach, Virginia (COP, Section 3, Figure 3.3-12; Dominion Energy 2022). Electricity would be transferred from each of the three offshore substations to the cable landing location via three 3-core copper and/or aluminum-conductor 230-kV subsea cables, for a total of nine offshore export cables. The offshore export cable route corridor width associated with the three cables originating from each OSS would be 1,280 feet (390 meters). Upon exiting the Lease Area, the three offshore export cable route corridors originating at the offshore substation would merge to become one overall offshore export cable route corridor containing all nine offshore export cables. The offshore export cable route corridor between the western edge of the Lease Area and the cable landing location would range in width from 1,970 feet (600 meters) to 9,400 feet (2,865 meters). Variability in the offshore export cable route corridor width would be driven by several external constraints, including existing telecommunications cable and transmission cable crossings; the U.S. Department of Defense exclusion area to the south; the vessel traffic lane and proposed Atlantic Coast Port Access Study safety fairway to the north; the Dam Neck Ocean Disposal Site (DNODS); obstructions, exclusion areas, and seabed conditions identified from existing data and ongoing surveys; potential risks due to the use of the area by third parties; and the approach to the HDD at the cable landing location. Within the offshore export cable route corridor, the nine offshore export cables would generally be spaced approximately 164 to 2,716 feet (50 to 828 meters) apart and constrained at times to be spaced 164 to 328 feet (50 to 100 meters) apart.

Dominion has proposed several cable installation methods for the inter-array and offshore export cables. The cable burial methods being considered as part of the PDE include jet plow, jet trenching, chain cutting, trench former, hydroplow (simultaneous lay and burial), mechanical plowing (simultaneous lay and burial), pre-trenching (both simultaneous and separate lay and burial), mechanical trenching (simultaneous lay and burial), and/or other technologies available at the time of installation. Final installation methods would be determined by the final engineering design process that is informed by detailed geotechnical data, risk assessments, and coordination with regulatory agencies and stakeholders. For all the proposed installation methods, a narrow temporary trench is created into which the cable is bed while the equipment is towed along the seabed. Inter-array cables would be buried to a depth of between 3.9 feet (1.2 meters) and 9.8 feet (3 meters); however, the exact depth would be dependent on the substrate encountered along the route. The offshore export cables would be buried to a target depth of between 3.3 feet (1 meter) and 16.4 feet (5 meters); for the portion of the offshore export cable that crosses the DNODS, 14.8 feet (4.5 meters) of cover may be added to a target burial depth of 9.8 feet (3 meters) for a total maximum burial depth of 24.6 feet (7.5 meters).

Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, and pre-grapnel runs. A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the siting corridor. Additionally, pre-sweeping may be required in areas of the submarine export cable corridor with sand waves. Pre-sweeping involves smoothing the seafloor by removing ridges and edges using a controlled flow excavator from a construction vessel to remove the excess sediment.

Dominion Energy has identified three in-service telecommunications cables within the offshore export cable route corridor that would be crossed by the offshore export cables. At cable crossings, both the existing infrastructure and the offshore export cables must be protected. The protection and crossing method would be determined on a case-by-case basis. At a minimum, it is expected that each asset crossing would include two layers of cable protection installed prior to and following offshore export cable installation, and a potential third layer of protection if stabilization and scour protection is deemed necessary. Dominion Energy anticipates using a combination of dump rocks, geotextile sand containers, and/or concrete mattresses depending on technical requirements (COP, Section 3.4.1.4; Dominion Energy 2022). Target burial depths at specific locations along the offshore export cable route corridor may be refined following the results of the ongoing geophysical survey data analysis, additional sediment mobility studies, and coordination with USACE and other stakeholders, and will be formalized in the *Facility Design Report/Fabrication Installation Report* (FDR/FIR), to be submitted to BOEM prior to installation.

The construction and installation phase of the proposed Project would make use of both construction and support vessels to complete tasks in the Offshore Project area. Construction vessels would travel between the Offshore Project area and the third-party port facility where equipment and materials would be staged. Dominion and the Port of Virginia have executed a lease agreement for a portion of the existing PMT facility in the city of Portsmouth, Virginia, to serve as a construction port. The port would support the staging of components and construction vessels for the Project.

2.1.2.2 Operations and Maintenance

The proposed Project is anticipated to have an operating period of 33 years.[5] Dominion Energy intends to lease an existing O&M facility, with the preferred location at Lambert's Point, located on a brownfield site in Norfolk, Virginia. Dominion Energy is also evaluating leasing options in Virginia Port Authority's Portsmouth Marine Terminal and Newport News Marine Terminal near Hampton Roads, Virginia. The

[5] Dominion Energy's lease with BOEM (Lease OCS-A 0483) has an operations term of 25 years that commences on the date of COP approval. See https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/Commercial%20Lease%20OCS-A%200483.pdf; see also 30 CFR 585.235(a)(3).) Dominion Energy would need to request an extension of its operations term from BOEM to operate the proposed Project for 33 years. For the purposes of maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, the Draft EIS analyzes a 33-year operations term.

O&M facility would monitor operations and would include office space, a control room, warehouse, shop, and pier space.

The proposed Project would include a comprehensive maintenance program and planned and unplanned inspections, including preventive maintenance based on statutory requirements, original equipment manufacturers' guidelines, and industry best practices. Dominion Energy would maintain an Oil Spill Response Plan and Safety Management System that would be developed and implemented prior to construction and installation activities in coordination with BOEM and the Bureau of Safety and Environmental Enforcement (COP, Appendices A and Q; Dominion Energy 2022).

2.1.2.2.1 Onshore Activities and Facilities

The switching station and onshore substation would be equipped with monitoring equipment and would be regularly inspected during the operational lifespan. Onshore maintenance activities could include routine maintenance, including the replacement or upgrade of electrical components and equipment. The onshore export cables and interconnection cables would require periodic testing; however, maintenance should not be required outside of occasional repair activities as a result of damage due to unanticipated events. Overhead lines would be inspected prior to being energized and routinely inspected by vegetation management crews every 3 years for woody vegetation and hazard trees, with additional inspections following localized storm events.

2.1.2.2.2 Offshore Activities and Facilities

Routine inspection and maintenance are expected for WTGs, foundations, and the OSSs. Offshore O&M activities would include inspections of Offshore Project components for signs of corrosion and wear on WTG components, inspection of electrical components associated with the WTGs and OSSs, surveys of cables to confirm they have not become exposed or that any cable protection measures have not worn away, replacement of consumable items such as filters and hydraulic oils, repairs or replacement of worn or defective components, and disposal of waste materials and parts. Crew transfer vessels and service operation vessels would be used to support O&M activities offshore. Helicopters are also being considered to support the Project's O&M activities.

The WTGs would be monitored through a supervisory control and data acquisition (SCADA) system, and offshore export cables and inter-array cables would be monitored through distributed temperature sensing equipment to provide real-time detection of possible faults. In the event of a fault or failure of an Offshore Project component, Dominion Energy would repair and replace it in a timely manner. Should an offshore export cable or inter-array cable fault, the failed or damaged portion of the cable would be spliced and replaced with a new, working segment. This would require the use of various cable installation equipment, as described in Section 2.1.2.1.2.

Appropriate safety systems would be included on all WTGs, including fire detection and an audible and visible warning system, painting and marking, lightning protection, aids to navigation in accordance with U.S. Coast Guard (USCG) requirements, and appropriate lighting for the aviation and maritime industries.

2.1.2.3 Decommissioning

In accordance with 30 CFR Part 585 and other BOEM requirements, Dominion Energy would be required to remove or decommission all Project infrastructure and clear the seabed of all obstructions following the end of the Project's operational activities and the lease. All foundations would need to be removed to 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)). Offshore export cables and inter-array cables would be retired in place or removed in accordance with the decommissioning plan. Unless otherwise authorized by BOEM, Dominion Energy would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed. See COP Section 3, Table 3.6-1 (Dominion Energy 2022) for additional details on removal methods and assumptions that would likely be applicable based on present-day understanding of available decommissioning approaches. Although the proposed Project is anticipated to have a lifespan of 33 years, some installations and components may remain fit for continued service after this time. Dominion Energy would have to apply for an extension to operate the proposed Project for more than the operations term.

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

If the COP is approved or approved with modifications, Dominion Energy would have to submit a bond that would be held by the U.S. government to cover the cost of decommissioning the entire facility if Dominion Energy would not otherwise be able to decommission the facility.

2.1.2.3.1 Onshore Activities and Facilities

At the time of decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. Dominion Energy anticipates removing the onshore substation buildings and equipment unless it is suitable for future use. Materials would be recycled as appropriate. Removal of the onshore export cable and interconnection cable is assumed by Dominion Energy to be limited to disconnecting and cutting at the fence line below ground level at both sides. The termination points would be removed, the cable would be cut 3 feet (0.9 meter) below ground level, and remaining cable would be capped off and earthed.

2.1.2.3.2 Offshore Activities and Facilities

The decommissioning process for the WTGs and OSSs is anticipated to the be the reverse of construction and installation, with turbine components or the offshore substation topside structure removed prior to foundation removal. Decommissioning of the topside structures for WTGs and OSSs is assumed by Dominion Energy to include removal of all WTG components including removal of the rotor, nacelle, blades, and tower, and removal of the offshore substation topside structure. Materials would be brought onshore for recycling and disposal. WTG monopile foundations and the OSSs piled jacket foundations would be removed by cutting below the mud line and lifting the foundation off by a heavy lift vessel (HLV) to a barge. The steel used in the foundations and towers would be recycled. The scour protection placed around the base of each foundation, if used, would be removed unless leaving in place is deemed appropriate through consultation with appropriate authorities. The offshore export cables and inter-array cables would be lifted out and cut into pieces or reeled in, and the cable would be recycled as appropriate.

2.1.3 Alternative B—Revised Layout to Accommodate the Fish Haven and Navigation

Alternative B was developed through the scoping process for the Draft EIS in response to comments that the original proposed siting of the three OSSs would disrupt the common grid pattern of the Project layout and produce potential impacts on a known Fish Haven area. Under Alternative B (Figure 2-3), the construction, O&M, and eventual decommissioning of a 2,587 MW wind energy facility consisting of 176 WTGs and three OSSs in the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP subject to applicable mitigation measures. Dominion Energy would use only 14 MW WTGs, each capable of generating up to 14.7 MW using power boost capability, to avoid impacts due to construction and operation of WTGs. Similar to Alternative A, Dominion Energy would use WTGs in a 0.93- by 0.75-nautical-mile (1.72- by 1.39-kilometer) offset grid in an east–west by northwest by southeast gridded layout. However, under Alternative B, the Fish Haven area located along the northern boundary of the Lease Area would be an exclusion zone where eight WTGs and associated inter-array cables and other Project infrastructure would not be sited. Three WTGs and associated inter-array cables would also be excluded from the northwest corner of the Lease Area to avoid conflicts with a proposed vessel traffic fairway. The three OSSs would be placed within the rows of the gridded WTG layout to minimize disruptions to surface and aerial navigation through the Wind Turbine Area. This configuration would still allow micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, to avoid sensitive cultural resources and marine habitats. Onshore components would be the same as described under Alternative A.

2.1.4 Alternative C—Sand Ridge Impact Minimization Alternative

Alternative C was developed through the scoping process for the Draft EIS in response to comments received requesting an alternative to minimize impacts on offshore benthic habitats. Under Alternative C (Figure 2-4), the construction, O&M, and eventual decommissioning of a wind energy facility would include a similar offshore layout and range of design parameters as described under Alternative B. However, in addition to avoiding the Fish Haven and the proposed vessel traffic fairway, Alternative C would avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, the removal of four WTGs from priority ridge habitat, and the relocation of one WTG to a spare position. Under Alternative C, the removal of four WTGs and relocation of one WTG allows for the reconfiguration of inter-array cabling that would otherwise be developed within priority sand ridge habitats, thus reducing potential seafloor disturbance, including the cross-cutting and trenching of sand ridges. As a result, an up-to 2,528 MW wind energy facility consisting of up to 172 WTGs (inclusive of two spare WTG positions) and three OSSs with associated export cables would be developed under Alternative C. As under Alternative B, Alternative C would use 14 MW WTGs generating up to 14.7 MW each using power boost capability in a 0.93- by 0.75-nautical-mile (1.72- by 1.38-kilometer) offset grid pattern. Onshore components would be the same as described under the Proposed Action.

2.1.5 Alternative D—Onshore Habitat Impact Minimization Alternative

Alternative D was developed through the scoping process for the Draft EIS in response to public comments regarding the potential impacts on sensitive onshore habitats, including wetlands. Under Alternative D, the construction, O&M, and eventual decommissioning of a wind energy facility would include the same offshore layout and range of design parameters as Alternative A: an up-to 3,000 MW wind energy facility consisting of up to 205 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area, with associated export cables. Unlike Alternative A, the construction of onshore interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid Route) (Figure 2-5). Therefore, under Alternative D BOEM would consider and potentially approve Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6, whereas only Interconnection Cable Route Option 1 is considered under Alternative A. Each of the following sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

- **Alternative D-1 (**Figure 2-6**):** Interconnection Cable Route Option 1 would be the same as described under the Proposed Action and would be approximately 14.2 miles (22.8 kilometers) long and installed entirely overhead (Figure 2-5). From the common location north of Harpers Road, Interconnection Cable Route Option 1 would continue to the onshore substation, and the new Harpers Switching Station would be located at NAS Oceana Parcel, pending Navy approval.

- **Alternative D-2** (Figure 2-7)**:** Interconnection Cable Route Option 6 (Hybrid Route) would be approximately 14.2 miles (22.8 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station (Figure 2-5). Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. Following Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, Interconnection Cable Route Option 6 would transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation. The maximum construction and operational corridor for the underground portion of Interconnection Cable Route Option 6 would be 86.5 feet (26 meters); the overhead portion would be 250 feet (76.2 meters), which is equivalent to the corridor width for Interconnection Cable Route Option 1.

Interconnection Cable Route 1 would be an entirely overhead route, while Interconnection Cable Route 6 (Hybrid Route) would involve installation of the interconnection cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores.

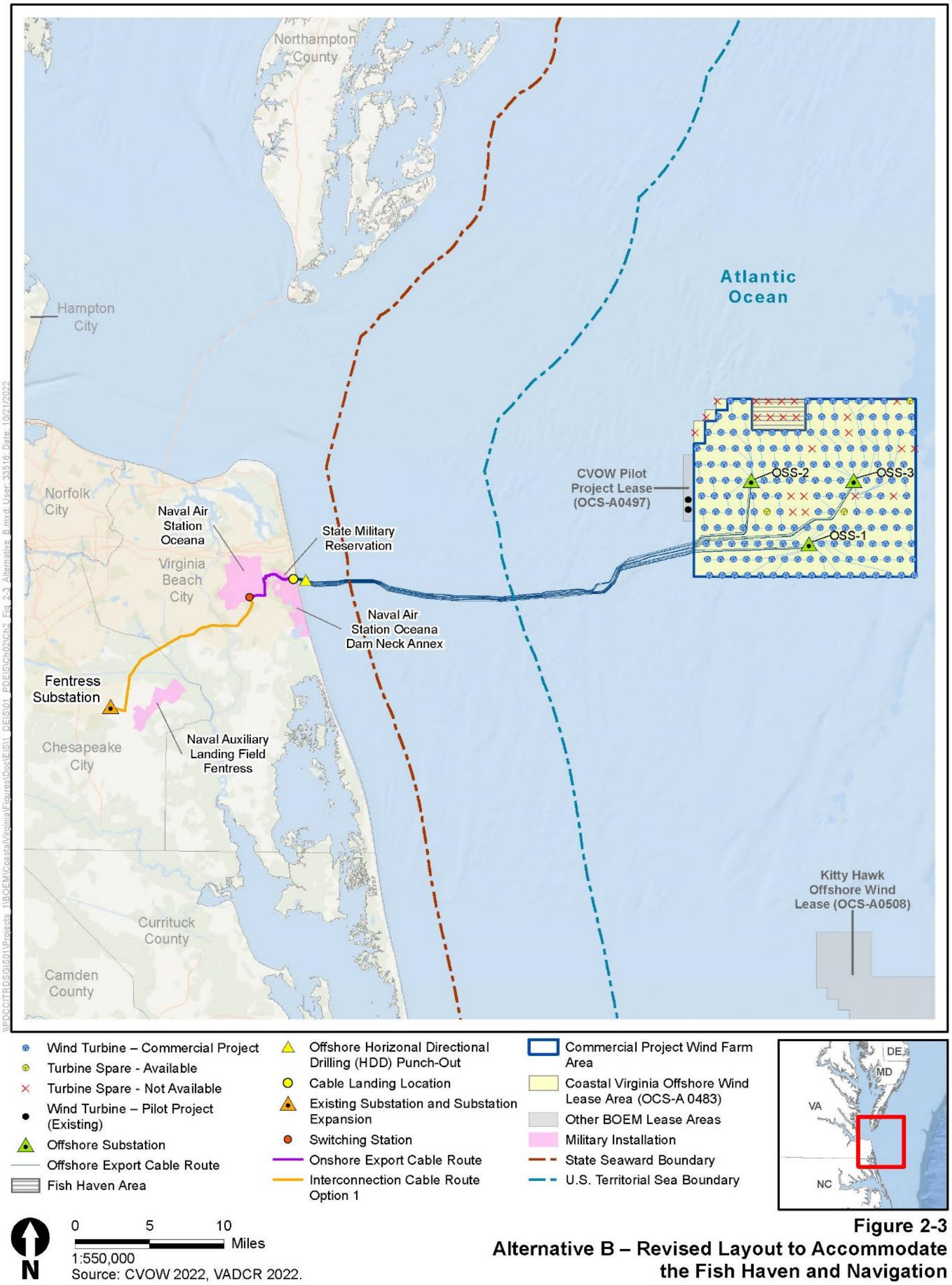

Figure 2-3 Alternative B: Revised Layout to Accommodate the Fish Haven and Navigation

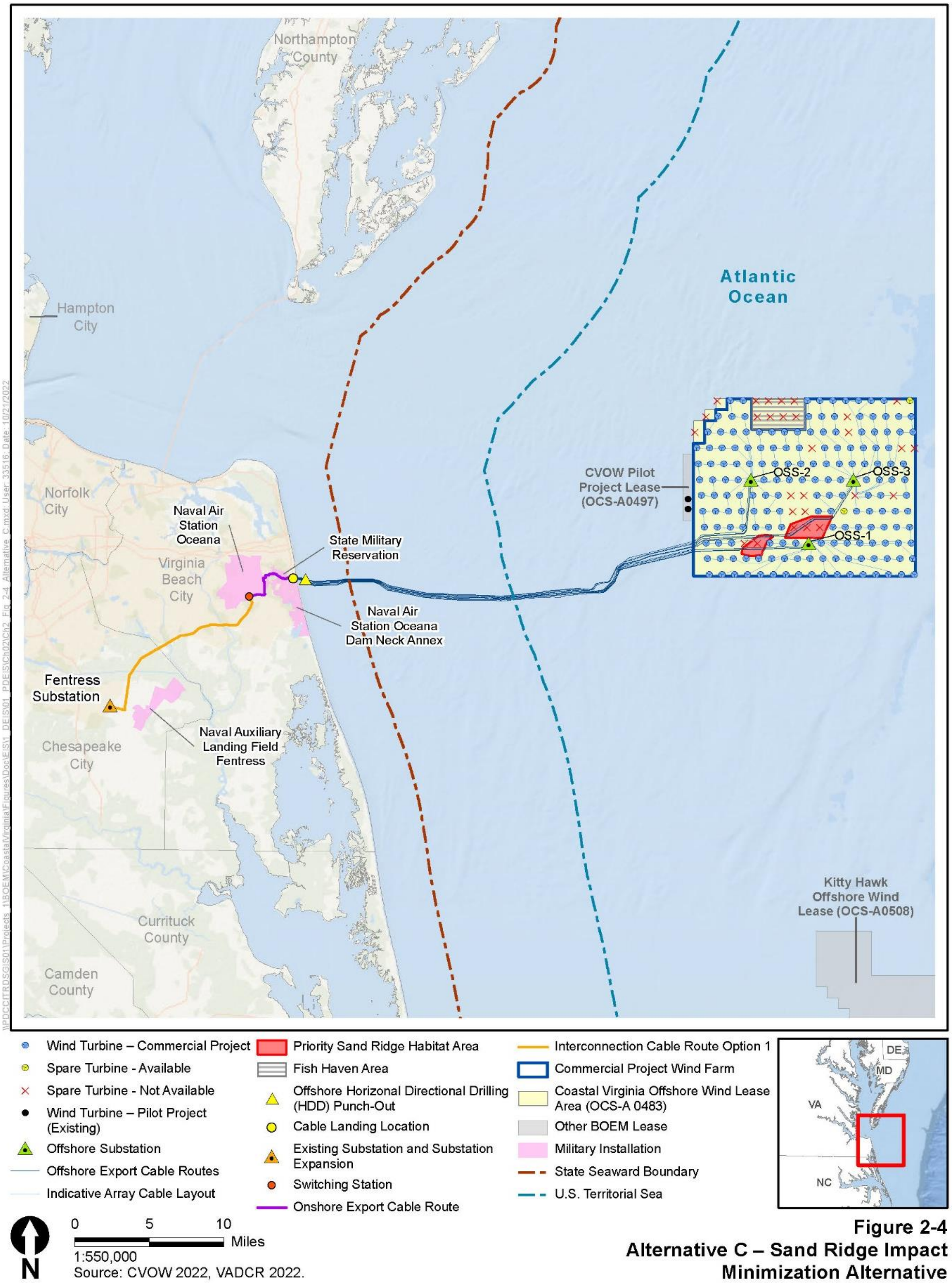

Figure 2-4 Alternative C: Sand Ridge Impact Minimization Alternative

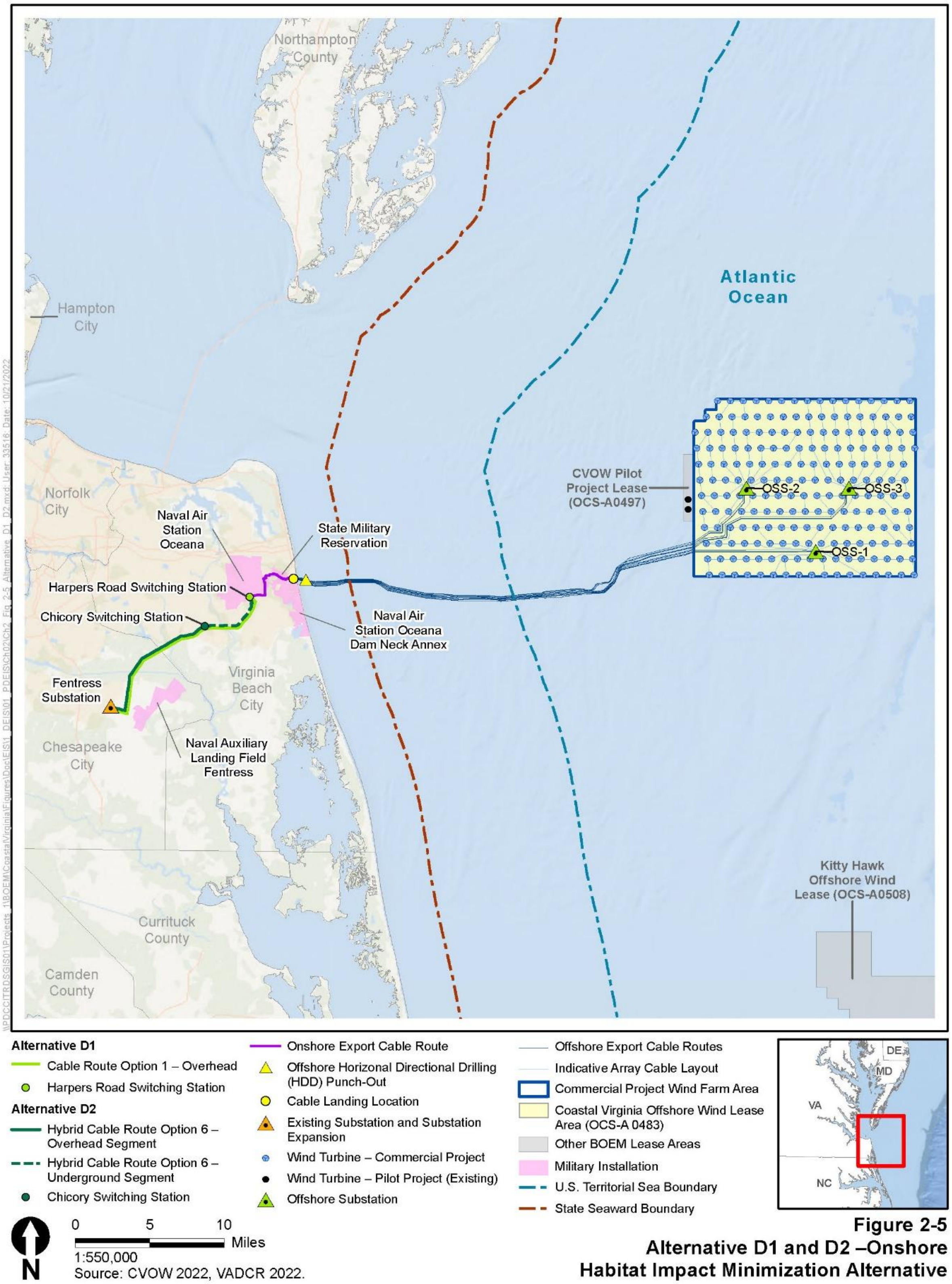

Figure 2-5 Alternative D: Onshore Habitat Impact Minimization Alternative

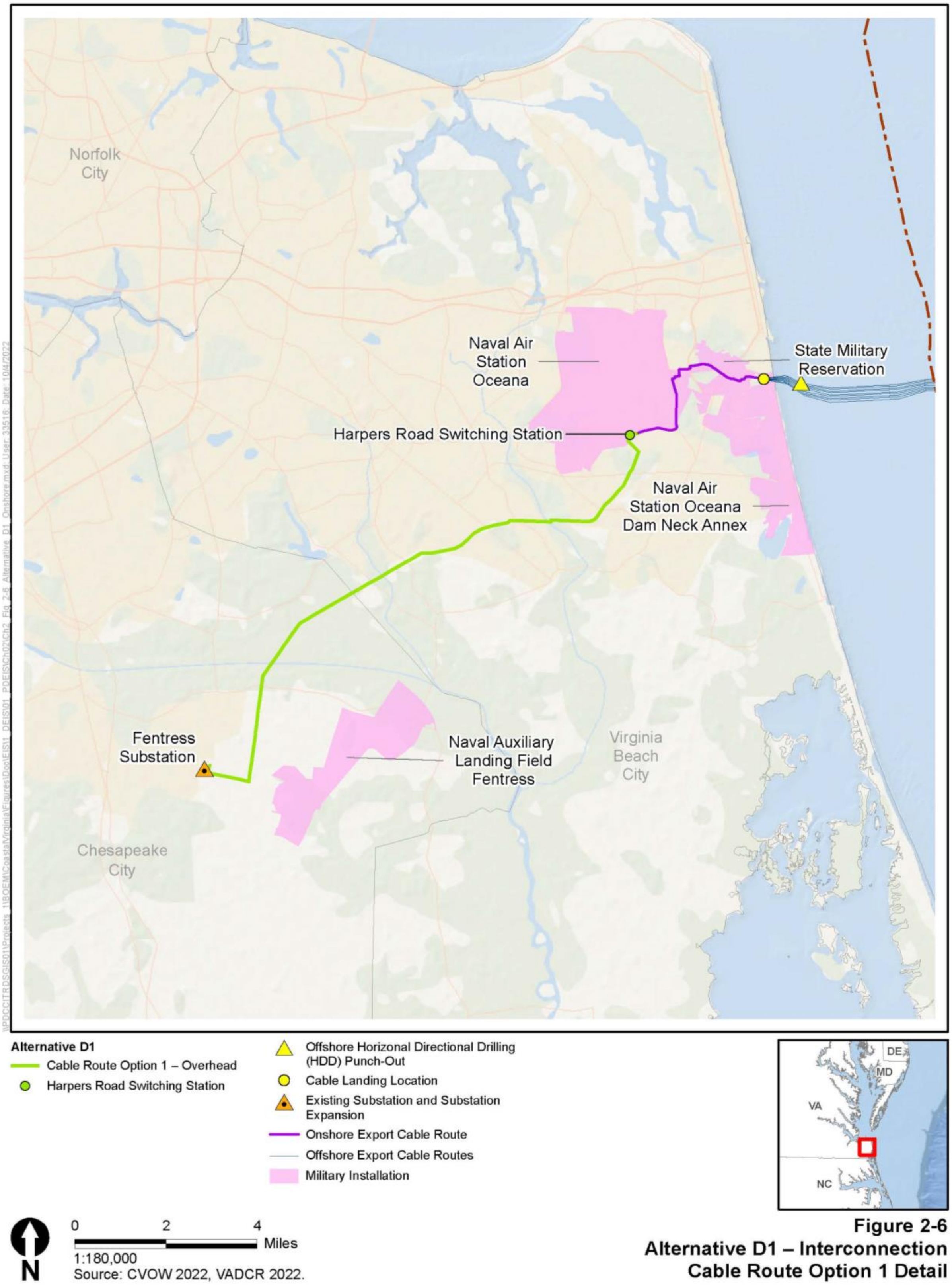

Figure 2-6 Alternative D1: Onshore Components Detail

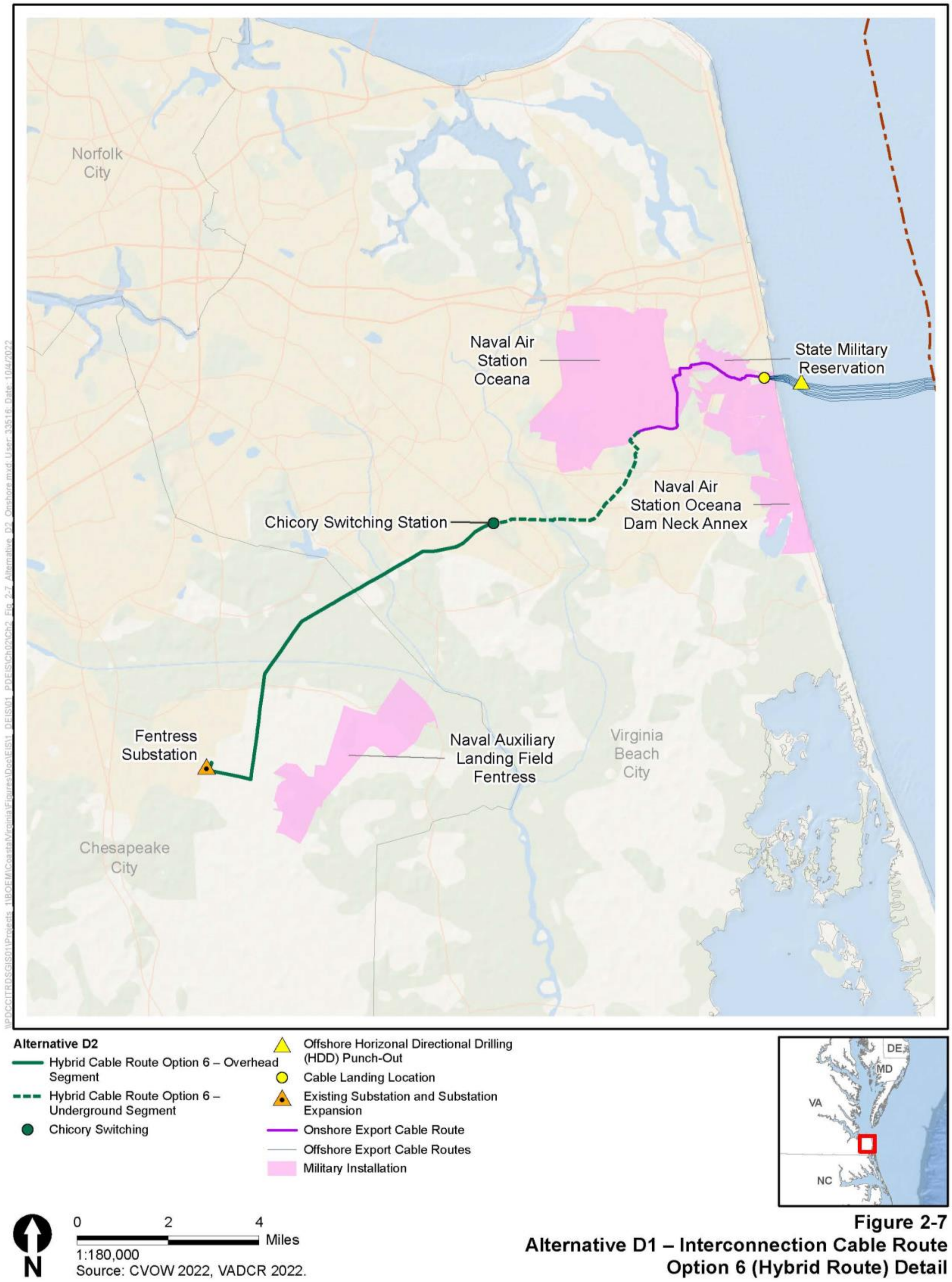

Figure 2-7 Alternative D2: Onshore Components Detail

2.1.6 Alternatives Considered but not Analyzed in Detail

Under NEPA, a reasonable range of alternatives framed by the purpose and need must be developed for analysis for any major federal action. The alternatives should be "reasonable," which the Department of the Interior has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action."[6] There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental effects of the project.[7] Alternatives that could not be implemented if they were chosen (for legal, economic, or technical reasons), or do not resolve the need for action and fulfill the stated purpose in taking action to a large degree, are therefore not considered reasonable.

BOEM considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies and through public comments received during the public scoping period for the EIS. BOEM then evaluated the alternatives and dismissed from further consideration alternatives that did not meet the purpose and need, did not meet the screening criteria, or both. The screening criteria are provided in BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act (NEPA)* (BOEM 2022).

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

[6] 43 CFR 46.420(b)
[7] 43 CFR 46.415(b)

Table 2-2 Alternatives Considered but not Analyzed in Detail.

Alternative	Rationale for Dismissal
Offshore Export Cables	
Coordinated offshore export cable route	Commenters recommended that BOEM consider offshore export cable routing alternatives that would have adjacent projects use a shared, common cable corridor. There is no offshore lease area immediately adjacent to CVOW-C; the nearest existing offshore lease area is off the coast of North Carolina. Developing a shared export cable corridor would not be practicable because CVOW-C and the nearest projects have different interconnection points to the electric power grid. At this time, these factors outweigh any potential future decrease in collective seabed disturbance that may result from having multiple projects sharing one cable corridor. Therefore, an alternative with a cable route shared by adjacent projects is not technically or economically practicable, and this alternative has not been carried forward at this time. An offshore routing constraints analysis was conducted by Dominion Energy along the offshore export cable route corridor as well as the adjacent CVOW-Pilot project cable route, dating back to 2013 when the Project was first identified. Constraints analyses are identified in COP Appendix W (Dominion Energy 2022). This constraints analysis identified potential offshore export cable routes; evaluated routing feasibility; and identified other challenges associated with existing cable assets, such as the DNODS, and Navy training and testing locations. The potential challenges and complexities of the offshore export cable routing (e.g., length, seabed features, burial depth, installation hazards, biological/cultural resources, commercial/recreational fishing) were considered as part of the selection criteria for the preferred and alternative cable landing locations. To the extent possible, the most direct route served as the starting point in developing the offshore export cable route corridor. This also is driven by technical constraints and costs, including cable costs, installation time, and limits associated with available and efficient heating, ventilation, and air conditioning (HVAC) transmission (as detailed in COP, Appendix W; Dominion Energy 2022). Section 2.1.2.1 of the May 6, 2022, version of the COP states: A potential landing in the vicinity of Sandbridge Road was investigated at a desktop level for feasibility. Discussions with the Navy's Office of Seafloor Cable Protection resulted in the determination of an exclusion zone for any subsea cable routes approaching from the north of the Sandbridge Road area. This line originates along the shoreline at Dam Neck Annex and extends to the shelf break to the east. This feature, and perhaps others like it, may be the reason the Department of Defense (DoD) prohibits any cables approaching from the north from crossing the DoD exclusion line and traversing south across the seabed to the Sandbridge area, which eliminated Sandbridge as a potential offshore export cable landing location. As such, a route to land in the area of the Sandbridge community or any points further south is precluded given this fatal flaw. For reasons stated above, this location is not carried forward in the PDE. Further, Section 2.1.1.2 of the May 6, 2022, version of the COP states: Though the details of the cable are not available to the public, it is inferred that a Navy subsea cable asset was installed approximately 4 nautical miles (7 kilometers) south of the offshore export cable routes. The only evidence of this cable asset that has been located in the public domain is referenced in the Final Environmental Assessment (EA) for the Sandbridge Beach Erosion

Alternative	Rationale for Dismissal
	Control and Hurricane Protection Project on Virginia Beach in 2018. In addition, the offshore export cable route corridor separating the two sand resource area polygons due south of DNODS is another indication that a cable passes through the area. Additionally, Dominion Energy evaluated utilizing the existing CVOW-Pilot corridor for the CVOW-C export cable route; however, the number of cables and required spacing to ensure the ability to microsite the routes, install the cables, and account for potential maintenance and repairs for the CVOW-C export cable route requires a larger footprint than what is available within the CVOW-Pilot export cable corridor. Specifically, the CVOW-C export cable route ROW varies in width from approximately 0.5 mile to 1.8 miles and would require a total ROW footprint of approximately 24.8 miles to accommodate the nine-cable layout. The CVOW-Pilot ROW totals approximately 1.0 mile (1.6 kilometers). The CVOW-C export cable corridor has been sited to be adjacent to the CVOW-Pilot cable corridor to the extent practical. The separation between the CVOW-C and CVOW-Pilot ROWs varies from 400 feet (122 meters) apart to approximately 2.0 miles (3.2 kilometers).
Evaluate alternatives for offshore export cable route reviewed by Dominion Energy	Commenters requested that an alternative evaluate the export cable route corridors considered by Dominion Energy and include an explanation of how the final export cable corridor was selected. An offshore routing constraints analysis was conducted along the offshore export cable rote corridor as well as the adjacent CVOW-Pilot project cable route. A summary of Dominion Energy's offshore routing constraints analysis and process for selecting the offshore export cable route is documented in the COP (Section 2.1.1.2; Dominion Energy 2022). Constraints analyses have been conducted and are identified in COP Appendix W (Dominion Energy 2022). Though the most direct route served as the starting point for developing the export cable route corridor, the final export cable route corridor was identified through constraints analysis, technical constraints, and routing feasibility, and reflected other challenges associated with existing constraints, such as the DNODS, Navy training and testing locations, and existing telecom and transmission cables. Additionally, potential challenges and complexities of the route such as length, seabed features, biological/cultural resources, and commercial/recreational fishing, were considered as part of the selection criteria for the preferred and alternative cable landing locations. Dominion Energy's preferred offshore export cable route minimizes route length, and has the least potential impacts on benthic habitat, the DNODS area, sand borrow areas, navigation channels, DoD training and testing areas, and existing submarine cables. As a result, Dominion Energy's preferred offshore export cable route corridor was determined to be the least environmentally damaging practicable alternative. An alternative export cable route corridor would be technically infeasible based on the constraints described above and in the rationale for dismissal for the coordinated offshore export cable route alternative; therefore, a separate alternative to consider other offshore export cable routes is not considered in the EIS.
Scour Protection	
Scour protection for foundations and offshore cables	Commenters recommended that BOEM consider alternatives that evaluate different possibilities for the composition and material of scour protection used in the Project. Suggestions include removing concrete

Alternative	Rationale for Dismissal
	mattresses as a possible option for scour protection and using layered rocks of different sizes and roughness. Scour protection proposed by Dominion Energy includes dumped rocks, geotextile sand containers, and concrete mattresses. The need, type, and method for installing scour protection has not been finalized and will be determined in consultation and coordination with relevant jurisdictional agencies prior to construction and installation (per COP Section 3; Dominion Energy 2022). Dominion Energy would submit the proposed final need, type, and method for installing scour protection as part of the Facility Design Report and Fabrication and Installation Report for BOEM's review. Project impacts associated with scour protection are disclosed in Chapter 3, *Affected Environment and Environmental Consequences,* of this EIS for relevant affected resources. Because, under all alternatives, scour protection is foreseen to be installed around the base of WTG foundations and OSSs foundations, and the type and method of installation would be determined at a later time, a separate alternative is not warranted.
Wind Turbine Array Layout and Spacing	
Transit corridor alternative	Commenters suggested that BOEM consider an alternative that would include a 2- to 4-nautical mile–wide transit corridor that aligns with the line-of-sight transit from Rudee Inlet in Virginia Beach to the Norfolk Canyon. BOEM considered the request for a 2- to 4-nautical mile–wide transit corridor and determined that an analysis of additional separation widths would not provide the U.S. Secretary of the Interior significantly different information regarding impacts on affected resources when compared to Alternative B, which would site OSSs in alignment with the common grid layout of the WTGs to minimize adverse impacts on surface and aerial navigation through the Project area. In previous BOEM NEPA analyses, BOEM found that eliminating structure locations to create corridors for transit did not meaningfully improve navigational safety in an aligned and regular gridded structure layout, as would exist under all the alternatives. Further, the spacing provided within Dominion Energy's proposed 0.93- by 0.75-nautical mile offset grid pattern is anticipated to be consistent with the findings expected to be published in the Final USCG Atlantic Coast Port Access Route Study (Dominion Energy 2022). Therefore, this alternative was not carried forward for detailed analysis.
Project and inter-array cable oriented to avoid specific benthic features	Commenters suggested that BOEM consider an alternative with WTG spacing and inter-array cable orientation that conforms with benthic features, such as sand ridges, and to create corridors for inter-array cables rather than a gridded layout, to allow for improved movement of whelk species and to minimize possible isolation of sensitive benthic species. BOEM has developed Alternative C to minimize impacts on offshore benthic habitats through a combination of: micrositing (up to 500 feet), the removal of four WTGs and associated inter-array cables, and the relocation of one WTG and associated inter-array cables from within priority sand ridge habitats. The generating capacity under Alternative C would allow Dominion Energy to meet its minimum 2,500-MW need for the project under the 2020 Virginia Clean Economy Act. There is no indication that whelk movement would be hindered by the presence of inter-array cables; however, potential impacts associated with offshore cables and foundations have been reviewed

Alternative	Rationale for Dismissal
	and disclosed in Chapter 3 of this EIS for relevant affected resources. As applicable, BOEM could also choose to implement additional mitigation measures to further reduce or avoid impacts. BOEM considered a variation to Alternative C that would utilize only 16 MW turbines and requested that Dominion Energy develop an Offshore Project layout avoiding sand ridge habitats and consisting of approximately 156 WTGs. However, a 16-MW turbine design is not currently commercially or technically available and is not likely to be available at the time of BOEM's anticipated Record of Decision (ROD). While the PDE for the Project does include a 16-MW WTG as the maximum capacity to allow for flexibility in the event technological advancements allow for an increase in the generating capacity of the selected turbine, Dominion Energy's preferred WTG design is the Siemens Gamesa Renewable Energy SG 14-22 DD WTG; Dominion Energy has selected and contracted 176 SG 14-22 DD WTGs for the Project. Given the custom nature of WTG orders, their custom site-specific foundations, and the supply chain constraints currently facing the offshore wind market, it is not reasonable nor economically feasible for BOEM to defer selection of a WTG model to the ROD. If a 16-MW WTG becomes available, Dominion Energy would conduct a financial assessment of whether to maintain 176 WTG positions or remove WTG locations. If determined favorable to remove WTG positions, Dominion Energy would consider prioritizing those located within priority sand ridge habitats in the Lease Area. Under this scenario, BOEM would review a 16-MW offshore layout in a future NEPA review, likely as a supplement to this EIS. Lessees prefer to have the WTGs arranged in such a way that the total wake effects for the individual WTG are minimized, which together with a goal to maintain a uniform layout to ease navigation, resulted in an offset grid pattern. As described in COP Section 3.3.1.1 and Section 4 (Dominion Energy 2022), the design of the WTG layout considered all existing uses of the Lease Area and surrounding areas such as vessel traffic patterns, commercial and recreational fishing activities, minimization of impacts on biological and cultural resources, as well as the safety of mariners and Project personnel. Based on these considerations, Dominion Energy designed the WTG layout to include a 397-foot (121-meter) setback (measured from the center point of the WTG) from the edge of the Lease Area to minimize potential impacts on existing uses and resources within and adjacent to the Lease Area. The setback is based on an assumed WTG blade length of 364 feet (111 meters) plus 3.3 feet (1 meter) to account for the rotation axis, with an additional 33-foot (10-meter) buffer to ensure that all WTG components are fully located within the Lease Area. Additionally, a 984-foot (300-meter) buffer was placed around known biological and cultural resources such as artificial reefs or shipwrecks. As a result, rotating the Project layout is infeasible as it would considerably increase impacts on safe navigation of the Project area, thereby obviously and substantially increasing the impacts on the human environment that outweigh potential benefits.
Minimum viable project scenario	Commenters recommended consideration of an alternative describing the minimum necessary components for a viable project. The commenters proposing a "minimum viable project design scenario" did not provide evidence that the alternative would avoid or

Alternative	Rationale for Dismissal
	substantially lessen one or more specific, significant socioeconomic or environmental effects of the Project. The "minimum viable project design scenario" would have substantially similar effects as alternatives that are analyzed in detail to address specific environmental and socioeconomic effects: Alternatives B, C, and D, all of which reduce the footprint of the Project to address specific impacts based on evidence of the sensitivity of resources and/or the need to accommodate other ocean uses, such as safe navigation. The generation capacity under Alternatives B, C, and D would allow Dominion Energy to meet its minimum 2,500-MW need for the Project under the 2020 Virginia Clean Economy Act.
Wind Turbine Technology	
Foundation type alternative	Commenters recommended that BOEM analyze an alternative that includes the use of non–pile-driven foundations. Dominion Energy considered multiple design alternatives for turbine foundations that were ultimately not selected for inclusion in the PDE for the COP. Alternative, non–pile-driven foundations considered but not carried forward include suction buckets, gravity-based structures, and floating foundations. Dominion Energy determined that these foundation types were not suitable for CVOW-C due to site conditions including soil sediment composition and water depth. See COP Volume 1, Section 2.2.2 (Dominion Energy 2022) for additional information on alternative foundation types considered. Because non–pile-driven foundations are technically infeasible for the CVOW-C Project area, they were eliminated from detailed analysis.
Mitigation	
Alternatives specific to each phase on the Project	A commenter encouraged BOEM to include alternatives specific to each phase of the Project to ensure environmental effects of the Project are avoided, mitigated, or minimized. Alternatives that only consider specific phases of the Project would not meet the purpose and need for Dominion Energy to construct and operate a commercial-scale offshore wind energy facility that would generate 2,500–3,000 MW. For each alternative evaluated in detail in the EIS, impacts at each stage of the Project have been analyzed. If the COP is approved or approved with modifications, BOEM could "mix and match" the EIS alternatives to develop a new preferred alternative, provided the design parameters are compatible and the alternative would still meet the purpose and need of the Proposed Action. For all alternatives evaluated in the EIS, BOEM could choose to implement additional mitigation measures to further reduce or avoid impacts, as appropriate. Refer to Appendix H, *Mitigation and Monitoring*, for BOEM's recommended measures to avoid or minimize impacts during the construction and operation of the Project. Because impacts from alternatives have been analyzed in detail for each phase of the Project and options for mitigation and minimization at each phase of the Project are already being evaluated as part of BOEM's review of the Proposed Action and alternatives, analyzing additional alternatives specific to each phase of the Project would not provide significantly different analysis, and thus this alternative was not carried forward for separate evaluation.

2.2 Non-Routine Activities and Low-Probability Events

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

- **Corrective maintenance activities:** These activities could be required as a result of other low-probability events, or as a result of unanticipated equipment wear or malfunctions. Dominion Energy would stock spare parts and have sufficient workforce available to conduct corrective maintenance activities, if required.
- **Collisions and allisions:** These events could result in spills (described below) or injuries or fatalities to wildlife (addressed in Chapter 3, *Affected Environment and Environmental Consequences*). Collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Project.
    - USCG requirement for lighting on vessels.
    - USCG requirement for aids to navigation, such as channel markers, safety signage, and buoys.
    - NOAA vessel speed restrictions.
    - The proposed spacing of WTGs and OSSs.
    - The lighting and marking plan that would be implemented, as described in Section 2.1.2.2.2, *Offshore Activities and Facilities.*
    - The inclusion of proposed Project components on navigation charts.
- **Cable displacement or damage by vessel anchors or fishing gear***:* This could result in safety concerns and economic damage to vessel operators and may require corrective action by Dominion Energy. However, such incidents are unlikely to occur because the proposed Project area would be indicated on navigational charts and the cable would be buried at least 3.3 feet (1 meter) below the seabed.
- **Chemical spills or releases:** For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills resulting from a catastrophic event. All vessels would be certified by the Project to conform to vessel O&M protocols designed to minimize risk of fuel spills and leaks. Dominion Energy would be expected to comply with USCG and Bureau of Safety and Environmental Enforcement regulations relating to prevention and control of oil spills through the implementation of an Oil Spill Response Plan (COP, Appendix Q; Dominion Energy 2022). Onshore, releases could occur from construction equipment or HDD activities; however, impacts would be minimized through the implementation of a Spill Prevention, Control, and Countermeasures Plan.
- **Severe weather and natural events:** Dominion Energy designed the proposed Project to withstand severe weather events. The WTGs are designed to withstand hurricane force winds expected in the Lease Area. The cut out wind speed of the WTG is anticipated to be 62.6 miles per hour (28.2 meters per second). If severe weather caused a spill or release offshore, the actions outlined previously would help reduce potential impacts. Severe flooding or coastal erosion could require repairs to Onshore Project components, with impacts associated with repairs being similar to those outlined in Chapter 3 for construction activities. While highly unlikely, structural failure of a WTG (i.e., loss of a blade or

tower collapse) due to severe weather would result in temporary hazards to navigation for all vessels, similar to the construction and installation impacts described in Chapter 3.

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

2.3 Summary and Comparison of Impacts by Alternative

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

Table 2-3 Summary and Comparison of Impacts among Alternatives with No Mitigation Measures

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.4 Air Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on air quality. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **moderate** adverse impacts due to emissions of criteria pollutants, volatile organic compounds (VOCs), hazardous air pollutants (HAPs), and greenhouse gases (GHGs), mostly released during construction and decommissioning, and **moderate beneficial** impacts on regional air quality after offshore wind projects are operational.	The Proposed Action would have **minor** adverse impacts attributable to air pollutant and GHG emissions and accidental releases. Alternative A-1 could have slightly lower air quality impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Project may lead to reduced emissions from fossil-fueled power-generating facilities and consequently **minor beneficial** impacts on air quality and climate. The Proposed Action would contribute a noticeable increment to the **minor** adverse and **moderate beneficial** impacts on air quality from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C could have slightly less impacts on air quality compared to the Proposed Action due to a reduced number of WTGs. Alternatives B and C could have lesser **minor** adverse impacts on air quality compared to the Proposed Action, to the extent that Alternatives B and C would reduce the number of WTGs. Alternatives B and C would have lesser **minor beneficial** impacts on air quality in the long term due to reduced emissions from fossil-fueled power plants, considering the reduced number of WTGs. The overall impact level for Alternatives B and C would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. Alternatives D-1 and D-2 would have the same number of WTGs as the Proposed Action and, therefore, the same anticipated offshore emissions and impact levels. Under Alternatives D-1 and D-2, the onshore interconnection cables could differ in length and construction techniques from those of the Proposed Action, and thus their construction emissions and impacts could differ from those of the Proposed Action. However, the impact levels would be the same as

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			for the Proposed Action: **minor** adverse and **minor beneficial**. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse and **moderate beneficial**.
3.5 Bats	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on bats. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts because bat presence on the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.	The Proposed Action would have **negligible** to **minor** adverse impacts on bats, especially if tree clearing is conducted outside of the active season. Alternative A-1 could have slightly less, but not appreciably different impacts on bats than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The primary risks to bats would be from potential onshore removal of roosting and/or foraging habitat and operation of offshore WTGs; however, occurrence of bats offshore is low and mortality is anticipated to be rare in the onshore or offshore environment. The Proposed Action would contribute an undetectable increment to the overall impact on bats. The overall impacts are expected to be **minor** adverse impacts on bats from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C may result in slightly less, but not materially different, **negligible** to **minor** adverse impacts on bats than those described under the Proposed Action due to a reduced number of WTGs. Alternatives D-1 and D-2 would have the same Offshore Project components as the Proposed Action and, therefore, would have similar impacts on bats offshore. Onshore, Alternatives D-1 and D-2 would limit the onshore interconnection cable route to either Route Option 6 (Alternative D-1) or Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These route options are analyzed as part of the Proposed Action and so impacts on bats would be the same as for the Proposed Action. Therefore, the impact levels of Alternatives B, C, D-1, and D-2 would be the same as

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			for the Proposed Action: **negligible** to **minor** adverse. The impacts associated with Alternatives B, C, D-1, and D-2, when each combined with the impacts of ongoing and planned activities (including offshore wind activities), would be the same as for the Proposed Action: **minor** adverse.
3.6 Benthic Resources	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** adverse, with the potential for **moderate beneficial** impacts on benthic resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative, when combined with all planned activities (including other offshore wind activities), would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts resulting from emplacement of structures (habitat conversion).	The Proposed Action would have **negligible** to **moderate** adverse impacts on benthic resources resulting from offshore construction and **moderate beneficial** impacts on benthic resources resulting from emplacement of structures (habitat conversion). Alternative A-1 would have slightly less of an impact due to three fewer WTGs and associated inter-array cabling. The adverse and beneficial impacts from Alternative A-1 would not be substantively different than from the Proposed Action. Adverse impacts would primarily result from new cable emplacement, pile-driving noise, anchoring, and the presence of structures. Beneficial impacts would result from the presence of new structures. The Proposed Action would contribute an undetectable to noticeable increment to the **moderate** adverse and **moderate beneficial** impacts on benthic resources from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities). The overall benthic impact would be **moderate** adverse.	Alternatives B and C would reduce the number of WTGs compared to the Proposed Action by 29 and 33 WTGs respectively, so the impacts would be slightly reduced compared to the Proposed Action, though not substantively different. There would be fewer foundations and fewer inter-array cables, which would reduce impacts associated with the presence of structures and conversion of habitat from soft-bottom to scour protection. However, the reduction in impacts would not be substantial enough to reduce the impact level, so these alternatives would have the same impact levels as the Proposed Action: **negligible** to **moderate** adverse and **moderate beneficial**. Alternatives D-1, and D-2 differ from the Proposed Action only in respect to the routing of the onshore interconnection cable and therefore would be the same as for the Proposed Action, **negligible** to **moderate** adverse to **moderate**

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			beneficial, with an overall benthic impact of **moderate** adverse.
3.7 Birds	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on birds. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including offshore wind activities) would have a **moderate** adverse impact on birds but could include **moderate beneficial** impacts because of the presence of offshore structures.	The Proposed Action would have **negligible** to **moderate** adverse impacts on birds, primarily associated with habitat loss and collision-induced mortality from rotating WTGs and permanent habitat loss and conversion from onshore construction. **Moderate beneficial** impacts would result from increased foraging opportunities for marine birds. Alternative A-1 could have slightly less, but not appreciably different impacts on birds than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action would contribute an undetectable increment to the **moderate** adverse and **moderate beneficial** impacts on birds from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C would reduce the number of WTGs compared to the Proposed Action, which would result in slightly less impacts on species with high collision sensitivity and high displacement sensitivity but would not change the impact level: **negligible** to **moderate** adverse impacts with **minor beneficial** impacts. Alternatives D-1 and D-2 would have the same Offshore Project components as the Proposed Action and, therefore, would have similar impacts on birds offshore as the Proposed Action. Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Route Option 6 (Alternative D-1) or Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These route options are analyzed as part of the Proposed Action and so impacts on birds from Alternatives D-1 and D-2 would be the same as for the Proposed Action. Therefore, the impact levels of Alternatives B, C, D-1, and D-2 would be the same as for the Proposed Action: **negligible** to **moderate** adverse impacts with

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			moderate beneficial impacts on birds. The overall impacts associated with Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse and **moderate beneficial**.
3.8 Coastal Habitat and Fauna	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on coastal habitat and fauna. Currently, there are no other offshore wind activities proposed in the geographic analysis area. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including offshore wind activities) would be **negligible**.	The Proposed Action would have **minor** adverse impacts on coastal habitat and fauna because habitat impacts would be limited, and coastal construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise. Alternative A-1 would have the same impacts on coastal habitat as the Proposed Action. The Proposed Action would contribute an undetectable increment to the **minor** adverse impacts on coastal habitat and fauna from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Because Alternatives B and C involve modifications only to offshore components, impacts on coastal habitat and fauna from those alternatives would be **minor** adverse. Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Route Option 6 (Alternative D-1) or Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These route options are analyzed as part of the Proposed Action and so impacts on coastal habitat and fauna would be the same. Therefore, the impact levels of Alternatives D-1, and D-2 would be **negligible** to **moderate** with **minor beneficial** impacts on coastal habitat and fauna.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.9 Commercial Fisheries and For-Hire Recreational Fishing	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in a **major** adverse impact on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing due primarily to the presence of structures (e.g., through gear loss, navigational hazards, space use conflicts, and potential impacts on fisheries surveys), new cable emplacement and pile-driving noise.	The Proposed Action would have **moderate** adverse impacts on commercial fisheries and **minor beneficial** impacts on for-hire recreational fishing. The impacts of the Proposed Action could also include long-term **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action would have **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing in the analysis area, driven largely by the presence of structures from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C could lead to **moderate** adverse impacts on commercial fisheries and for-hire recreational fishing and **minor beneficial** impacts on for-hire recreational fishing due to the increase in structures provided by WTGs, OSSs, and associated scour pads. Both adverse and beneficial impacts would be slightly less than for the Proposed Action considering the lower number of WTGs for Alternatives B and C. Alternative D differs from the Proposed Action only with respect to onshore routing of the interconnection cable. Alternative D would result in the same level of impacts as under the Proposed Action: **major** adverse on commercial fisheries and **moderate** adverse on for-hire recreational fishing The impacts of Alternatives B, C, D-1, and D-2, when each combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action: **minor** to **major** adverse.
3.10 Cultural Resources	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in overall **moderate** adverse impacts on cultural resources, primarily as a result of dredging, cable	The Proposed Action would have **moderate** to **major** adverse impacts on cultural resources primarily from the introduction of intrusive visual elements, which alter character-defining ocean views of historic properties onshore that contribute to the resource's eligibility for the NRHP; and dredging, cable emplacement, and activities	Alternatives B and C would have similar **moderate** to **major** adverse impacts on individual cultural resources as the Proposed Action assuming implementation of mitigation measures. Impacts would be slightly less than for the Proposed

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	emplacement, and activities that disturb the seafloor. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts on cultural resources.	that disturb the seafloor, which result in damage to or destruction of submerged archaeological sites or other underwater cultural resources (e.g., shipwreck, debris fields, ancient submerged landforms) from offshore bottom-disturbing activities. Alternative A-1 could have slightly less, but not appreciably different offshore impacts on cultural resources than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. Onshore impacts would be the same as for the Proposed Action. The Proposed Action would have **moderate** to **major** adverse impacts on cultural resources from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Action considering the lower number of WTGs for Alternatives B and C. Alternative D-1 and D-2 would have the same impacts offshore as for the Proposed Action, as the offshore components of Alternatives D-1 and D-2 are the same as for the Proposed Action. Alternatives D-1 and D-2 would have similar **moderate** to **major** adverse impacts on individual cultural resources onshore as the Proposed Action or Alternative A-1 assuming implementation of mitigation measures. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **moderate** to **major** adverse.
3.11 Demographics Employment, and Economics	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts.	The Proposed Action and Alternative A-1 would have **negligible** to **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would result in **minor** adverse and **moderate beneficial** impacts on demographics, employment, and economics from the	Alternatives B and C would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action because of the reduced number of WTGs, but the overall impact would be the same: **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts. Alternatives D-1 and D-2 would not change the number of WTGs and therefore the impacts are anticipated to be the same as those of the

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Proposed Action: **negligible** to **minor** adverse and **negligible** to **moderate beneficial**. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **negligible** to **minor** adverse and **negligible** to **minor beneficial**.
3.12 Environmental Justice	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** adverse and **minor beneficial** impacts on environmental justice populations. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts due to cable emplacement, construction-phase noise and vessel traffic, and the long-term presence of offshore structures, which could affect marine-dependent businesses, resulting in job losses for low-income workers.	The Proposed Action or Alternative A-1 would have a range of impacts on environmental justice populations, such as **negligible** adverse impacts due to air emissions, light, noise, port utilization, and vessel traffic, **minor** adverse impacts as a result of disruption of marine activities during construction, and **minor** to **moderate** adverse impacts due to the long-term presence of structures in the offshore environment. Potential **minor beneficial** impacts would result from port utilization and the enhanced employment opportunities. Overall, BOEM expects that the Proposed Action or Alternative A-1 would result in **negligible** to **moderate** adverse impacts and **minor beneficial** impacts on environmental justice populations. These action alternatives would not result in disproportionately “high and adverse” impacts on environmental justice populations. The combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would	Impacts of Alternatives B, C, D-1, and D-2 would be the same as those of the Proposed Action for environmental justice populations and would range from **negligible** to **moderate** adverse and **minor beneficial**. These action alternatives would not result in disproportionately “high and adverse” impacts on environmental justice populations. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **negligible** to **moderate** adverse impacts and **minor beneficial** impacts.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		result in **negligible** to **moderate** adverse impacts and **minor beneficial** impacts on environmental justice populations.	
3.13 Finfish, Invertebrates, and Essential Fish Habitat	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** adverse impacts on finfish, invertebrates, and essential fish habitat (EFH). *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** to **moderate** adverse impacts on finfish, invertebrates, and EFH. It is anticipated that the greatest impact on finfish and invertebrates would be caused by ongoing regulated fishing activity and climate change.	The Proposed Action would result in **negligible** to **moderate** adverse impacts for finfish, invertebrates, and EFH. The primary adverse impacts on finfish would be from noise during construction and operation of the proposed Project. Long-term adverse impacts on EFH from construction and installation of the Proposed Action would be **minor**, as the resources would likely recover naturally over time. The Proposed Action and Alternative A-1 would have **negligible** to **moderate** adverse impacts on invertebrates through temporary disturbance and displacement, habitat conversion, and behavioral changes, injury, and mortality of sedentary fauna. The presence of structures may have a **minor beneficial** impact on invertebrates through an “artificial reef effect.” Despite invertebrate mortality and varying extents of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the resources would likely recover naturally over time. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action would contribute a noticeable increment to the **negligible** to	Alternatives B and C would reduce the number of WTGs by 29 and 33 WTGs, respectively and would slightly reduce adverse impacts on finfish, invertebrates, and EFH compared to the Proposed Action, given that there would be fewer foundations developed and, therefore, less permanent loss of habitat and lower noise impacts during associated pile driving; however, the impact level would be the same as for the Proposed Action: **negligible to moderate** adverse. Alternatives D-1 and D-2 differ from the Proposed Action only in relation to the onshore routing of the interconnection cable and therefore impacts on Finfish, Invertebrates, and EFH would be the same as for the Proposed Action, with an overall Finfish, invertebrate and EFH impact of **moderate** adverse. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **negligible** to **moderate** adverse.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		moderate adverse impacts on finfish, invertebrates, and EFH from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	
3.14 Land Use and Coastal Infrastructure	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse impacts and **minor beneficial** impacts on land use and coastal infrastructure**.** *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts and **minor beneficial** impacts.	The Proposed Action or Alternative A-1 would result in **negligible** to **minor** adverse impacts and **minor beneficial** impacts on land use and coastal infrastructure. Beneficial impacts would result from port utilization. Adverse impacts would primarily result from land disturbance during onshore installation of the cable route and substation, accidental spills, and construction noise and traffic. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action would have **minor** adverse impacts and **minor beneficial** impacts from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C would reduce the number of WTGs, resulting in slightly decreased visual impacts of WTGs on coastal communities compared to the Proposed Action, but would not change the impact levels. Alternatives B and C therefore would have the same levels of impacts on land use and coastal infrastructure as the those of Proposed Action—**negligible** to **minor** adverse impacts and **minor beneficial** impacts. Alternatives D-1 and D-2 would have similar impacts on land use and coastal infrastructure as those of Proposed Action: **negligible** to **minor** adverse impacts and **minor beneficial** impacts. Alternatives D-1 and D-2 impacts, when combined with ongoing and planned activities would be the same as the Proposed Action: long-term **minor** adverse impacts and **minor beneficial** impacts. The impacts of Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.15 Marine Mammals	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** adverse impacts on marine mammals, as impacts would be detectable and measurable, but populations would be expected to recover sufficiently. The presence of structures could potentially result in **minor** beneficial impacts Adverse impacts on mysticetes, odontocetes, and pinnipeds would be primarily due to underwater noise, vessel activity (vessel collisions), commercial and recreational fishing gear interactions, and ongoing climate change. *Cumulative Impacts of the No Action Alternative:* Considering all impact-producing factors (IPFs) together, the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** adverse impacts on marine mammals, except for the North Atlantic right whale, on which impacts could be **major** adverse due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. Adverse impacts would be primarily due to underwater	BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** adverse and could include **minor beneficial** impacts. Adverse impacts, which would be detectable and measurable, are expected to result mainly from pile-driving noise, increased vessel traffic, and the presence of structures as related to fishing gear entanglement. Populations are expected to recover fully from these individual IPFs. Beneficial impacts are expected to result from the presence of structures as related to the artificial reef effect. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The incremental impacts contributed by the Proposed Action to the overall impact on marine mammals considering other ongoing and planned activities (including offshore wind activities). would range from undetectable to measurable and appreciable. The impact on marine mammals from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would be **moderate** adverse for most marine mammal species, with the exception of the North Atlantic right whale, on which impacts could be **major** adverse due to its population status. The main drivers for these adverse impact levels are underwear noise, vessel activity (vessel strikes) and entanglement risk.	Alternatives B and C would result in similar impacts on marine mammals as for the Proposed Action, with some impacts being minimally decreased in duration and geographic extent considering the reduction in the number of WTGs for Alternatives B and C. The impacts resulting from the Alternatives B and C individually would be similar to those of the Proposed Action and would range from **negligible** to **moderate** and could include **minor beneficial** impacts. Alternatives D-1 and D-2 would have the same offshore components as for the Proposed Action; impacts of Alternatives D-1 and D-2 would therefore be the same as for the Proposed Action. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the similar to or the same as for the Proposed Action and would range from **moderate** to **major** adverse and could include **minor beneficial** impacts.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	noise, vessel activity (vessel collisions), fishing entanglement, and climate change.		
3.16 Navigation and Vessel Traffic	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on navigation and vessel traffic. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** to **moderate** adverse impacts primarily due to the presence of structures and increased vessel traffic, leading to congestion at affected ports, an increased likelihood of collisions and allisions, and increased risk of accidental releases.	The Proposed Action would result in **minor** to **moderate** adverse impacts on navigation and vessel traffic. Adverse impacts would include changes in navigation routes due to the presence of structures and cable emplacement, delays in ports, degraded communication and radar signals, and increased difficulty of offshore search and rescue or surveillance missions within the Wind Turbine Area. Some commercial fishing, recreational, and other vessels would choose to avoid the Wind Turbine Area, leading to potential congestion of vessels along the Wind Turbine Area borders. The increase in potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users in the geographic analysis area. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action would have **minor** to **major** adverse impacts on navigation and vessel traffic from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	Alternatives B and C may slightly reduce impacts on navigation and vessel traffic due to the reduction in WTG positions and alignment of OSSs within the rows of the WTGs, but would not change the impact levels. Alternatives B and C therefore would have the same levels of impacts on navigation and vessel traffic as that of the Proposed Action, **minor** to **major** adverse Alternatives D-1 and D-2 would have the same impact as those under the Proposed Action and range from **minor** to **moderate** adverse**.** The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **minor** to **major** adverse.
3.17 Other Uses	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in	The Proposed Action would result in **negligible** adverse impacts for aviation and air traffic and cables and pipelines; **minor** adverse impacts for marine mineral	Impacts of Alternatives B and C would be similar to those of the Proposed Action for marine mineral extraction, military and national

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	negligible adverse impacts for marine mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems and **moderate** adverse impacts on scientific research and surveys. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** adverse impacts for aviation and air traffic, cables and pipelines, and radar systems; **minor** adverse impacts for marine mineral extraction and national security and military uses; and **major** adverse impacts for scientific research and surveys.	extraction, radar systems; **moderate** adverse impacts for military and national security uses; and **moderate** adverse impacts for NOAA's scientific research and surveys. The installation of WTGs in the Project area would result in increased navigational complexity and increased allision risk for vessel traffic and low-flying aircraft and would result in line-of-sight interference for radar systems. Additionally, the presence of structures would exclude certain areas within the Project area occupied by Project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling and affect survey gear performance, efficiency, and availability for NOAA surveys supporting commercial fisheries and protected-species research programs. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action would contribute to the impacts of ongoing and planned a noticeable increment to the **negligible** to **minor** adverse impacts for aviation and air traffic, cables and pipelines, marine mineral extraction and radar systems; **moderate** adverse impacts for military and national security uses; and **major** adverse impacts for NOAA's scientific research and surveys.	security uses, aviation and air traffic, cables and pipelines, and scientific research and surveys, with the overall impact ratings of **negligible** to **major** adverse. Alternatives B and C may slightly reduce impacts on other uses due to the reduction in WTG positions and alignment of OSSs within the rows of the WTGs, but would not change the impact levels. Alternatives B and C could potentially decrease impacts on radar systems by removing the WTGs closest to the shore, which would possibly reduce line-of-sight impacts. Alternatives D-1 and D-2 would have the same offshore components as for the Proposed Action and therefore offshore impacts of Alternatives D-1 and D-2 would be the same as for the Proposed Action. Impacts of Alternative D-1 and D-2 would be the same as or similar to those of the Proposed Action for cables and pipelines, marine mineral extraction, military and national security uses, radar, and aviation and air traffic, with the overall impact ratings of **negligible** to **major** adverse. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities)

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			would be the same impact levels as for the Proposed Action.
3.18 Recreation and Tourism	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** adverse and **negligible beneficial** impacts on recreation and tourism. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse and **minor beneficial** impacts on recreation and tourism.	The Proposed Action would result in **negligible** to **minor** adverse and **negligible** to **minor beneficial** impacts on recreation and tourism. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; and the long-term presence of scour protection and structures in the Wind Turbine Area during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures. The Proposed Action or Alternative A-1 in combination with other ongoing activities (including offshore wind activities) would contribute an undetectable to noticeable increment to the **minor** adverse, and **minor beneficial** impacts on recreation and tourism.	Impacts of Alternatives B and C would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. Construction of Alternatives B and C would install fewer WTGs and associated inter-array cables, which would slightly reduce the construction footprint and installation period. The impact levels are anticipated to remain the same as for the Proposed Action: **negligible** to **minor** adverse and **negligible** to **minor beneficial**. Alternatives D-1 and D-2 would differ from the Proposed Action only with respect to the onshore interconnection cable routes, and Alternatives D-1 and D-2 would not result in a discernable difference in impacts on recreation and tourism compared to the Proposed Action. Alternatives D-1 and D-2 would result in the same **negligible** to **minor** adverse and **negligible** to **minor beneficial** impacts. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **negligible** to **minor** adverse and **negligible** to **minor beneficial**.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.19 Sea Turtles	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on sea turtles. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** adverse and **minor** beneficial impacts on sea turtles. Potential impacts on sea turtles from multiple construction activities within the same calendar year could affect migration, feeding, breeding, and individual fitness. The foundations from WTG and OSS may provide foraging and sheltering opportunities.	The Proposed Action would result in overall **moderate** adverse impacts on sea turtles. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action would have an overall **moderate** adverse impact on sea turtles from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities). The main drivers are pile-driving noise, the presence of structures, ongoing climate change, and ongoing vessel traffic posing a risk of collision.	Alternatives B and C would have similar impacts on sea turtles as described for the Proposed Action and would be **moderate** adverse**.** Alternatives B and C would install fewer WTGs and associated inter-array cables, which would slightly reduce the construction footprint and installation period but would not change the impact levels. Alternatives D-1 and D-2 would differ from the Proposed Action only with respect to the onshore interconnection cable routes, and therefore Alternatives D-1 and D-2 would have the same impact on sea turtles as the Proposed Action: **moderate** adverse. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse.
3.20 Scenic and Visual Resources	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on scenic and visual resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all other planned activities (including other offshore wind activities) would	Impacts of the Proposed Action on scenic and visual resources would range from **minor** to **moderate** adverse**.** The main drivers for this impact rating are the adverse impacts associated with the presence of structures, lighting, and vessel traffic. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that	Alternatives B and C, would reduce the number of WTGs visible from the seascape and landscape compared to the Proposed Action. However, because of the eliminated WTGs offshore distance and location, these alternatives impacts on scenic and visual resources and would not change the overall impact level of **minor** to **major** adverse. The impacts of Alternatives B and C on

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	result in **moderate** to **major** adverse impacts on visual and scenic resources due to addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.	Alternative A-1 would reduce the number of WTGs. The Proposed Action would contribute substantially to the **moderate** adverse impact on scenic and visual resources from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	scenic and visual resources would be similar to the impacts of the Proposed Action: **minor** to **moderate** adverse. Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Route Option 6 (Alternative D-1) or Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. Although the Chicory Switching Station would be visible to some residences, Route Option 6 (Alternative D-1) would reduce the overall visual impacts on suburban residential character compared to the other routes from major to moderate. The overall impact level of Alternatives D-1 and D-2 would be the same as the Proposed Action: **moderate** adverse. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse.
3.21 Water Quality	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse impacts on water quality.	The Proposed Action would result in **negligible** to **minor** adverse impacts on water quality primarily due to sediment resuspension and potential accidental releases. The impacts are likely to be	Alternatives B and C may result in slightly less, but not materially different impacts on water quality due to relocated or a reduced number of WTGs that would be

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	Cumulative Impacts of the No Action Alternative: The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts because any potential detectable impacts are not anticipated to exceed water quality standards.	temporary or small in proportion to the geographic analysis area and the resource would recover completely after decommissioning. A larger offshore spill, although unlikely to occur based on BOEM modeling, could have **minor** to **moderate** adverse impacts on water quality. Alternative A-1 could have slightly less, but not appreciably different impacts than the Proposed Action, to the extent that Alternative A-1 would reduce the number of WTGs. The Proposed Action when combined with the impacts from ongoing and planned activities (including offshore wind activities) would be **minor** adverse, primarily due to short-term, localized effects from increased turbidity and sedimentation. BOEM has considered the possibility of a **moderate** adverse impact resulting from potential accidental releases; this level of impact could occur if there was a large-volume release. While it is an impact on water quality that should be considered, it is unlikely to occur based on BOEM's accidental release modeling.	constructed, operated, and maintained. Alternatives B and C would install fewer WTGs and associated inter-array cables, which would slightly reduce the construction footprint and installation period, but would not change the impact levels. Alternative D-1 and D-2 would differ from the Proposed Action only with respect to the onshore interconnection cable routes, and therefore offshore impacts on water quality for Alternatives D-1 and D-2 would be the same as for the Proposed Action: **minor** to **moderate** adverse. Alternatives D-1 and D-2 could have slightly less potential for onshore water quality impacts compared to the Proposed Action, but water quality regulatory requirements and Dominion Energy's proposed mitigation measures would be the same as for the Proposed Action. Therefore, onshore water quality impacts under Alternatives B, C, D-1, and D-2 would be the same as those of the Proposed Action: **minor** adverse. Similar to the Proposed Action, a large-volume spill offshore, although unlikely to occur based on BOEM modeling, could have **minor** to **moderate** adverse impacts on water quality under any of the alternatives.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			The impacts of Alternatives B, C, D-1, and D-2 when each combined with impacts from ongoing and planned activities (including offshore wind activities) would be the same as those of the Proposed Action: **minor** adverse. BOEM has considered the possibility of a **moderate** adverse impact resulting from accidental releases offshore from offshore wind development; however, it is unlikely to occur based on BOEM modeling.
3.22 Wetlands	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on wetlands. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** adverse impacts on wetlands, primarily through land disturbance.	The Proposed Action or Alternative A-1 may result in impacts on wetlands through short-term or permanent disturbance from activities within or adjacent to these resources. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), construction of the Proposed Action would have **moderate** to **major** adverse impacts on wetlands. The Proposed Action would have **moderate** to **major** adverse impacts on wetlands from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	Because Alternatives B and C involve modifications only to offshore components, and offshore components would not contribute to impacts on wetlands, impacts on wetlands from those alternatives would be the same as those under the Proposed Action: **moderate** to **major** adverse. Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Interconnection Cable Route Option 6 (Alternative D-1) or Interconnection Cable Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These interconnection cable route options are analyzed as part of the Proposed Action and so impacts on birds from Alternatives D-1 and D-2 would be the same as for the Proposed Action.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			The impacts from Alternatives B, C, D-1, and D-2 when each combined with impacts from ongoing and planned activities (including offshore wind activities) would be the same as those of the Proposed Action: **moderate** to **major** adverse.

3. Affected Environment and Environmental Consequences

This chapter addresses the affected environment for each resource area and the potential environmental consequences to those resources from the alternatives described in Chapter 2, *Alternatives Including the Proposed Action*. In addition, it addresses the impact of the alternatives when combined with other past, present, or reasonably foreseeable planned activities using the methodology and assumptions outlined in Chapter 1, *Introduction*, and Appendix F, *Planned Activities Scenario*. The planned activities considered in Appendix F include other ongoing and planned actions within the geographic analysis area for each resource that are occurring at the same time as the proposed Project or that could occur later in time but are still reasonably foreseeable.

Where information is incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter, BOEM identified that information and conducted its analysis in accordance with Section 1502.22 of the CEQ regulations. The findings of this assessment are presented in Appendix D, *Analysis of Incomplete or Unavailable Information*.

3.1. Impact-Producing Factors

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

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

The BOEM (2019) study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS. As discussed in the BOEM (2019) study, reasonably foreseeable actions other than offshore wind projects may also affect the same resources as the proposed Project or other offshore wind projects, possibly via the same IPFs or via IPFs through which offshore wind projects do not contribute. BOEM determined the relevance of each IPF to each resource analyzed in this Draft EIS. If an IPF was not associated with the proposed Project, it was not included in the analysis. Table 3.1-1 provides a brief description of the primary IPFs involved in this analysis, including examples of sources and activities that result in each IPF. The IPFs cover all phases of the Project, including construction, operations and maintenance, and decommissioning. Each IPF is assessed in relation to ongoing activities, planned activities, and the Proposed Action. Planned activities include planned non-offshore wind activities and future offshore wind activities.

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

IPF	Sources and/or Activities	Description
Accidental releases	• Mobile sources (e.g., vessels) • Installation, operation, and maintenance of onshore or offshore stationary sources (e.g., renewable energy structures, transmission lines, cables)	Refers to unanticipated release or spills into receiving waters of a fluid or other substance (e.g., fuel, hazardous materials, suspended sediment, trash, or debris). Accidental releases are distinct from routine discharges, the latter typically consisting of authorized operational effluents controlled through treatment and monitoring systems and permit limitations.
Discharges	• Vessels • Structures • Onshore point and non-point sources • Dredged material ocean disposal • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure	Generally, refers to routine permitted operational effluent discharges to receiving waters. There can be numerous types of vessel and structure discharges (e.g., bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, and seawater cooling system effluent). These discharges are generally restricted to uncontaminated or properly treated effluents that may have best management practice or numeric pollutant concentration limitations imposed through USEPA National Pollutant Discharge Elimination System (NPDES) permits or USCG regulations.
Air emissions	• Internal combustion engines (e.g., generators) aboard stationary sources or structures • Internal combustion engines within mobile sources (e.g., vessels, vehicles, or aircraft)	Refers to the release of gaseous or particulate pollutants into the atmosphere. Releases can occur on- and offshore.
Anchoring	• Anchoring of vessels • Attachment of a structure to the sea bottom by use of an anchor, mooring, or gravity-based weighted structure (i.e., bottom-founded structure)	Anchors, anchor chain sweep, mooring, and the installation of bottom-founded structures can alter the seafloor.

IPF	Sources and/or Activities	Description
Electromagnetic Fields (EMF)	• Substations • Power transmission cables • Inter-array cables • Electricity generation	Power generation facilities and cables produce electric fields (proportional to the voltage) and magnetic fields (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of the magnetic and induced electric fields from offshore wind energy projects: 1) the amount of electrical current being generated or carried by the cable, 2) the design of the generator or cable, and 3) the distance of organisms from the generator or cable.
Land disturbance	• Onshore construction • Onshore land use changes • Erosion and sedimentation • Vegetation clearance • Wetland and waters of the United States impacts	Refers to land disturbances for any onshore construction activities.
Lighting	• Vessels or offshore structures above or under water • Onshore infrastructure	Refers to the presence of light above the water onshore and offshore, as well as underwater associated with offshore wind development and activities that use offshore vessels.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Mattress and rock placement	Refers to disturbances associated with installing new offshore submarine cables on the seafloor, commonly associated with offshore wind energy.
Noise	• Aircraft • Vessels • Turbines • Geophysical and geotechnical surveys • Operations and maintenance • Pile driving • Dredging and trenching	Refers to noise from various sources. Commonly associated with construction activities, geophysical and geotechnical surveys, and vessel traffic. May be impulsive (e.g., pile driving) or broad spectrum and continuous (e.g., from Project-associated marine transportation vessels). May also be noise generated from turbines themselves or interactions of the turbines with wind and waves.
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to effects associated with port activity, upgrades, or maintenance that occur only as a result of the Project. Includes activities related to port expansion and construction from increased economic activity and maintenance dredging or dredging to deepen channels for larger vessels.

IPF	Sources and/or Activities	Description
Presence of structures	• Onshore and offshore structures including towers and transmission cable infrastructure	Refers to effects associated with onshore or offshore structures other than construction-related effects, including the following: • Space-use conflicts • Fish aggregation/dispersion • Bird attraction/displacement • Marine mammal attraction/displacement • Sea turtle attraction/displacement • Scour protection • Allisions • Entanglement • Gear loss/damage • Fishing effort displacement • Habitat alteration (creation and destruction) • Migration disturbances • Navigation hazard • Seabed alterations • Turbine strikes (birds, bats) • Viewshed (physical, light) • Microclimate and circulation effects
Traffic	• Aircraft • Vessels • Vehicles	Refers to marine and onshore vessel and vehicle congestion, including vessel strikes of sea turtles and marine mammals, collisions, and allisions.
Energy generation/security	• Wind energy production	Refers to the generation of electricity and its provision of reliable energy sources as compared to other energy sources (energy security). Associated with renewable energy development operations.
Climate change	• Emissions of greenhouse gases	Refers to the effects of climate change, such as warming and sea level rise, and increased storm severity or frequency. Ocean acidification refers to the effects associated with the decreasing pH of seawater from rising levels of atmospheric carbon dioxide.

Source: BOEM 2019.

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

3.2. Mitigation Identified for Analysis in the Environmental Impact Statement

During the development of the Draft EIS and in coordination with cooperating agencies, BOEM considered potential additional mitigation measures that could further avoid, minimize, or mitigate impacts on the physical, biological, socioeconomic, and cultural resources assessed in this document. These potential additional mitigation measures are described in Appendix H, *Mitigation and Monitoring*, Table H-1, and analyzed in the relevant resource sections in Chapter 3. BOEM may choose to incorporate one or more of these additional mitigation measures in the preferred alternative. In addition, other mitigation measures may be required through completion of consultations and authorizations with respect to several environmental statutes such as the MMPA, Section 7 of the ESA, or the Magnuson-Stevens Fishery Conservation and Management Act. Mitigation imposed through consultations will be included in the Final EIS. Those additional mitigation measures presented in Appendix H, Table H-2, may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. BOEM may choose to incorporate one or more additional measures in the ROD and adopt those measures as conditions of COP approval. All Applicant-Proposed Measures (APM) listed in Appendix H are part of the Proposed Action (see Section 2.1 for details).

3.3. Definition of Impact Levels

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

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

- Short-term effects. Effects that may extend up to 3 years. Construction and conceptual decommissioning activities are anticipated to occur for 2 to 3 years. An example would be clearing of onshore shrubland vegetation during construction; the area would be revegetated when construction is complete and, after revegetation is successful, this effect would end. Short-term effects may be further defined as being temporary if the effects end as soon as the activity ceases. An example would be road closures or traffic delays during onshore cable installation. Once construction is complete, the effect would end.
- Long-term effects. Effects that may extend for more than 3 years and may extend for the life of the Project (37 years). An example would be the loss of habitat where a foundation has been installed.
- Permanent effects. Effects that extend beyond the life of the Project. An example would be the conversion of land to support new onshore facilities or the placement of scour protection that is not removed as part of decommissioning.

The following terms are used to describe the incremental impact of the action alternative in relation to the combined impacts from all ongoing and planned activities, including both non-offshore wind and offshore wind activities.

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

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3.4. Air Quality

This section discusses potential impacts on air quality from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for air quality. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.4-1, includes the airshed within 25 miles (40 kilometers) of the Wind Farm Area (corresponding to the OCS permit area) and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and ports that may be used for the Project. The geographic analysis area encompasses the geographic region subject to U.S. Environmental Protection Agency (USEPA) review as part of an OCS permit for the Project under the Clean Air Act (CAA). The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the mustering port(s) outside of the OCS permit area. Given the dispersion characteristics of emissions from marine vessels, equipment and similar emission sources that would be used during proposed construction activities, the maximum potential air quality impacts would likely be within a few miles of the source. BOEM selected the 15.5-mile (25-kilometer) distance to assure that the locations of maximum potential air quality impact would be considered.

3.4.1 Description of the Affected Environment for Air Quality

The overall geographic analysis area for air quality covers the Virginia Beach, Virginia, region and the adjacent portions of the Atlantic Ocean, which includes the air above the Wind Farm Area and adjacent OCS area, the offshore and onshore export cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports used to support proposed Project activities. In addition, some vessel trips could occur in the Corpus Christi–Victoria, Texas, region. COP Section 4.1.3 (Dominion Energy 2022), provides further description of the geographic analysis area. Appendix I, *Environmental and Physical Settings*, provides information on climate and meteorological conditions in the Project region.

Air quality within a region is measured in comparison to the National Ambient Air Quality Standards (NAAQS), which are standards established by USEPA pursuant to the CAA (42 U.S.C. 7409) for several common pollutants, known as criteria pollutants, to protect human health and welfare. The criteria pollutants are carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone, particulate matter smaller than 10 microns in diameter (PM_{10}), particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). Virginia has established ambient air quality standards (AAQS) that are similar to the NAAQS. COP Table 4.1-12 (Dominion Energy 2022) shows the NAAQS. Emissions of lead from Project-associated sources would be negligible because lead is not a component of liquid or gaseous fuels; accordingly, lead is not analyzed in this EIS. Ozone is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily nitrogen oxides (NO_X) and VOCs, in the presence of sunlight. Potential impacts of a project on ozone levels are evaluated in terms of NO_X and VOC emissions.

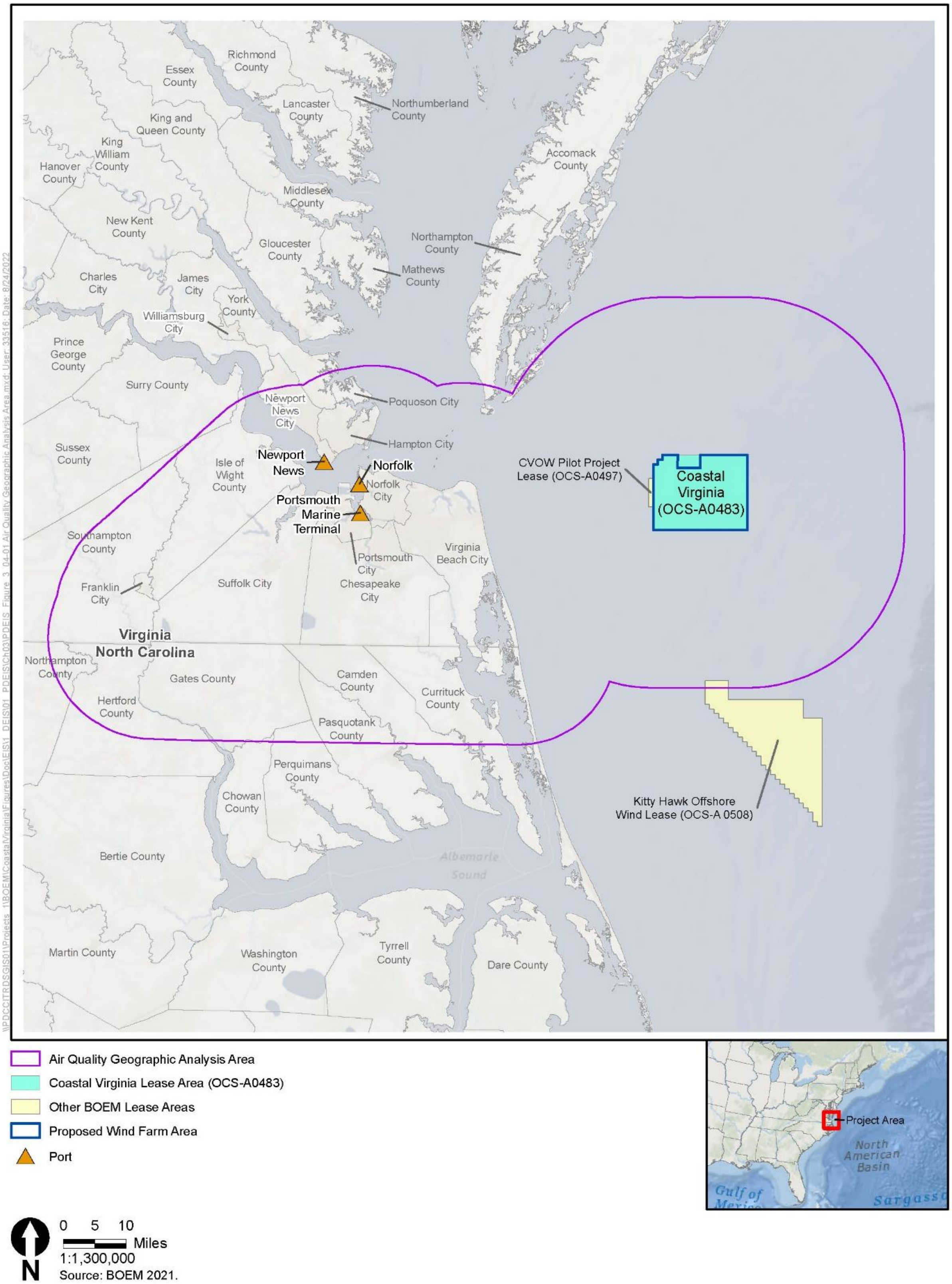
USEPA designates all areas of the country as attainment, nonattainment, or unclassified for each criteria pollutant. An attainment area is an area where all criteria pollutant concentrations are within all NAAQS. A nonattainment area does not meet the NAAQS for one or more pollutants. Unclassified areas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

The nearest onshore areas to the Wind Farm Area are the City of Virginia Beach, Virginia, and the other cities and counties that comprise the Virginia Beach-Norfolk-Newport News metropolitan area. These cities and counties are designated maintenance for ozone. These maintenance areas include facilities that the Project could use in the Hampton Roads area, such as the Portsmouth Marine Terminal. More distant ports that may be used include Corpus Christi, Texas, which is in an area designated attainment for all pollutants. Figure 3.4-1 displays the maintenance areas that intersect the geographic analysis area.

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

The CAA defines Class I areas as certain national parks and wilderness areas where very little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres and wilderness areas larger than 5,000 acres that were in existence before August 1977. Projects subject to federal permits are required to notify the federal land manager responsible for designated Class I areas within 62 miles (100 kilometers) of the Project. The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of the Project on air quality–related values. The nearest Class I area to the Project is the Swanquarter Wilderness Area in North Carolina, located about 87 miles (140 kilometers) south of the Project.

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



Note: Corpus Christi, Texas, area is not shown.

Figure 3.4-1 Air Quality of the Geographic Analysis Area

GHGs are gases that trap heat in the atmosphere and contribute to global climate change by retaining heat in the atmosphere. The primary GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and certain industrial gases. The GHG emissions from the Project are a result of fuel combustion that produces emissions of CO_2, CH_4, and N_2O, as well as leakage of sulfur hexafluoride (SF_6) from gas-insulated switchgear. Because each GHG constituent has a different heat-trapping ability, GHG emissions typically are expressed as CO_2 equivalent (CO_2e) based on the specific global warming potential (GWP) for each gas. The GWP of each GHG reflects how strongly it absorbs energy compared to CO_2. CO_2e is calculated based on the sum of the individual GHG emissions weighted by their respective GWPs.[1]

3.4.2 Environmental Consequences

3.4.2.1 Impact Level Definitions for Air Quality

Definitions of impact levels are provided in Table 3.4-1. Impact levels are intended to serve NEPA purposes only and are not intended to establish thresholds or other requirements with respect to permitting under the CAA.

Table 3.4-1 Impact Level Definitions for Air Quality

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

3.4.3 Impacts of the No Action Alternative on Air Quality

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

3.4.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for air quality described in Section 3.4.1, *Description of the Affected Environment for Air Quality*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on air quality are generally associated with onshore impacts, including onshore construction. Onshore

[1] The GWPs used to calculate CO_2e were taken from Table A-1 of 40 CFR Part 98, Subpart A. The GWPs are 1 for CO_2, 25 for CH_4, 298 for N_2O, and 22,800 for SF_6.

construction activities and associated impacts are expected to continue at current trends and have the potential to affect air quality through temporary and permanent air emissions. The only ongoing offshore wind activity within the geographic analysis area is the existing CVOW-Pilot Project, which is currently in operation and consists of two 12 MW turbines and approximately 24 miles (44.5 kilometers) of offshore export cable. Operation and maintenance activities for the CVOW-Pilot Project produce emissions but have negligible air quality impacts because only two turbines must be serviced.

In 2019, Virginia Governor Ralph Northam by Executive Order 43 established Virginia's objectives for statewide energy production.

- By 2028, Virginia will achieve 5,500 MW of wind and solar energy. At least 3,000 MW of this target should be under development by 2022.
- By 2030, 30 percent of Virginia's electric system will be powered by renewable energy resources.
- By 2050, 100 percent of Virginia's electricity will be produced from carbon-free sources, such as wind, solar, and nuclear.

The Virginia Clean Economy Act of 2020 was passed to implement Executive Order 43. The law requires new measures to promote energy efficiency, sets a schedule for closing old fossil-fuel power plants, and requires electricity to come from 100 percent renewable sources such as solar or wind. Energy companies must pay penalties for not meeting their targets, and part of that revenue would fund job training and renewable energy programs in historically disadvantaged communities.

Nonetheless, impacts from fossil-fuel facilities are expected to be mitigated partially by implementation of other offshore wind projects in the regions off New England, New York, New Jersey, Delaware, and Maryland, to the extent that these wind projects would result in a reduction in emissions from fossil-fueled power generating facilities. Other ongoing and planned activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; oil and gas activities; and onshore development activities (see Appendix F, Sections F.2.5 through F.2.9, F.2.12, and F.2.13 for further description of ongoing and planned activities).

3.4.3.2 Cumulative Impacts of the No Action Alternative

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

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

Air emissions: Most air pollutant emissions and air quality impacts from future offshore wind projects would occur during construction, potentially from multiple projects occurring simultaneously. The only projects currently proposed for which construction could occur simultaneously with the Project is Kitty Hawk Wind North and Kitty Hawk Wind South. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. Potential areas of overlap could include port and vessel activity in the Newport News/Norfolk/Hampton Roads region. As a result, air quality impacts would shift spatially and temporally across the geographic analysis area. All projects would be required to comply with the CAA. Primary emission sources would include vessel traffic, increased public and commercial vehicular traffic, air traffic, combustion emissions from construction equipment, and fugitive[2] emissions from construction-generated dust.

During operations, emissions from future offshore wind projects within the geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. COP Appendix N (Dominion Energy 2022) provides details of these emissions sources for construction and operations, as well as regulatory applicability of emissions by geographic area for purposes of NEPA and permitting.

The aggregate operational emissions for all projects within the geographic analysis area would vary by year as successive projects begin operation. As wind energy projects come online, power generation emissions overall would decrease, and the region as a whole would realize a net benefit to air quality. The future offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts within the geographic analysis area include projects within all or portions of Lease Area OCS-A 0508 (Appendix F, Table F-3). Projects currently proposed in this lease area include Kitty Hawk Wind North and Kitty Hawk Wind South, which together would have a maximum capacity of 2,484 Mw from the installation of 190 WTGs (Table F2-1). Based on the assumed offshore construction schedule in Table F-3, construction of the Proposed Action would occur in 2023–2027, construction of Kitty Hawk Wind North would occur in 2024–2026, and construction of Kitty Hawk Wind South would occur in 2026–2029. Consequently, construction of either or both Kitty Hawk Wind projects would overlap with construction of the Proposed Action in 2024-2027.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than the Proposed Action within the geographic analysis area (i.e., Kitty Hawk Wind North and Kitty Hawk Wind South), summed over all construction years, are estimated to be 4,263 tons of CO, 15,586 tons of NO_X, 538 tons of PM_{10}, 521 tons of $PM_{2.5}$, 264 tons of SO_2, 670 tons of VOCs, and 963,302 tons of carbon dioxide equivalent (CO_2e) (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F3-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

During operations, emissions from future offshore wind projects within the geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. Estimated operational emissions from Kitty Hawk Wind North and Kitty Hawk Wind South would be 343 tons per year of CO, 869 tons per year of NO_X, 39 tons per year of PM_{10}, 36 tons per year of $PM_{2.5}$, 12 tons per year of SO_2, 43 tons per year of VOCs, and 64,216 tons per year of carbon dioxide (CO_2e) (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F3-4). Operational emissions would overall be intermittent and dispersed throughout the 112,799-acre Lease Area and the vessel routes from the onshore O&M facility and would generally contribute to small and localized air quality impacts.

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

[2] Fugitive emissions are emissions that are not emitted from a stack, vent, or other specific point that controls the discharge. For example, windblown dust is fugitive particulate matter.

degrees Celsius (0.5–1.4 degrees Fahrenheit) by 2100. Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about the air pollutant emission contributions of the existing and projected mixes of power generation sources, and generally estimate the annual health benefits of an individual commercial-scale offshore wind project to be valued in the hundreds of millions of dollars (Kempton et al. 2005; Buonocore et al. 2016).

Climate change: Construction and operation of other (not the proposed Project) offshore wind projects would produce GHG emissions that would contribute incrementally to climate change. CO_2 is relatively stable in the atmosphere and, for the most part, mixed uniformly throughout the troposphere and stratosphere. As such, the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects would likely reduce regional GHG emissions by displacing energy from fossil fuels.[3] This reduction would more than offset the relatively small GHG emissions from offshore wind projects (Appendix F). U.S. offshore wind projects would by themselves probably have a limited impact on global emissions and climate change, but they may be substantial and beneficial as a component of many actions addressing climate change, and integral for fulfilling state plans regarding climate change.

Accidental releases: Future offshore wind activities could release air toxics or hazardous air pollutants (HAPs) because of accidental chemical spills within the geographic analysis area. Section 3.21, *Water Quality*, includes a discussion of the nature of releases that would be anticipated. Up to about 80,448 gallons (304,529 liters) of coolants, 986,204 gallons (3.7 million liters) of oils and lubricants, and 157,713 gallons (597,009 liters) of diesel fuel would be contained in the wind turbine and substation structures for Kitty Hawk Wind North and Kitty Hawk Wind South (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-3).

If accidental releases occur, they would be most likely during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short-term periods (hours to days)[4] of HAP emissions through surface evaporation. HAP emissions would consist of VOCs, which may be important for ozone formation. By comparison, the smallest tanker vessel operating in these waters (a general-purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 and 30.3 million liters). Tankers are relatively common in these waters, and the total WTG chemical storage capacity within the geographic analysis area for air quality is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). BOEM expects air quality impacts from accidental releases would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 33-year period with a higher probability of spills during future project construction, but they would not be expected to contribute appreciably to overall impacts on air quality.

3.4.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, air quality would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Additional, higher-emitting, fossil-fuel energy facilities would be built, or would be kept in service, to meet future power demand, fired by natural gas, oil, or coal (Dominion Energy 2020). To the extent that

[3] In 2020, the generation mix of the Pennsylvania-New Jersey-Maryland (PJM) Interconnection, the regional grid to which the Project would connect, was approximately 40 percent natural gas, 34 percent nuclear, 19 percent coal, 3 percent wind, 2 percent hydroelectric, and 2 percent other sources, on an annual average basis (Monitoring Analytics 2021).
[4] For example, small diesel fuel spills (500-5,000 gallons) usually will evaporate and disperse within a day or less (NOAA 2006).

state goals and regulations for expansion of renewable energy capacity are met, and the added renewable energy capacity is sufficient to meet demand, such additional fossil-fuel energy facilities might not be built or kept in service. Impacts of building or retaining fossil-fuel energy facilities would be mitigated partially by other future offshore wind projects including offshore New England, New York, New Jersey, Delaware, and Maryland.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change. Climate predictions for the Southeast indicate increased temperatures, which can increase ozone levels, and warmer and drier autumns that are expected to result in lengthening of the period of seasonal ozone exposure (Global Change Research Program 2018).

BOEM anticipates that the impacts of ongoing activities, such as air pollutant emissions and GHGs, would be **moderate**, because ambient pollutant concentrations would be expected to increase but not to levels that could exceed the NAAQS or Virginia AAQS.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and air quality would continue to be affected by the primary IPFs. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on air quality. Furthermore, potential activities other than offshore wind include increasing air pollutant and GHG emissions through construction and operation of new energy generation facilities to meet future power demands. Continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts in Virginia and the neighboring states. BOEM anticipates that the impacts of planned activities other than offshore wind would be **moderate**. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **moderate** impacts on air quality, primarily driven by recent market and permitting trends indicating future fossil-fueled electric generating units would most likely include natural-gas–fired facilities.

Considering all of the IPFs collectively, BOEM anticipates that the overall air quality and climate impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind would result in **moderate** adverse impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Pollutant emissions during operations would be generally lower and more transient. Construction and operations would contribute most to emissions of CO_2. Most air pollutant emissions and air quality impacts would occur during multiple overlapping project construction phases from 2024 through 2025 (Appendix F, Table F-3). Overall, adverse air quality impacts from future offshore wind projects are expected to be relatively small and transient. Future offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequent **moderate** beneficial impacts on air quality.

3.4.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Emission ratings of construction equipment and vehicle engines;
- Location of construction laydown areas;
- Choice of cable-laying locations and pathways;

- Choice of marine traffic routes to and from the Wind Farm Area and offshore export cable routes;
- Soil characteristics at excavation areas, which may affect fugitive emissions; and
- Emission control strategy for fugitive emissions due to excavation and hauling operations.

Changes to the design capacity of the WTGs would not alter the maximum potential air quality impacts for the Proposed Action and other action alternatives because the maximum-case scenario involved the maximum number of WTGs (205) allowed in the PDE.

3.4.5 Impacts of the Proposed Action on Air Quality

The Proposed Action may generate emissions and affect air quality in the Virginia Beach region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur in the onshore export cable corridors and at points of interconnection. Offshore emissions would be within the OCS and state offshore waters. Offshore emissions would occur in the Lease Area and the offshore export cable corridors. COP Section 3 (Dominion Energy 2022) provides additional information on land use and proposed ports.

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

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

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

Air emissions – Construction: Fuel combustion and solvent use associated with the Proposed Action or Alternative A-1 would cause construction-related emissions. The air pollutants would include criteria pollutants, VOCs, and HAPs, as well as GHGs. During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality. Construction equipment would comply with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts. The total estimated construction emissions of each pollutant are summarized in Table 3.4-2. COP Appendix N (Dominion Energy 2022) provides details of the emission sources for construction.

Table 3.4-2 Coastal Virginia Offshore Wind Total Construction Emissions (U.S. tons)

Year	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	HAP	CO_2e
2023	262	795	26	25	10	32	3.4	59,591
2024	1,248	4,207	139	135	64	173	17	276,171
2025	2,026	6,934	234	227	108	288	28	435,851
2026	942	2,717	96	93	32	110	11	174,714
2027	391	1,139	36	35	14	44	4.3	72,908
Total	**4,869**	**15,793**	**532**	**516**	**227**	**646**	**64**	**1,019,235**

Source: COP Section 4.1.3.3 (Dominion Energy 2022)
Sum of individual values may not equal total due to rounding.

3.4.5.1 Offshore Construction

Emissions from potential sources or construction activities associated with the Proposed Action or Alternative A-1 would vary throughout the construction and installation of offshore components. Emissions from offshore activities would occur during pile and scour protection installation, offshore cable laying, turbine installation, and substation installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and substations so that workers could operate lights, controls, and other equipment before cabling is in place. There also would be emissions from engines used to power pile-driving hammers and air compressors used to supply compressed air to noise-mitigation devices during pile driving (if used). Emissions from vessels used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. The Project may need emergency generators at times, potentially resulting in increased emissions for limited periods. Dominion Energy's measures to avoid, minimize, and mitigate the potential impact-producing factors include compliance with applicable fuel-efficiency and emissions standards, compliance with fuel sulfur content standards, and compliance with a Fugitive Dust Control Plan (COP, Table 4.1-22; Dominion Energy 2022).

The nearest Class I area, the Swanquarter Wilderness Area in North Carolina, is located about 87 miles (140 kilometers) south of the Project. This distance is greater than the 100-kilometer distance within which USEPA recommends that the federal land manager of the Class I area be notified about a project that requires a federal air quality permit. Winds blow from the Project area toward the Swanquarter Wilderness Area for only a small portion of the year (Appendix I, Figure I.2-1). Emissions from Project construction activities would not be concentrated at a single point but would occur throughout the analysis area. As a result, those Project emissions that occur when the wind is blowing from the Project area toward the Swanquarter Wilderness Area would be relatively well dispersed before being transported toward the Swanquarter Wilderness Area. For these reasons, adverse air quality impacts are not expected at the Swanquarter Wilderness Area due to the Proposed Action or Alternative A-1.

The largest air quality impacts are anticipated during construction, with smaller and more infrequent impacts anticipated during decommissioning. During the construction phase, the total emissions of criteria pollutants and ozone precursors from all offshore wind projects, including the Proposed Action or Alternative A-1, proposed within the geographic analysis area, summed over all 4 construction years, are estimated to be 5,241 tons of CO, 16,265 tons of NO_X, 551 tons of PM_{10}, 534 tons of $PM_{2.5}$, 227 tons of SO_2, 663 tons of VOCs, and 1,059,288 tons of CO_2 (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would shift spatially and temporally across the geographic analysis area. The largest combined air quality impacts from offshore wind would occur during overlapping construction and decommissioning of multiple offshore wind projects. Construction of the proposed Project would overlap with construction of Kitty Hawk Wind North from 2024 to 2027, and with the first year (2026) of Kitty Hawk Wind North's operations (Appendix F, Table F-3). Most air quality impacts would remain offshore because the highest emissions would occur in the offshore region, and the northerly and southwesterly prevailing winds would result in most emission plumes remaining offshore. However, ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined impacts on air quality from ongoing and planned activities would be minor during construction. During overlapping construction activities, there could be higher levels of impacts, but these effects would be short term in nature, as the overlap in the geographic analysis area would be limited in time.

3.4.5.2 Onshore Construction

Onshore activities of the Proposed Action or Alternative A-1 would consist primarily of HDD, duct bank construction, cable-pulling operations, and switching station and substation construction. The environmental impacts from Alternative A-1 would be the same as the Proposed Action for onshore construction. Onshore construction would include 14.2 miles (22.9 kilometers) of interconnection cable following Interconnection Cable Route Option 1.

Emissions would primarily be from operation of diesel-powered equipment and vehicle activity such as bulldozers, excavators, and heavy trucks, and fugitive particulate emissions from excavation and hauling of soil. Dominion Energy's proposed mitigation measures include complying with applicable fuel-efficiency and emissions standards, complying with fuel sulfur content standards, and developing and implementing a Fugitive Dust Control Plan (COP, Table 4.1-22; Dominion Energy 2022).

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

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to air quality impacts from ongoing and planned activities associated with onshore construction would be minor. Emissions from ongoing and planned activities, including the Proposed Action, would be highly variable and limited in spatial extent at any given period. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

3.4.5.3 Operation and Maintenance

Air emissions – O&M: During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. The WTGs operating under the Proposed Action or Alternative A-1 would have no pollutant emissions. Emergency generators on the substations would operate only during emergencies or testing, so emissions from these sources would be negligible and transient. Pollutant emissions from O&M would be mostly the result of operations of ocean vessels and helicopters used for maintenance activities. Crew transfer vessels and helicopters would transport crews to the Wind Farm Area for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the Wind Farm Area for significant maintenance and repairs. The proposed Project's contribution would be additive with the impact(s) of any and all other operational activities, including offshore wind activities, that occur within the geographic analysis area. COP Section 3.5 (Dominion Energy 2022) provides a more detailed description of offshore and onshore O&M activities, and COP Table 4.1-21 summarizes emissions during O&M. The impacts of Alternative A-1 would be slightly less than the Proposed Action due to the use of three fewer WTGs. The annual estimated emissions for O&M are summarized in Table 3.4-3. COP Appendix N (Dominion Energy 2022) provides details of these emission sources for operations, as well as regulatory applicability of emissions by geographic area for purposes of NEPA and permitting.

Table 3.4-3 Coastal Virginia Offshore Wind Operations and Maintenance Emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	HAP	CO_2e
Annual	382	481	19	19	0.37	18	2.0	41,214
Lifetime (33 years)	12,622	15,879	641	621	12	584	65	1,360,062

Source: COP Table 4.1-21; Dominion Energy 2022.
Values have been rounded.

BOEM anticipates that air quality impacts from O&M of the Proposed Action or Alternative A-1 alone would be minor, occurring for short periods several times per year during the anticipated 33 years.

Emissions from onshore O&M activities would be limited to periodic use of construction vehicles and equipment. Onshore O&M activities would include occasional inspections and repairs to the onshore substation and splice vaults, which would require minimal use of worker vehicles and construction equipment. Dominion Energy intends to use port facilities in the Hampton Roads, Virginia, area to support O&M activities. BOEM anticipates that air quality impacts due to onshore O&M from the Proposed Action or Alternative A-1 alone would be minor, intermittent, and occurring for short periods.

Increases in renewable energy could lead to reductions in emissions from fossil-fueled power plants. The USEPA AVERT tool (USEPA 2021b) was used to estimate the emissions avoided as a result of the Proposed Action. Once operational, the Proposed Action would result in annual avoided emissions of 2,803 tons of NO_X, 375 tons of $PM_{2.5}$, 4,396 tons of SO_2, and 5,867,210 tons of CO_2. The avoided CO_2 emissions are equivalent to the emissions generated by about 1.2 million passenger vehicles in a year (USEPA 2020a). The amount of emissions avoided from Alternative A-1 would be similar to but slightly less than those from the Proposed Action due to three fewer WTGs being used. Accounting for construction emissions and assuming decommissioning emissions would be the same, and including emissions from future operations, operation of the Proposed Action would offset emissions related to its development and eventual decommissioning within different time periods of operation depending on the pollutant: NO_X would be offset in approximately 11 years of operation, $PM_{2.5}$ in 3 years, SO_2 in 1 month, and CO_2 in 4 months. If emissions from future operations and decommissioning were not included, the times required for emissions to "break even" would be shorter. From that point, the Project would be offsetting emissions that would otherwise be generated from another source.

The potential health benefits of avoided emissions can be evaluated using USEPA's CO-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool (USEPA 2020b). COBRA is a tool that estimates the health and economic benefits of clean energy policies. COBRA was used to analyze the avoided emissions that were calculated for the Proposed Action. Table 3.4-4 presents the estimated avoided health effects.

Table 3.4-4 COBRA Estimate of Annual Avoided Health Effects with Proposed Action

Discount Rate[1] (2023)	Avoided Mortality (cases/year)		Monetized Total Health Benefits (U.S. dollars/year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	23.468	53.118	$256,803,637	$581,261,911
7%	23.468	53.118	$228,730,914	$517,720,736

[1] The discount rate is used to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the “time value of money” preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2021c).
[2] The low and high estimates are derived using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2021c).

Air emissions – Decommissioning: At the end of the operational lifetime of the Project, Dominion Energy would decommission the Project. Dominion Energy anticipates that all structures above the seabed level or aboveground would be completely removed. The decommissioning sequence would generally be the reverse of the construction sequence, involve similar types and numbers of vessels, and use similar equipment.

The dismantling and removal of the turbine components (blades, nacelle, and tower) and other offshore components would largely be a “reverse installation” process subject to the same constraints as the original construction phase. Onshore decommissioning activities would include removal of facilities and equipment and restoration of the sites to pre-Project conditions where warranted. Emissions from Project decommissioning were not quantified but are expected to be less than for construction. The Project anticipates pursuing a separate OCS Air Permit for those activities because it is assumed that marine vessels, equipment, and construction technology will change substantially in the next 37 years and in the future will have lower emissions than current vessels and equipment. Dominion Energy anticipates minor and temporary air quality impacts from the Proposed Action or Alternative A-1 due to decommissioning.

Climate change: The Proposed Action or Alternative A-1 would produce GHG emissions that contribute to climate change; however, its contribution would be less than the emissions offset during operation of the Project. Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are largely a function of global emissions. Consequently, the Proposed Action or Alternative A-1 would have negligible impacts on climate change during these activities and an overall net beneficial impact on criteria pollutant and ozone precursor emissions as well as GHGs, compared to a similarly sized fossil-fueled power plant or to the generation of the same amount of energy by the existing grid.

Overall, it is anticipated that there would be a net reduction in GHG emissions as a result of reduced emissions from fossil-fueled electric generation, and no collective adverse impact on climate change as a result of offshore wind projects. Additional offshore wind projects would likely contribute a relatively small emissions increase of CO_2. Development of offshore wind projects including the Proposed Action or Alternative A-1 and construction, O&M, and eventual decommissioning activities would cause some GHG emissions to increase, primarily through emissions of CO_2. The additional GHG emissions anticipated from the planned activities including the Proposed Action or Alternative A-1 over the 37-year period would have a negligible incremental contribution to existing GHG emissions.

Compared to the Proposed Action, Alternative A-1 could have slightly lower emissions from offshore construction and operation, and slightly lesser climate impacts, to the extent that this alternative would reduce the number of WTGs (three fewer WTGs compared to the Proposed Action). Emissions from onshore construction would be the same for the Proposed Action and Alternative A-1. To the extent that a reduced number of WTGs would lead to the use of higher-capacity turbine generators, and should the total annual MW-hours generated be diminished due to differing wind cut-in speeds of such higher-capacity turbine generators, then benefits from reduced emissions from fossil-fueled power plants would be diminished.

Accidental releases: The Proposed Action could release VOCs or HAPs because of accidental chemical spills. Based on the COP (Tables 3.3-2 and 3.3-6), the Proposed Action would have up to about 855,756 gallons (3.2 million liters) of coolants and damping liquid, 685,745 gallons (2.6 million liters) of oils and lubricants, and 20,121 gallons (76,165 liters) of diesel fuel in its 205 WTGs and three offshore substation structures. Accidental releases including spills from vessel collisions and allisions may lead to short-term periods of VOC and HAP emissions through evaporation. VOC emissions also would be a precursor to ozone formation. Air quality impacts would be short term and limited to the local area at and around the accidental release location. BOEM anticipates that a major spill is very unlikely due to vessel and offshore wind energy industry safety measures, as discussed in Section 3.21.5, *Impacts of the Proposed Action on Water Quality*, as well as the distributed nature of the material. BOEM anticipates that these activities would have a negligible air quality impact as a result of the Proposed Action alone.

Collectively, based on the COP (Tables 3.3-2 and 3.3-6; Dominion Energy 2022) and Kitty Hawk Wind North (2021), and Kitty Hawk Wind South (2022) there would be up to about 167,163 gallons (632,781 liters) of coolants, 1,681,564 gallons (6.4 million liters) of oils and lubricants, and 178,122 gallons (674,265 liters) of diesel fuel contained in the 403 structures among the Proposed Action and future planned activities in the geographic analysis area.

Compared to the Proposed Action, Alternative A-1 could have slightly lesser impacts from accidental releases to the extent that this alternative would reduce the number of WTGs.

3.4.5.4 Cumulative Impacts of the Proposed Action

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

Air emissions – O&M: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined impacts of ongoing and planned activities would be minor. Using the assumptions in Appendix F, Table F-3, O&M emissions from ongoing and planned activities could begin in 2026. Emissions would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions. Planned activities, including the Proposed Action, are estimated to emit 1,234 tons per year of CO, 4,090 tons per year of NO_X, 141 tons per year of PM_{10}, 136 tons per year of $PM_{2.5}$, 63 tons per year of SO_2, 172 tons per year of VOCs, and 260,888 tons per year of CO_2 when all projects are operating (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-4).Anticipated impacts on air quality from O&M emissions would be transient, small in magnitude, and localized. A net improvement in air quality is expected on a regional scale as the Project begins operation and displaces emissions from fossil-fueled sources.

Air emissions – Decommissioning: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined air quality impacts from ongoing and planned activities would be minor. The decommissioning process for all offshore wind projects is expected to be similar to that for CVOW, and impacts would be similar to those of CVOW decommissioning. Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. If decommissioning activities for projects overlap in time, then impacts could be greater for the duration of the overlap.

Climate Change: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined GHG impacts on air quality from ongoing and planned activities would be beneficial from the net decrease in GHG emissions, to the extent that fossil-fueled generating facilities would reduce operations as a result of increased energy generation from offshore wind projects.

Accidental Releases: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined accidental release impacts on air quality from ongoing and planned activities would be negligible due to the short-term nature and localized potential effects. Accidental spills would occur infrequently over the 33-year period with a higher probability of spills during construction of projects, but they would not be expected to contribute appreciably to overall impacts on air quality, as the total storage capacity within the geographic analysis area is considerably less than the existing volumes of hazardous liquids being transported by ongoing activities and is distributed among many different locations and containers.

3.4.5.5 Conclusions

Impacts of the Proposed Action. The Proposed Action or Alternative A-1 would result in a net decrease in overall emissions over the region compared to the No Action Alternative. Although there would be some air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation (Table 3.4-4). **Minor** air quality impacts would be anticipated for a limited time during construction, maintenance, and decommissioning, but there would be a **minor beneficial** impact on air quality near the Wind Farm Area and the surrounding region overall to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants in the future. Compared to the Proposed Action, Alternative A-1 could have slightly lesser air quality impacts, to the extent that this alternative would reduce the number of WTGs. Dominion Energy has proposed mitigation measures that would reduce potential impacts through complying with applicable emissions and fuel standards and requiring dust control plans for onshore construction areas. Because of the amounts of emissions, the fact that emissions are spread out in time (4 years for construction and then lesser emissions annually during operation), and the large geographic area over which they would be dispersed (throughout the 112,799-acre Lease Area and the vessel routes from the onshore facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS and Virginia AAQS.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends, impacts resulting from individual IPFs affecting air quality would range from **negligible** to **minor,** with **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action or Alternative A-1 to the air quality impacts of ongoing and planned activities would be **minor**. The main driver for this impact rating is emissions related to construction activities increasing commercial vessel traffic, air traffic, and truck and worker vehicle traffic. Combustion emissions from construction equipment, and fugitive emissions, would be higher during overlapping construction activities but short term in nature, as the overlap would be limited in time. Therefore, the overall impacts on air quality would be **minor** because pollutant concentrations associated with offshore wind development are not expected to exceed the NAAQS and Virginia AAQS.

3.4.6 Impacts of Alternatives B and C on Air Quality

Impacts of Alternatives B and C. The air quality and climate impacts of Alternatives B and C would be similar to those of the Proposed Action. Alternatives B and C could have lower emissions from offshore construction and operation compared to the Proposed Action (207 WTGs), to the extent that these alternatives would reduce the number of WTGs (up to 176 WTGs under Alternative B and up to 172 WTGs under Alternative C). Based on the number of WTGs, emissions would be greatest with the Proposed Action, less with Alternative B, and least with Alternative C, with Alternatives B and C having emissions levels similar to each other.

To the extent that a reduced number of WTGs and the use of lower-capacity turbine generators (14 MW for Alternatives B and C) would result in a reduction in the total annual MW-hours generated compared to the Proposed Action, benefits from reduced emissions from fossil-fueled power plants would be lower. As under the Proposed Action, construction of the onshore interconnection cables would follow Interconnection Cable Route Option 1, and would have the same emissions as the Proposed Action for interconnection cable construction.

Compared to the Proposed Action, Alternatives B and C could have slightly lesser impacts from accidental releases to the extent that these alternatives would reduce the number of WTGs.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.4.6.1 Conclusions

Impacts of Alternatives B and C. Minor impacts would be expected under Alternatives B and C. The same construction, O&M, and decommissioning activities described for the Proposed Action would still occur, albeit at slightly differing scales. Alternatives B and C could have **minor** air quality impacts compared to the Proposed Action, with impacts varying slightly based on potentially shorter construction periods due to reduced numbers of WTGs. Overall, Alternatives B and C would have similar **minor** impacts on air quality compared to the Proposed Action, with impacts varying only slightly based on differing numbers of WTGs. As under the Proposed Action, Alternatives B and C would result in **minor beneficial** impacts on air quality in the long term due to reduced emissions from fossil-fueled power plants.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contributions of Alternatives B and C to the impacts of individual IPFs affecting air quality and climate change from ongoing and planned activities would be the same as those of the Proposed Action, with impacts ranging from **negligible** to **minor**. Offshore wind projects, including Alternatives B and C, would result in **moderate beneficial** impacts overall due to reduced emissions from fossil-fueled power plants.

3.4.7 Impacts of Alternative D on Air Quality

Impacts of Alternative D. The air quality impacts of Alternative D would be similar to those of the Proposed Action. Alternatives D-1 and D-2 would have the same number of WTGs and the same offshore cable route as the Proposed Action and, therefore, the same anticipated offshore emissions. Alternatives D-1 and D-2 differ in the selection of onshore interconnection cable routes. Under Alternative D-1, only Interconnection Cable Route Option 1 would be approved and constructed, and the new Harpers Switching Station would be constructed. Under Alternative D-2, only Interconnection Cable Route Option 6 would be approved and constructed, and the new Chicory Switching Station would be constructed.

The overall length of onshore interconnection cable for Alternative D-1 (Interconnection Cable Route Option 1) is the same as for Alternative D-2 (Interconnection Cable Route Option 6) at 14.2 miles. However, Alternative D-2 (Interconnection Cable Route Option 6) would use a hybrid above/below ground approach having 9.7 miles overhead and 4.5 miles underground, while Alternative D-1 (Interconnection Cable Route Option 1) would use an entirely aboveground (overhead) approach.

The underground portion of Alternative D-2 (Interconnection Cable Route Option 6) could be constructed by surface trenching, HDD, microtunneling, or similar methods, or a combination of these, depending on local geotechnical and surface conditions. Surface trenching typically involves greater use of earthmoving equipment than does overhead line construction or the other underground construction techniques, and consequently has potential for greater emissions (on a per-mile basis), especially of fugitive dust. Also, based on the types of construction equipment CVOW would use, BOEM expects that overhead construction would produce greater emissions (on a per-mile basis) than HDD or microtunneling. Thus, the total emissions from construction of the underground portion of the cable could be either greater or less than emissions from construction of the same length of overhead cable, depending on the relative distances that were constructed by each underground construction method. As a result, short-term, minor air quality impacts associated with the installation of cables for Alternative D-2 (Interconnection Cable Route Option 6) could differ from the impacts associated with installation of cables for Alternative D-1 (Interconnection Cable Route Option 1).

In addition, Alternative D-2 (Interconnection Cable Route Option 6) includes construction of the Chicory Switching Station, which would have a total footprint of 35.5 acres (14.4 hectares), while Alternative D-1 (Interconnection Cable Route Option 1) includes construction of the Harpers Switching Station, which would have a total footprint of 45.4 acres (18.4 hectares). The construction total disturbance area is an indicator of amounts of land-disturbing activities and associated construction equipment usage and the resulting emissions. Therefore, BOEM expects that emissions associated with the construction of the Harpers Switching Station would be greater than with the Chicory Switching Station, especially for fugitive dust, due to the larger disturbance area of the Harpers Switching Station. However, BOEM expects that the overall construction air quality impacts for the onshore interconnection cables would be short term and minor under either Alternative D-1 (Interconnection Cable Route Option 1) or Alternative D-2 (Interconnection Cable Route Option 6).

Impacts from accidental releases under Alternative D would be the same as under the Proposed Action.

Overall, the differences in emissions among the Proposed Action and the other action alternatives would be small, and the air quality and climate impacts would be substantively the same as described for the Proposed Action. Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under the other action alternatives would be similar to those of the Proposed Action and, therefore, the impacts on air quality from accidental releases are expected to be comparable to those of the Proposed Action.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternatives D-1 and D-2 to air quality impacts resulting from ongoing and planned activities would be the same as those described under the Proposed Action.

3.4.7.1 Conclusions

Impacts of Alternative D. The expected short-term, **minor** impacts associated with the Proposed Action alone would not change under Alternative D-1 or D-2. Alternatives D-1 and D-2 would have the same number of WTGs as the Proposed Action and the same construction, O&M, and decommissioning activities would still occur, albeit at slightly differing scales. Their construction emissions would differ because of differences in cable construction methods and the footprint sizes of the proposed switching stations. Overall, Alternatives D-1 and D-2 would have similar **minor** impacts on air quality compared to the Proposed Action, with construction impacts varying based on the potential selection of onshore cable routes and substations. As under the Proposed Action, Alternatives D-1 and D-2 would result in **minor beneficial** impacts on air quality and climate change in the long term due to reduced emissions from fossil-fueled power plants.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contributions of Alternatives D-1 and D-2 to the impacts of individual IPFs affecting air quality and climate change from ongoing and planned activities would be similar to those of the Proposed Action, with impacts ranging from **negligible** to **minor**. Offshore wind projects, including the Alternatives D-1 and D-2, would result in **moderate beneficial** impacts overall due to reduced emissions from fossil-fueled power plants.

3.5. Bats

This section discusses potential impacts on bat resources from the Proposed Action, alternatives, and ongoing and planned activities in the bat geographic analysis area. The bat geographic analysis area, as described in Appendix F, *Planned Activities Scenarios*, Table F-1 and illustrated on Figure 3.5-1, includes the East Coast from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. The offshore limit was established to capture the migratory movements of most species in this group, while the onshore limits cover onshore habitats used by species that may be affected by onshore and offshore components of the proposed Project.

3.5.1 Description of the Affected Environment for Bats

Detailed descriptions of bats occurring inland and offshore Virginia can be found in the COP (Section 4.2.3.1, Section 2.1 of Appendix O-1, and Section 1.2 of Appendix O-2; Dominion Energy 2022a). Seventeen bat species are known to occur in Virginia; 14 of these species are thought to have the potential to occur in coastal areas of Virginia either in or adjacent to the proposed Project area (COP, Section 4.2.3.1, Table 4.2-12; Dominion Energy 2022a). Two of the 14 bat species are federally listed; the northern long-eared bat (*Myotis septentrionalis*) and the Indiana bat (*Myotis sodalis*). The northern long-eared bat is threatened and is found throughout Virginia; however, USFWS has proposed to reclassify the bat from threatened to endangered, and a final decision will be announced in November 2022. The Indiana bat is endangered and typically does not occur in the eastern part of Virginia (Timpone et al. 2011), but more recent studies have documented its presence, including a maternity colony, in the coastal plain of the state (St. Germain et al. 2017; Silvis et al. 2017; De La Cruz 2020). The northern long-eared bat and Indiana bat also are listed as state threatened and endangered species, respectively (VDWR 2021). Bats use a variety of terrestrial environments for foraging and roosting during summer breeding and migration periods. The Onshore Project components would be located primarily in already developed areas, but bats could use other types of nearby undeveloped habitats.

Bat species consist of two distinct groups based on their overwintering strategy: cave-hibernating bats (cave bats) and migratory tree bats (tree bats). Cave-hibernating bats migrate from summer habitat to winter hibernacula in the mid-Atlantic region (Maslo and Leu 2013), while tree bats migrate to southern parts of the United States (Cryan 2003), and some species are likely present year-round in Virginia (Timpone et al. 2011). Of the tree bat species, only the silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*) are considered migratory in North America due to their seasonal (spring and fall) migrations over several degrees of latitude (Cryan 2003), with the eastern red bat being more likely to occur offshore (Hatch et al. 2013; Sjollema et al. 2014).

Bats are terrestrial species that spend almost their entire lives on or over land but can occasionally occur offshore during spring and fall migration and under very specific conditions such as low wind, good visibility, and high temperatures (Smith and McWilliams 2016; True et al. 2021). Generally, bat activity offshore is less than onshore and decreases with increased distance from shore (Brabant et al. 2021; Solick and Newman 2021). Recent studies, combined with historical anecdotal accounts, indicate that tree bats sporadically travel offshore during spring and fall migration, with 80 percent of acoustic detections occurring in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Petersen 2016). However, unlike tree bats, the likelihood of detecting a *Myotis* species or other cave bat is substantially less in offshore areas because bat activity in the mid-Atlantic decreases 6 miles (20 kilometers) from shore (Pelletier et al. 2013; Sjollema et al. 2014; Petersen 2016).

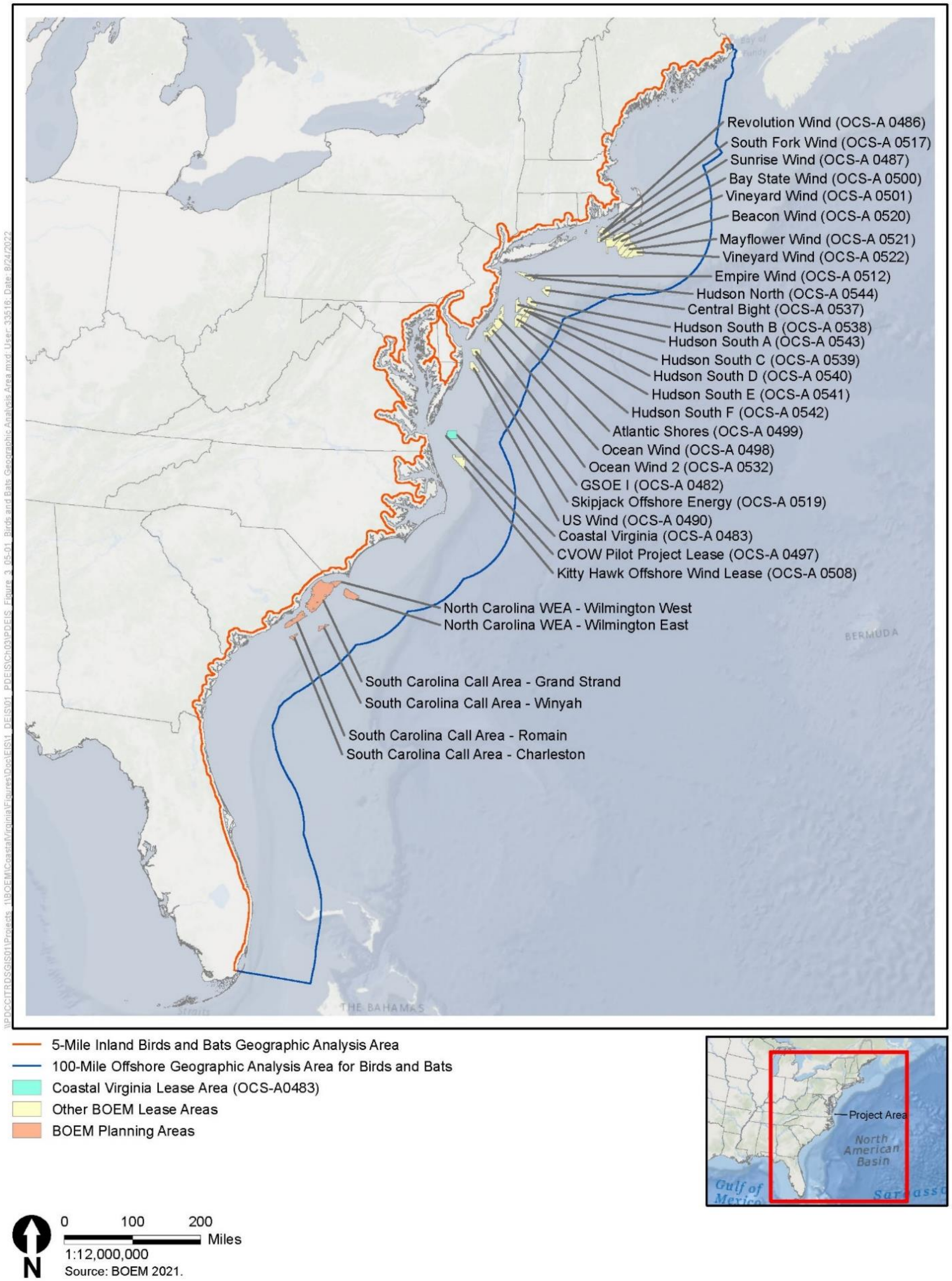


Figure 3.5-1 Birds and Bats Geographic Analysis Area

Results from the Project offshore bat acoustic survey (COP, Appendix O-2; Dominion Energy 2022a) did not document *Myotis* species or any federally listed species in the Offshore Project area. All bat species conclusively identified from the acoustic survey results were long-distance migratory tree bat species (i.e., eastern red bat, Seminole bat [*Lasiurus seminolus*], silver-haired bat, and hoary bat), but some cave-hibernating species may be present among the bats that were unidentified. Overall survey results from April to May 2021 showed a mean of 1.07 bat passes per acoustic detector night, which represented low activity levels across seasons and were concentrated during the fall migration period. Bat passes were distributed across the Offshore Project area and although concentrations of passes occurred, they often represented single nights with multiple bat passes rather than repeated use of the same area over many nights. Additionally, groups of bats were continuously recorded and represented 69 percent of all bat passes recorded, suggesting that a small number of individual bats contributed to large amounts of detected bat activity. Additionally, bats were documented day and night roosting on the vessels in the Offshore Project area. Moreover, post- construction Acoustic and Thermographic Offshore Monitoring of birds and bats for the CVOW-Pilot Project has been underway since April 2021 to collect seasonal information with respect to bat presence at the two WTGs installed for the Pilot Project (Dominion Energy 2022b). Data through the spring (April 1 to June 15, 2021) and fall (August 15 to October 31, 2021) monitoring seasons showed three bat species were present at the WTGs during both seasons: the silver-haired bat, the eastern red bat, and hoary bat. The number of bat detections was much higher in the fall with 415 calls, compared to in the spring when there were only 4 calls. However, it is important to note that abundance cannot be inferred based on the number of detections as many detections could have been the same individual passing by the detector multiple times. Given these data, the potential exists for some migratory tree bats to encounter offshore facilities during spring and fall migration. BOEM expects this exposure risk to be limited to very few individual tree bats and to occur, if at all, during migration. Given the distance of the Wind Farm Area from shore, BOEM does not expect foraging bats to encounter operating WTGs outside spring and fall migration.

Bats in the geographic analysis area are subject to pressure from ongoing activities generally associated with onshore impacts (e.g., onshore construction and climate change). Onshore construction activities and associated impacts are expected to continue at present trends and have the potential to result in impacts on bat species. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence. Additionally, cave bat species, including the northern long-eared bat, are experiencing drastic declines due to white-nose syndrome (WNS) caused by the fungal pathogen *Pseudogymnoascus destructans*. In Virginia, WNS has resulted in dramatic population declines for the little brown bat (*Myotis lucifugus*), Indiana bat, and tri-colored bat (*Perimyotis subflavus*) since 2009 (Reynolds 2021). The Proposed Action has the potential to result in impacts on cave bat populations already affected by WNS. While the WNS-related mortality of bats in northeastern North America reduces the likelihood of many individuals being present in the onshore portions of the proposed Project area (Cheng et al. 2021; Reynolds 2021), the biological significance of mortality resulting from the Proposed Action, if any, may be increased given the drastic reduction in cave bat populations in the region. Further, data collected from 2010 to 2019 by the U.S. Geological Survey (USGS) shows that predicted summer occurrence for the northern long-eared, little brown, and tri-colored bats is low along the coast of Virginia, indicating that at least some species are only present in low numbers in the onshore portion of the Project area (Udell et al. 2022).

3.5.2 Environmental Consequences

3.5.2.1 Impact Level Definitions for Bats

Definitions of impact levels are provided in Table 3.5-1. There are no beneficial impacts on bats.

Table 3.5-1 Impact Level Definitions for Bats

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

3.5.3 Impacts of the No Action Alternative on Bats

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

3.5.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for bats described in Section 3.5.1, *Description of the Affected Environment for Bats,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on bats are generally associated with onshore construction and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bat species through temporary and permanent habitat removal and temporary noise impacts, which could cause avoidance behavior and displacement. Mortality of individual bats could occur, but population-level effects would not be anticipated. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on bats include:

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

Ongoing O&M of the Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect bats through the primary IPFs of noise, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.5.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.5.3.2 Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that may affect bats include increasing onshore construction and the infrequent installation of new structures on the OCS (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). These activities may result in temporary and permanent onshore habitat impacts and temporary or permanent displacement and injury of or mortality to individual bats, but population-level effects would not be expected. See Appendix F, Attachment 1, Table F1-2 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for bats.

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

Noise: Construction of numerous offshore wind projects is projected between 2023 and 2030 in the geographic analysis area (Appendix F, Table F-3). Construction noise from these other projects, most notably from pile driving, may temporarily cause effects on some migrating bats if they are present during construction periods. However, notable noise impacts are not expected because research indicates that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals; no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

Other noise impacts (i.e., displacement from potentially suitable habitats or migration routes) could occur as a result of construction noise (Schaub et al. 2008), but the likelihood of impact is low because only limited use of the OCS is expected, and the use would occur only during spring and fall migration. Additionally, onshore construction noise also has the potential to result in impacts on bats foraging or roosting in the vicinity of construction activities. BOEM anticipates that these impacts would be temporary and highly localized, and bats would be expected to move to a different roost farther from construction noise. This movement would not be expected to result in any impacts, as frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998).

Given the temporary and localized nature of potential impacts and the expected biologically insignificant response to those impacts, no individual fitness or population-level impacts would be expected to occur as a result of onshore or offshore noise associated with offshore wind development.

Presence of structures: The primary threat to bats would be from collisions with offshore WTGs. Over 3,287 structures (WTGs, OSSs, and meteorological towers) could be constructed in the geographic analysis area (Appendix F, Table F-3), which could affect migration patterns or pose a collision risk to individual bats.

Although adverse impacts on bats from collisions with operating WTGs cannot be quantified, some level of mortality during operation of offshore wind facilities is assumed. Any new operating wind facility would require a thorough regulatory and environmental review to appropriately site the facility to avoid, minimize, and mitigate adverse impacts on bat species.

Cave bats (including the federally and state listed northern long-eared and Indiana bat) do not tend to fly offshore (even during migrations) and, therefore, exposure to construction vessels during construction or maintenance activities, or the rotor swept zone (RSZ) of operating WTGs in the lease areas is expected to be negligible, if exposure occurs at all (Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016).

Tree bats, include the eastern red bat, the hoary bat, and the silver-haired bat, may pass through the offshore wind lease area during migrations, with limited potential for migrating bats to encounter vessels during construction and conceptual decommissioning of WTGs, OSSs, and offshore export cable corridors, although structure and vessel lighting may attract bats due to increased prey abundance.

Some bats may encounter, or perhaps be attracted to, the offshore wind related structures to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects (OSSs and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the base of onshore turbine towers (Choi et al. 2020).

Offshore operations and maintenance would present a seasonal risk factor to migratory tree bats that may use the offshore habitats during spring or fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during spring or fall migration, the overall occurrence of bats on the OCS is low (COP, Appendix O-2; Dominion Energy 2022a; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022b).

Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with offshore wind development. WTGs for the proposed Project would be spaced approximately 0.75 nautical mile (1.39 kilometers) in an east–west direction and 0.93 nautical mile (1.72 kilometers) in a north–south direction. BOEM assumes that WTGs for other projects would be similarly spaced.

Several factors would reduce potential interactions between bats and operating WTGs, including the proposed spacing between structures associated with offshore wind development and the distribution of anticipated projects. Individual bats migrating over the OCS in the RSZ of projected WTGs would likely fly through project areas with only slight course corrections, if any, to avoid operating WTGs.

Unlike terrestrial migration routes, there are no offshore landscape features that would concentrate migrating tree bats and increase exposure to the offshore wind lease area on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016).

- The potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity is associated with relatively low wind speeds and warm temperatures (Smith and McWilliams 2016; True et al. 2021). Given the rarity of tree bats in the offshore environment, when combined with broadly spaced turbines and the patchiness of projects, the likelihood of collisions is expected to be low.
- The likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats have been shown to suppress activity during periods of strong winds, low temperatures, and rain (Smith and McWilliams 2016; True et al. 2021).

Land disturbance: Onshore construction activities involving land disturbance could result in localized, minor, and temporary impacts on bats, including avoidance, displacement, and habitat loss. These impacts would not be biologically notable, and no population-level effects would occur (Hann et al. 2017; Whitaker 1998).

Onshore land development or port expansion activities could also result in limited loss of roosting or foraging habitat for some bat species. However, such minor impacts would be limited in extent, and would not measurably affect bat population abundance or viability as individual projects would be expected to minimize tree removal if not occurring in previously disturbed habitats. As such, onshore construction activities associated with offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

Other considerations: The federally threatened northern long-eared bat is the only bat species listed under the Endangered Species Act that may be affected by the proposed Project; the Indiana bat is considered extralimital and rare along coastal areas. Ongoing activities, future non-offshore wind activities, and offshore wind activities other than the proposed Project may also affect the northern long-eared bat. As previously described and discussed further in the Biological Assessment (BA) (BOEM 2022), the possibility of impacts on the northern long-eared bat would be limited to onshore impacts that would generally be during facilities construction.

3.5.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, bats would continue to be affected by existing environmental trends and ongoing activities.

Ongoing activities are expected to have continuing temporary to long-term impacts (disturbance, displacement, injury, mortality, and habitat loss) on bats primarily through onshore construction impacts, the presence of structures, and climate change. BOEM anticipates that the potential impacts on bats resulting from ongoing activities would be **minor**. In addition to ongoing activities, the impacts of planned actions other than offshore wind development may also contribute to impacts on bats, including increasing onshore construction (Appendix F, Attachment 2), however these impacts would be **negligible**. BOEM expects the combination of ongoing and planned actions other than offshore wind development to result in **minor** impacts on bats.

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

Considering all the IPFs together, the overall impacts associated with offshore wind activities in the geographic analysis area would result in **minor** adverse impacts because of ongoing climate change, interactions with operating WTGs on the OCS, and onshore habitat loss. Offshore wind activities are not expected to materially contribute to the IPFs discussed above. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration and given that cave bats do not typically occur on the OCS, none of the IPFs associated with offshore wind activities that occur offshore would be expected to appreciably contribute to overall impacts on bats. Some potential for temporary disturbance and permanent loss of onshore habitat may occur as a result of offshore wind development. However, habitat removal would be minimal when compared with other past, present, and reasonably foreseeable activities, and any impacts resulting from habitat loss or disturbance would not result in individual fitness or population-level effects in the geographic analysis area.

3.5.4 Relevant Design Parameters and Potential Variances in Impacts

The primary proposed Project design parameters that would influence the magnitude of impact on bats are provided in Appendix E, *Project Design Envelope and Maximum Case Scenario*, and include the following.

- The number, size, and location of WTGs.
- The time of year during which construction occurs.

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

- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to bats.
- Season of construction: the active season for bats in the geographical analysis area is generally from March through November. Construction outside of this window would have a lesser impact on bats than construction during the active season. However, non-hibernating populations may persist in the area during winter.

3.5.5 Impacts of the Proposed Action on Bats

Noise: Pile-driving noise and onshore and offshore construction noise associated with the Proposed Action or Alternative A-1 alone would not increase the impacts of noise beyond the impacts described under the No Action Alternative (Section 3.5.3, *Impacts of the No Action Alternative on Bats*) and is expected to result in negligible impacts on bats because construction activity would be short term, temporary, and highly localized.

Auditory impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile driving or other construction activities and no temporary or permanent hearing loss would be expected (Schaub et al. 2008; Simmons et al. 2016).

Per the Project BA prepared for the U.S. Fish and Wildlife Service (USFWS) (BOEM 2022), the interconnection cable route would pass through several areas designated as high or very high ecological value and are in areas with documented northern long-ear bat maternity roosts; however, there are no hibernacula present in the vicinity of Onshore Project components. Dominion Energy will conduct presence/absence surveys for bats (acoustic and/or mist-net) along the interconnection cable route for all options and develop avoidance and minimization measures in coordination with the Virginia Department of Wildlife Resources (VDWR), USFWS, and appropriate regulatory agencies to ensure protection of northern long-eared bats.

Behavioral impacts from onshore construction activities could occur associated with use of Direct Steerable Pipe Thrusting for the installation of the offshore export cables to the cable landing location, which would result in temporary noise impacts from installation of the cofferdam, from Direct Steerable Pipe Thrusting in the sea-to-shore transition, and at beach work areas and could result in temporary, localized disturbance or displacement of bats. Disturbance impacts at the cable landing location would be short term and limited because the landing is located in a proposed parking lot. The onshore export cable predominately follows developed corridors and previously disturbed land to a common location north of Harpers Road. The onshore export cable route would pass through several habitat types, including open space, developed, forested, agricultural, and wetlands (Tables 3.8-2, 3.8-3, and 3.22-3) that may support bat species, resulting in temporary disturbance impacts on bats. From that point, onshore clearing and construction (and associated noise) would be required at the Harpers Switching Station and for the overhead lines from Harpers Switching Station to Fentress Substation resulting in impacts on varying acreages of wetlands and National Land Cover Database (NLCD) land cover classes, as shown in Tables 3.8-2 and 3.22-3.

Onshore clearing and construction would result in disturbance to bats at the Harpers Switching Station. The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the Harpers Switching Station (BOEM and Dominion Energy 2022). However, impacts at the Harpers Switching Station would be to previously developed areas within the Aeropines Golf Club (Table 3.8-2 and 3.8-3). With respect to the interconnection cable route, Interconnection Cable Route Option 1 is approximately 14.2 miles (22.9 kilometers) long and will be installed entirely overhead and result in disturbance impacts on a total of 72.70 acres (29.43 hectares) of wetland and NLCD land cover classes (Tables 3.8-2, 3.8-3, and 3.22-3). The interconnection cable route would culminate at the onshore substation, which would also require land clearing and result in impacts on wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3) and subsequent disturbance impacts on bats. Overall, noise from onshore clearing and construction would be localized and temporary. If the noise disturbs bats, they would likely temporarily move away, potentially from preferred foraging or roosting habitats. However, BOEM expects that no individual fitness or population-level impacts would be expected to occur resulting in negligible impacts on bats from the Proposed Action or Alternative A-1, and lasting impacts on local breeding populations are not anticipated. Conceptual decommissioning of the Project would have similar impacts as construction and would likely be conducted under similar seasonal restrictions.

While Alternative A-1 would result in a slightly reduced duration of noise due to the construction of three fewer WTGs, the difference in potential impacts from noise on bats would be nominal.

Presence of structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes are described in detail in Section 3.5.1. The Proposed Action would add up to 205 new WTGs, and Alternative A-1 would add 202 WTGs on the OCS where few currently exist.

There is some correlative evidence from inland studies that bat mortality increases with tower height (Barclay et al. 2007; Georgiakakis et al. 2012). Therefore, the Proposed Action could result in higher probability of bat mortality if 16-MW WTGs are chosen over 14-MW WTGs. However, because the overall occurrence of bats (including listed species) on the OCS is low (COP, Appendix O-2, Dominion Energy 2022a; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022b), the impacts of the Proposed Action are expected to result in minor long-term impacts in the form of mortality; BOEM anticipates the occurrence of such impacts to be rare. In addition, Dominion Energy would use BMPs identified by BOEM COP guidelines (BOEM 2020) and comply with FAA and USCG requirements for lighting and, to the extent practicable, use lighting technology (e.g., low-intensity strobe lights, flashing red aviation lights) that minimize impacts on bat species. Impacts under Alternative A-1 would be slightly less than under the Proposed Action due to the construction and operation of three fewer WTGs.

Land disturbance: Impacts associated with construction of onshore elements of the Proposed Action or Alternative A-1 could occur if construction activities occur during the active season (generally March through November). Impacts may include injury or mortality of individuals, particularly juveniles who are nonvolant (i.e., unable to fly) and cannot flush from a roost, if occupied by bats at the time of removal. According to the BA prepared for the USFWS (BOEM 2022), Dominion Energy would conduct presence/absence surveys for bats (acoustic and/or mist-net) along the Onshore Project area and develop avoidance and minimization measures in coordination with the VDWR, USFWS, and appropriate regulatory agencies to ensure protection of northern long-eared bats, limiting the potential for direct injury or mortality from the removal of occupied roost trees.

There would be potential for habitat impacts on bats as a result of the loss of potentially suitable roosting or foraging habitat. However, the cable landing location would be located in a proposed parking lot, which is highly unlikely to provide important habitat for any bat species. While bats may be present in habitat adjacent to the onshore export cable route, exposure is expected to be limited (COP, Appendix O-1; Dominion Energy 2022a) because much of the routing is collocated with existing roads. However, the onshore substation and switching station would require tree and vegetation clearing on varying acreages of wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3).

Interconnection Cable Route Option 1 would be approximately 14.2 miles (22.9 kilometers) long and would result in approximately 77.24 acres (31.26 hectares) of temporary disturbance to various NLCD land cover classes (Table 3.8-2). While the NLCD does include wetland land cover classes, refer to Section 3.22 (Table 3.22-3) for wetland impacts on the Onshore Project components based on wetland delineation survey data. The portion of the route that passes through the forested and wetland areas associated with the North Landing River likely provides quality roosting and/or foraging habitat for bats.

Approximately 76 percent of Interconnection Cable Route Option 1 would be collocated with existing linear development. Overall, impacts on bat habitat during construction are expected because northern long-eared bat maternity roosts have been documented adjacent to the Naval Auxiliary Landing Field Fentress, within 2.57 miles (4.14 kilometers) of the proposed route, there have been acoustic detections of Indiana bats in the region (12–14 miles [19–22 kilometers] from the cable landing location and Fentress Substation), and bat activity has been documented throughout the year (COP, Appendix O-1; Dominion Energy 2022a). Tree/vegetation clearing would occur along the route in various NLCD land cover class types (Table 3.8-2) and clearing activities would avoid trees favorable for bat maternity roosting locations and would be conducted outside of the roosting season to avoid bat maternity roosting locations to the extent practicable. Dominion Energy would maintain a minimum no-tree-clearing buffer of 150 feet (45 meters) around any known northern long-eared bat maternity roosts and would conduct mist-netting surveys along portions of the interconnection cable route for all alternatives and the Onshore Project area that would require tree removal. Additionally, due to the potential impacts, monitoring and mitigation during all seasons may be required.

The switching station parcel at Harpers Road (Interconnection Cable Route Option 1) would be built in a semi-developed area within the Aeropines Golf Club (COP, Appendix O-1; Dominion Energy 2022a). Because the Harpers Switching Station would be located adjacent to non-disturbed areas, there is potential for impacts on bat habitat due to the small amount of anticipated tree clearing in mixed forest and woody wetland NLCD land cover classes (Table 3.8-2). The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the Harpers Switching Station (BOEM and Dominion Energy 2022). The onshore substation parcel (Fentress) is in an existing developed area and is associated with fragmented habitat; expansion of the parcel would require clearing within forested and wetland NLCD land cover classes (Table 3.8-2); therefore, impacts on bat habitat could occur but are unlikely (COP, Appendix O-1; Dominion Energy 2022a; BOEM and Dominion Energy 2022). Refer to Section 3.21, Section 3.14, *Land Use and Coastal Infrastructure*, and Section 3.22, *Wetlands,* for additional details of potential impacts on surface waters, land use, and wetlands.

BOEM anticipates that minor impacts would occur due to adherence to USFWS northern long-eared bat conservation measures; further, these minor habitat impacts would not result in individual fitness or population-level effects given the limited amount of habitat removal. Dominion Energy would likely leave onshore facilities in place for future use. There are no plans to disturb the land surface or terrestrial habitat during conceptual decommissioning of the Proposed Action. Therefore, onshore temporary impacts of conceptual decommissioning would be negligible.

3.5.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities. In the context of reasonably foreseeable environmental trends, combined noise impacts on bats from ongoing and planned actions, including the Proposed Action or Alternative A-1, would likely be negligible. Combined impacts on bats arising from the presence of structures from ongoing and planned actions, including the Proposed Action or

Alternative A-1, would likely be minor given the expected limited use of the OCS by migrating tree bats. As the Proposed Action or Alternative A-1 would account for about 9.7 percent or 9.6 percent (up to 205 or 202 of 3,287) of the new WTGs on the OCS, a majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action or Alternative A-1. The combined land disturbance impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would likely be minor, as a small amount of habitat loss would be expected.

3.5.5.2 Conclusions

Impacts of the Proposed Action. Construction, installation, operation, and conceptual decommissioning of the Proposed Action or Alternative A-1 alone would have **negligible** to **minor** impacts on bats, especially if tree-clearing activities are conducted outside the active season. The main notable risk would be from operation of the offshore WTGs, which could lead to **minor** long-term impacts in the form of mortality, although BOEM anticipates this to be rare, and from onshore construction, which could lead to **minor** long-term impacts from loss of suitable onshore roosting and/or foraging habitat. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section 3.5.3.

Cumulative Impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be **negligible** to **minor**. Considering all the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would result in **minor** impacts on bats in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and onshore habitat loss. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through the permanent but limited impacts attributed to onshore habitat loss. Thus, the overall impacts on bats would likely be **minor** because while most impacts are expected to be avoided due to the limited occurrence of bats in the offshore wind lease area (23.75 nautical miles [44 kilometers] from land), some mortality and a small amount of onshore habitat loss is expected.

3.5.6 Impacts of Alternatives B and C on Bats

Impacts of Alternatives B and C. With the exception of the number and size of WTGs, impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning under Alternatives B and C would be similar to those described under the Proposed Action. IPFs associated with the construction and installation of up to 176 WTGs under Alternatives B (each 14 MW) and up to 172 WTGs under Alternative C (each 14 MW), including pile-driving noise and temporary avoidance and displacement, would be decreased by approximately 14 percent (Alternative B) or up to approximately 16 percent (Alternative C) compared to the Proposed Action. Fewer WTGs under Alternatives B and C when compared the Proposed Action may allow greater opportunity for migrating tree bats (if present) to avoid WTGs. Overall, the expected negligible to minor impacts on bats would not be materially different than those described under the Proposed Action. The use of 14 MW WTGs under Alternatives B and C may have some potential to decrease collision risk in comparison to the largest WTGs contemplated under the Proposed Action (16 MW) based on early studies of terrestrial wind facilities (Barclay et al. 2007; Georgiakakis et al. 2012). However, more recent research indicates there is no correlation between bat fatality rates and wind turbine size (Smallwood 2020). Given the expected limited use of the OCS by migrating tree bats (COP, Appendix O-2; Dominion Energy 2022a; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022b), impacts would be expected to remain minor.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.5.6.1 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would involve fewer and potentially smaller WTGs, compared to the Proposed Action, which would have an associated decrease in potential collision risk to bats. However, BOEM expects that the impacts resulting from these alternatives would be similar to the Proposed Action with individual IPFs leading to impacts ranging from **negligible** to **minor**.

Cumulative Impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on bats from ongoing and planned actions, including Alternatives B and C, would be similar to those described for the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts. While Alternatives B and C may result in a slightly lower level of impact on bats than described under the Proposed Action, the overall impacts of Alternatives B and C on bats would be the same level as under the Proposed Action: **minor**. This impact rating is derived primarily by ongoing conditions such as climate change, as well as disturbance and habitat removal associated with onshore construction. As described above for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.5.7 Impacts of Alternative D on Bats

Impacts of Alternative D. All offshore components of Alternative D-1 or D-2 are the same as the Proposed Action (205 WTGs and 3 OSSs for the Proposed Action and 202 WTGs and 3 OSSs for Alternative A-1) and impacts on bats from the Offshore Project components would be the same as evaluated under the Proposed Action. Onshore, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same.

In contrast to the Proposed Action, Alternative D-2 involves approval of only Interconnection Cable Route Option 6 (Hybrid Route), which would be approximately 14.2 miles (22.8 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods and installed via open trench, micro tunneling, and HDD. It would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation (Fentress).

In contrast to the Proposed Action, Alternative D-2 involves approval of only Hybrid Interconnection Cable Route Option 6, which would be approximately 14.2 miles (22.8 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods including open trench, micro tunneling, and HDD. The route would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation (Fentress).

Noise and land disturbance from onshore construction activities of Interconnection Cable Route Option 6 would result in behavioral and habitat loss/fragmentation impacts on bats as a result of temporary disturbance and clearing of a total of 77.16 acres (31.23 hectares) of NLCD land cover classes (Tables 3.8-4 and 3.8-5) whereas the Proposed Action would result in impacts on a total of 77.24 acres (31.26 hectares) (Tables 3.8-2 and 3.8-3). While the NLCD does include wetland land cover classes, refer to Section 3.22 (Table 3.22-4) for wetland impacts on the Onshore Project components based on wetland delineation survey data. Approximately 76 percent of Interconnection Cable Route Option 1 (Proposed Action) and 70 percent of Interconnection Cable Route Option 6 (Alternative D-2) would be collocated with existing linear development. The Chicory Switching Station (Interconnection Cable Route Option 6) is in an area identified as general ecological integrity (C5), and would be built within a forested parcel, with potential for habitat loss/fragmentation for bats due to tree clearing within multiple forest NLCD land cover classes (Table 3.8-4). The Chicory Switching Station would have a footprint of 35.5 acres (14.4 hectares) but would result in a greater area of impact on undeveloped NLCD land cover classes than the Harpers Switching Station, which would be located entirely within the existing Aeropines Golf Club. Overall, impacts at the Chicory Switching Station (Alternative D-2) would predominantly occur on previously undisturbed forest/wetland habitats (Tables 3.8-4 and 3.8-5), whereas impacts at the Harpers Switching Station (Proposed Action) would be on portions of developed areas (Tables 3.8-2 and 3.8-3). Similar to the Proposed Action, impacts associated with onshore clearing and construction would be localized and temporary. While Alternative D-2 would result in a slight increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates the difference in potential impacts on bats would be nominal.

The impacts resulting from noise and land disturbance under Alternative D-1would be the same as those described under the Proposed Action. Alternative D-2 would have a slightly increased potential to permanently affect forested and wetland habitats when compared to the Proposed Action. As described for the Proposed Action, and based on wetland and NLCD cover class mapping, Alternative D-1 (Interconnection Cable Route Option 1) would have the least potential to permanently affect forested and wetland habitats as compared to Alternative D-2 (Hybrid Interconnection Cable Route Option 6). No individual fitness or population-level effects would be expected from onshore construction and associated loss/fragmentation of foraging associated with Alternative D-1 or D-2, and, as a result, BOEM anticipates minor impacts. While Alternative D-2 would result in an increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates impacts of Alternative D-1 or D-2 to be similar on bats to those described under the Proposed Action: negligible to moderate impacts with overall moderate impacts on bats.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.5.7.1 Conclusions

Impacts of Alternative D. The Proposed Action only considers Interconnection Cable Route Option 1 while Alternatives D-1 and D-2 consider Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2). BOEM anticipates the impacts on bats resulting from Alternative D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be slightly greater than under the Proposed Action due to construction and clearing occurring on a larger area of undisturbed forest/wetland habitats; however, the impacts are not expected to change under

Alternatives D-1 or D-2 relative to the Proposed Action. Impacts on bats would range from **negligible** to **minor**. Impact ratings associated with individual IPFs would not change.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on bats from ongoing and planned actions, including Alternative D-1 or D-2, would be similar to those described for the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts that range from temporary to long term. While Alternative D-1 would result in the same level of impact on bats and Alternative D-2 may result in a slightly higher level of impact on bats than described under the Proposed Action, the overall impacts of Alternative D-1 or D-2 on bats would be the same as under the Proposed Action: **minor**. This impact rating is derived primarily by ongoing conditions such as climate change, as well as disturbance and habitat removal associated with onshore construction. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.6. Benthic Resources

This section discusses potential impacts on benthic resources, other than fishes and commercially important benthic invertebrates, from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The benthic geographic analysis area, as shown on Figure 3.6-1, includes both a 10-mile (16.1-kilometer) radius/buffer around the Wind Farm Area and a 330-foot buffer around the export cable route corridors. The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect marine benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to proposed Project activities would likely be on a smaller spatial scale than 10 miles (16.1 kilometers). Finfish, invertebrates of commercial or recreational value, and EFH are addressed in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*.

3.6.1 Description of the Affected Environment for Benthic Resources

This section discusses potential impacts on benthic resources, excluding fishes (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*) and commercially important benthic invertebrates (Section 3.13) from the proposed Project, alternatives, and ongoing and planned activities in the benthic resources geographic analysis area. The benthic resources geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.6-1, includes the Offshore Project area.

Descriptions of the benthic resources offshore Virginia are provided in a previous Environmental Assessment (EA) (BOEM 2015); benthic resources offshore Virginia are characterized in the lease issuance EA for New Jersey, Delaware, Maryland, and Virginia (BOEM 2012) and the COP (Dominion Energy 2022) and are incorporated by reference.

The benthic resources specific to marine habitats and associated biological assemblages in the Offshore Project area are described in Section 4.2.4 of the COP (Dominion Energy 2022), prepared in accordance with BOEM site characterization requirements (30 CFR 585.626), and BOEM's benthic habitat survey guidelines (BOEM 2019). The description of the benthic resources in the Offshore Project area was supported by a 2020 Benthic Resource Characterization Survey (BRCS) with the survey report (COP, Appendix D; Dominion Energy 2022). The BRCS included the Offshore Project area, which includes those portions of the Project components in the Lease Area and offshore export cable route corridor that could be directly or indirectly affected by the construction and installation, operations and maintenance, or conceptual decommissioning of the Project. The Lease Area covers approximately 112,799 acres (45,648 hectares) of seafloor with water depths up to 98 feet (30 meters) in the offshore export cable route corridor and 49 to 131 feet (15 to 40 meters) in the Lease Area. The following conclusions were drawn based on the results of the 2020 BRCS, with other findings incorporated by reference.

- The surficial benthic substrate in the Mid-Atlantic Bight is primarily soft-bottom, sandy seascape exhibiting both flat-bottom relief and benthic features such as ripples, sand waves, and ridges. Areas of heterogenous, hard-bottom, and other complex habitats also exist within the Mid-Atlantic Bight. (MARCO n.d.; Stevenson et al. 2004; USGS n.d.).
- The Offshore Project area is dominated by fine to coarse sand, 93.2 percent primarily fine sand with patches of gravel (3.7 percent) and silt clay substrates (3.0 percent) within the Lease Area and along the export cable route corridor. Muddy sand is prevalent in the nearshore portion of the export cable route corridor, while the rest is dominated by low-relief sandy seabed, with sand ridges, and ripples.
- Bottom topography in the Offshore Project area is characterized by a sedimentary fan, shelf valley tributaries to the north and east, and a series of sand ridges trending northeast to southwest. Rugosity

is virtually zero throughout the area.

- Natural reefs are reportedly absent from the Offshore Project area. However, artificial reef habitat, including the Triangle Reef (also known as “Triangle Wrecks” and charted as a fish haven) is located in the northern portion of the Lease Area (Figure 3.6-3). Additionally, other charted shipwrecks that likely function as artificial reef habitats are present in other locations of the Offshore Project area and adjacent waters.
- No seagrass beds are reported to occur within the offshore export cable route corridor or elsewhere in the Offshore Project area.
- Typical of the Mid-Atlantic Bight, sand shoals, ridges, waves, megaripples, and ripples were identified in the Offshore Project area and provide habitat for benthic infaunal organisms typical of this region.
- The dominant benthic infauna identified in the Offshore Project area were annelids, mollusks, and arthropods. Polychaetes were numerically dominant across all sampling areas, followed by mollusks and crustaceans.
- Mollusks had the highest overall biomass followed by annelids and crustaceans.

The inner continental shelf is characterized by a seabed morphology consisting of relatively flat, migrating sand waves and ripples with occasional larger shoals. Surficial sediment types are generally sand of varying coarseness with mixtures of silt or gravel (Williams et al. 2006) (Figure 3.6-2). Offshore shoal complexes (two or more shoals and the trough separating them) provide habitat and microhabitats for adults, settled juveniles, and larvae for multiple fish and invertebrate species, which use these shoal complexes for spawning, larval recruitment, foraging, and migration (Rutecki et al. 2014). However, a 2-year study conducted on the inner continental shelf of the Mid-Atlantic Bight showed greater species diversity, abundance, and richness in flat-bottom habitats than in shoal habitats. They also noticed seasonal trends with lower values of all those indices during the winter than in the spring through fall (Slacum et al. 2010). (Refer to Section 3.9 and Section 3.13 for additional information). Shoal habitats occur in high-energy environments and migrate in a generally southwest direction within the Mid-Atlantic Bight (Rutecki et al. 2014).

The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources and includes a 10-mile (16.1-kilometer) buffer around the Lease Area and a 330-foot (100.6-meter) buffer around the offshore export cable route corridor. These buffers would account for transport via local water masses and for benthic invertebrate larval transport due to ocean currents. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to proposed Project activities would likely be on a smaller spatial scale than 10 miles (16.1 kilometers).

Various benthic fauna are found in the continental shelf habitat of the Project area ranging in size from microscopic to larger macrofauna. Common macrofauna of the inner continental shelf include species from several taxa, including echinoderms (e.g., sea stars, sea urchins, sand dollars), cnidarians (e.g., sea anemones, soft corals), mollusks (e.g., bivalves, cephalopods, gastropods), bryozoans, sponges, and crustaceans [i.e., amphipods]) (BOEM 2012). The Project area has similar fauna with polychaete worms numerically dominant throughout and mollusks comprising most (78.2 percent) of the total biomass, followed by annelids (9.6 percent), and arthropods (7.8 percent) (COP, Appendix D; Dominion Energy 2022).

Artificial reefs are human-made underwater structures that are developed intentionally or from remnants of objects built for other purposes, such as shipwrecks. Artificial reef habitat does occur in the northern portion of the Lease Area ("Triangle Reef" fish haven) (Figure 3.6-3; COP Figure 4.2-15; Dominion Energy 2022), as well as charted shipwrecks that function as artificial reef habitat in other locations of the Offshore Project area and adjacent waters (COP, Figure 4.2-15; Dominion Energy 2022). Triangle Reef consists of several large, scuttled World War II-era ships (tankers and transport ships), tires, cable spools, and other materials deposited in the fish haven since the 1970s to facilitate artificial reef development (Lucy 1983; VMRC 2020).

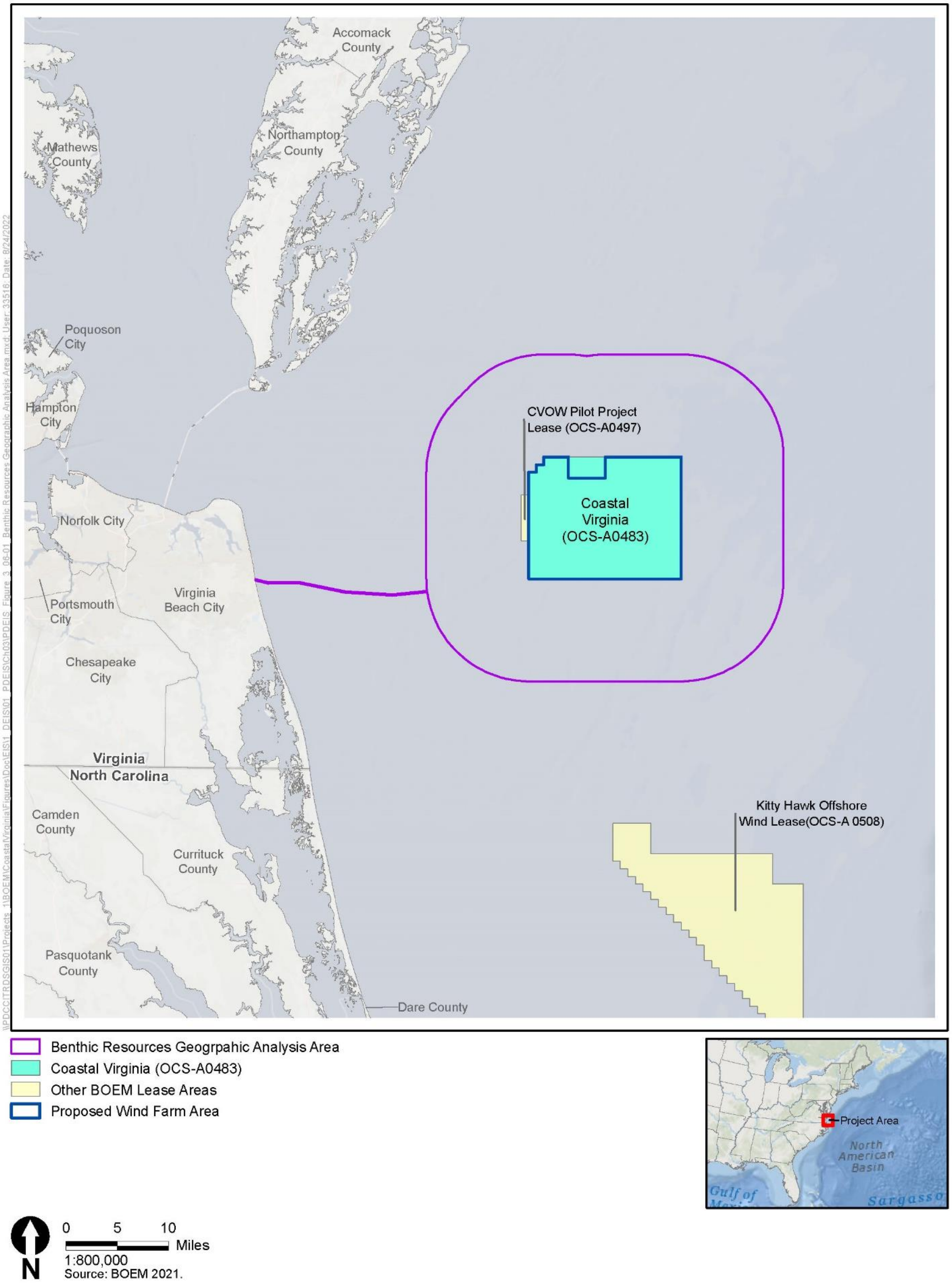


Figure 3.6-1 Benthic Resources Geographic Analysis Area

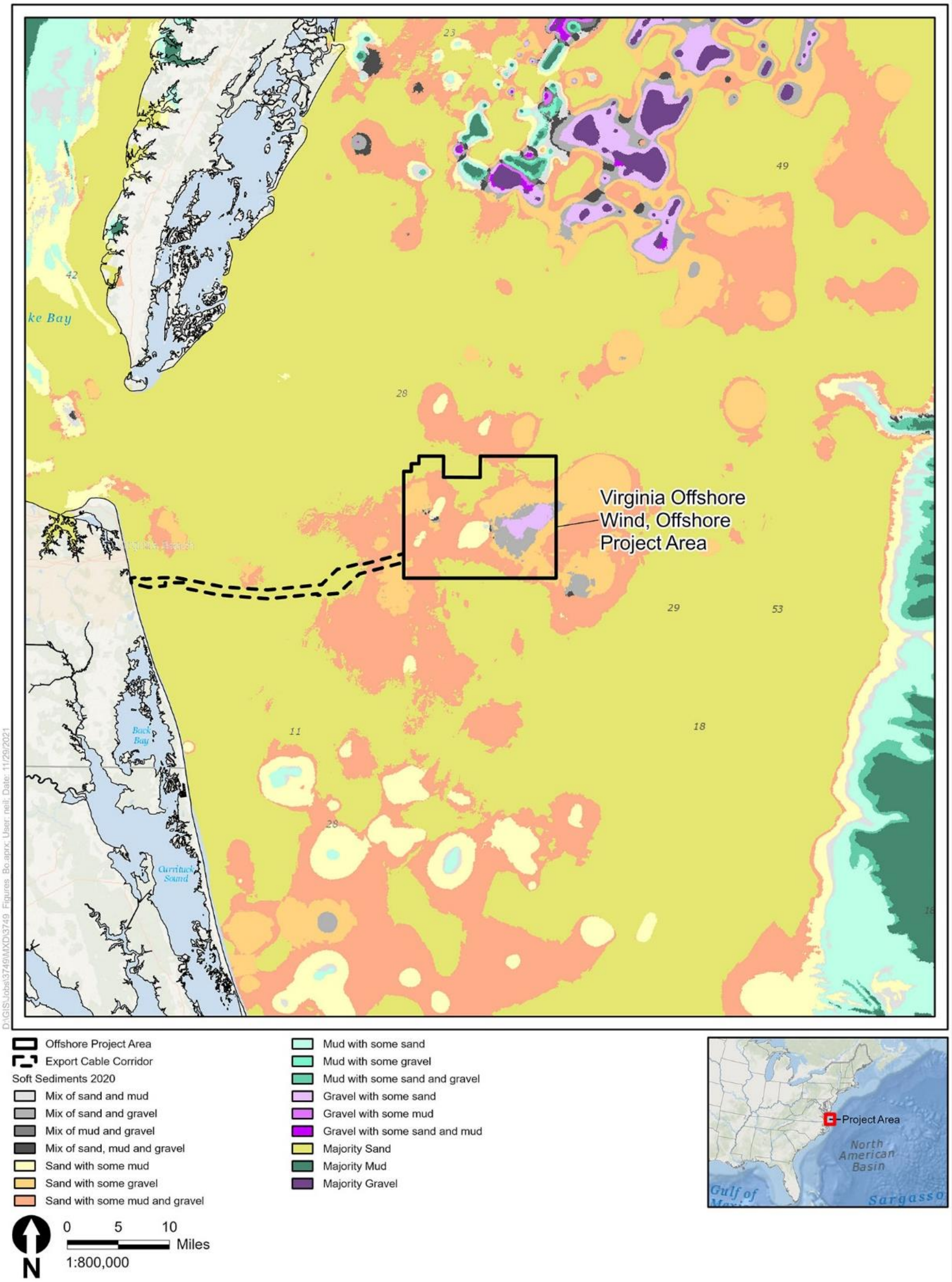


Figure 3.6-2 Soft Sediment Types in the Offshore Project Area for the Coastal Virginia Offshore Wind Project

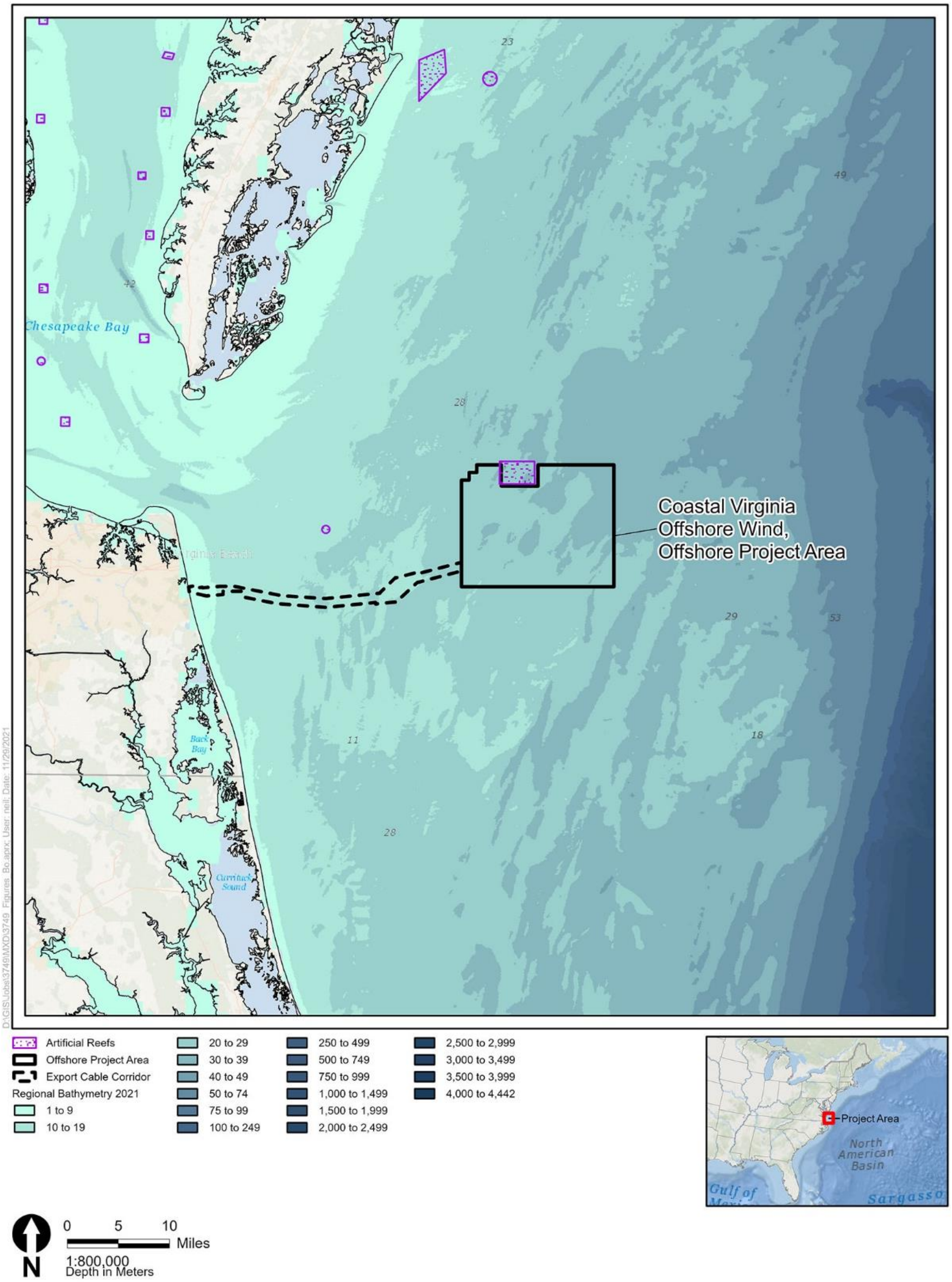


Figure 3.6-3 Bathymetry and Artificial Reef Areas in the Offshore Project Area for the Coastal Virginia Offshore Wind Project

3.6.2 Environmental Consequences

Definitions of impact levels are provided in Table 3.6-1.

Table 3.6-1 Impact Level Definitions for Benthic Resources

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

3.6.3 Impacts of the No Action Alternative on Benthic Resources

When analyzing the impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of ongoing activities including ongoing non-offshore wind activities and ongoing offshore wind activities on the baseline conditions for benthic resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities within the geographic analysis area, as described in Appendix F.

Benthic resources are subject to pressure from ongoing activities and conditions, especially climate change, commercial fishing using bottom-tending gear (e.g., dredges, bottom trawls, traps/pots), undersea cables and conduits, and sediment dredging; these activities are anticipated to continue for the foreseeable future and could noticeably affect the habitat, abundance, diversity, community composition, and percent cover of benthic fauna and flora. Benthic resources may be affected by climate change, including ocean acidification and warming, sea level rise, and altered habitat/ecology. Ocean acidification caused by atmospheric carbon dioxide may contribute to reduced growth or the decline of benthic resources with calcareous shells (Pacific Marine Environmental Laboratory 2020). Warming of ocean waters is expected to influence the distribution and migration of some benthic species and may influence the frequencies of various diseases (Hoegh-Guldberg and Bruno 2010; Brothers et al. 2016). Based on trends in the Northeast and Mid-Atlantic regions over the last 35 years, some benthic fish and invertebrate species have moved to the north and/or further offshore into deeper waters (NOAA 2022). Additionally, ocean-atmosphere numerical models generally predict a decline/slowing of the Atlantic meridional overturning circulation (AMOC) from effects of climate change Demo et al. 2021). The AMOC currents are the main driver of the distributions of nutrients, heat, and carbon present in the ocean, which affect the biogeochemical cycles and ecosystems around the globe (Bakker et al. 2016; Good et al. 2018). During the last glacial period, sizable and sudden climatic shifts occurred in the North Atlantic when major fluctuations occurred in the AMOC (Schmittner 2005) Modeled simulations show a decline of plankton stocks of more than 50 percent, which would have large implications on the productivity of the oceans in the future (Schmittner 2005). Because this IPF is a global phenomenon, impacts on benthic resources through this IPF would be very similar to those in the planned action scenario (Appendix F) and ongoing activities.

Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by the Commonwealth of Virginia, individual local municipalities, NOAA, or all depending on jurisdiction, affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing) (Section 3.9). Disturbance of benthic invertebrate communities by commercial fishing activities can adversely affect community structure and diversity and limit recovery (Avanti Corporation and Industrial Economics 2019), although this impact is less notable in sandy areas that are strongly influenced by tidal currents and waves (Nilsson and Rosenberg 2003; Sciberras et al. 2016). Dredging (e.g., for navigation corridors) typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance, although full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line installation in the trench. Therefore, seabed profile alterations, while locally intense, are likely to impart limited spatial and temporal impact on benthic resources in the geographic analysis area.

New offshore submarine cables associated with the Proposed Action would cause short-term disturbance of seafloor habitats and injury and mortality of benthic resources in the immediate vicinity of the cable emplacement activities. The cable routes for future projects have not been fully determined at the time of preparation of this EIS. Dredging, mechanical trenching, or both used during cable installation can cause localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through sediment deposition. Dredging typically occurs only in sandy or silty habitats, which are abundant in the benthic resources geographic analysis area and are quick to recover from disturbance. The trench width will range from 16 feet (5 meters) to a maximum of 65.2 feet (20 meters). The maximum dredge impact area associated with cable installation is estimated to be 48 acres (19 hectares) within the 112,799-acre (45,648-hectare) Lease Area. Therefore, such impacts, while locally intense, have limited impact on benthic resources in the geographic analysis area.

If artificial reef structures continue to be added to the fish haven area, measurable beneficial benthic impacts could result from the creation of reefing habitat. The primary IPF for benthic resources is physical disturbance. Marine communities in the Offshore Project area are influenced by changes in physiochemical conditions including temperature, pH, storm frequency and severity, and nutrient availability that may be influenced by climate change. Following physical disturbance of the benthos, sessile and slow-moving species may have limited ability to relocate and avoid the rapid onset of adverse conditions; these species may therefore experience range retractions rather than shifts. Alternatively, if an environmental change is gradual relative to the organism's life cycle, even relatively sessile species may adjust. Changes in long-term thermal trends also can influence seasonal movement patterns of marine species. Further, climate change-induced warming of bottom water temperatures on the Mid-Atlantic continental shelf is expected to continue, with a corresponding range shift for sessile and sedentary benthic species to the north and possibly offshore in response (Powell et al. 2020). These changes in centers of benthic species abundance to the north and south will affect community structure and function (Hale et. al. 2017). Additionally, warming ocean temperatures and other climate change–related factors may induce favorable environmental conditions for invasive species (Zhang et al. 2020).

Under the No Action Alternative, the proposed Project would not be built. If the Project is not approved, then impacts from the proposed Project (Section 3.6.2, *Environmental Consequences*) would not occur. Impacts from ongoing, future non-offshore wind, and future offshore wind activities would likely still occur resulting in similar impacts on benthic resources, but the extent and intensity of impact would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area.

3.6.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for benthic resources described in Section 3.6.1, *Description of the Affected Environment for Benthic Resources*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on benthic resources are generally associated with inshore dredging, coastal development, offshore construction including bottom disturbance and habitat conversion, and climate change. Impacts associated with climate change have the potential to alter species distributions and increase individual mortality and disease occurrence.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on benthic resources include:

- Continued O&M of the CVOW-Pilot Project (2 WTGs) installed in OCS-A 0497.

Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.6.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.6.3.2 Cumulative Impacts of the No Action Alternative

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

Planned non-offshore wind activities that may affect benthic resources include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, port improvement, military use, marine transportation, fisheries use and management, global climate change, and oil and gas activities (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). These activities may result in bottom disturbance and habitat conversion, but population-level effects would not be expected. The paragraphs below provide an overview of what is known regarding the IPFs described above. See Appendix F, Table F1-3 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for benthic resources.

The Lease Area is within the Virginia Capes Range Complex and the Virginia Capes Operating Area actively used by the military. Anchoring from vessels related to the ongoing military use, along with survey, commercial, and recreational activities, continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Sessile and slow-moving species (e.g., corals, sponges, and sedentary shellfish) would be most likely to be impacted. All impacts would be localized and temporary, resulting in a negligible impact. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles, corals), if it occurs, could be long term.

The Federal Communications Commission has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the geographic analysis area for benthic resources, short-term disturbance would be expected. Any additional submarine cable installation would produce sedimentation as would the ongoing cable maintenance activities. Sediment dredging results in fine sediment deposition, which causes local and short-term disturbances, but could have long-term negative effects on eggs and larvae of demersal species and benthic invertebrates. Due to the life cycles of demersal finfish and invertebrate species, adverse impacts may extend outside of the vicinity of a port. The magnitude of impacts would depend on the time (season) and place (habitat type) where the activities would occur.

Noise from nearshore construction is expected to gradually increase in line with human population growth along the coast. In addition, the general trend along the coast from Virginia to Maine is that port activity will increase modestly. The increase in global shipping traffic is expected to continue rising, which may require port modifications, leading to local impacts.

The presence of structures would increase seabed scour and sediment suspension. Impacts would likely be highly localized and difficult to detect. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. Any new cables, towers, buoys, or piers would also create relief. Benthic species dependent on hard-bottom habitat could benefit from an increase in hard surfaces, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010) and would result in a minor impact.

All offshore wind leasing activities that BOEM considers reasonably foreseeable by lease areas and projects is presented in Appendix F, Table F-3, including approximately 36 planned projects projected to have more than 40 gigawatts of generating capacity (Appendix F, Table F2-1) with over 3,000 turbines/foundations (Figure 3.6-4). The geographic analysis area for the Project includes a 10-mile (16.1-kilometer) buffer around the Lease Area and a 330-foot (100.6-meter) buffer around the offshore export cable route corridor. Of the 36 planned projects, none are within the geographic analysis area of the Proposed Action. The closest planned offshore wind activities from the Proposed Action are the Kitty Hawk Wind North and Kitty Hawk Wind South, OCS-A 0508 Lease Area offshore North Carolina (COP, Appendix F, Table F-4; Dominion Energy 2022); this lease area is located approximately 24 miles (38.4 kilometers) south of the Offshore Project area (Figure 3.6-5). The Kitty Hawk Wind North and South lease area was leased in 2017 to Avangrid Renewables, LLC, and could include up to 190 WTGs occupying approximately 122,406 acres (49,536 hectares).

BOEM expects ongoing and planned activities within the geographic analysis area to affect benthic resources through the following primary IPFs.

Accidental releases: Accidental releases would continue to occur as a result of ongoing and planned activities. Impacts of accidental releases are relative to their magnitude. Smaller releases are expected to occur at a higher frequency and to be less severe, while major releases are expected to be rare but have greater impacts. If accidental releases do occur, their impacts are likely to be localized and short term, with a full recovery expected. The low likelihood, properties of the materials likely to be released, and volume of the potential releases along with the cleanup measures in place suggest impacts would be negligible on benthic resources.

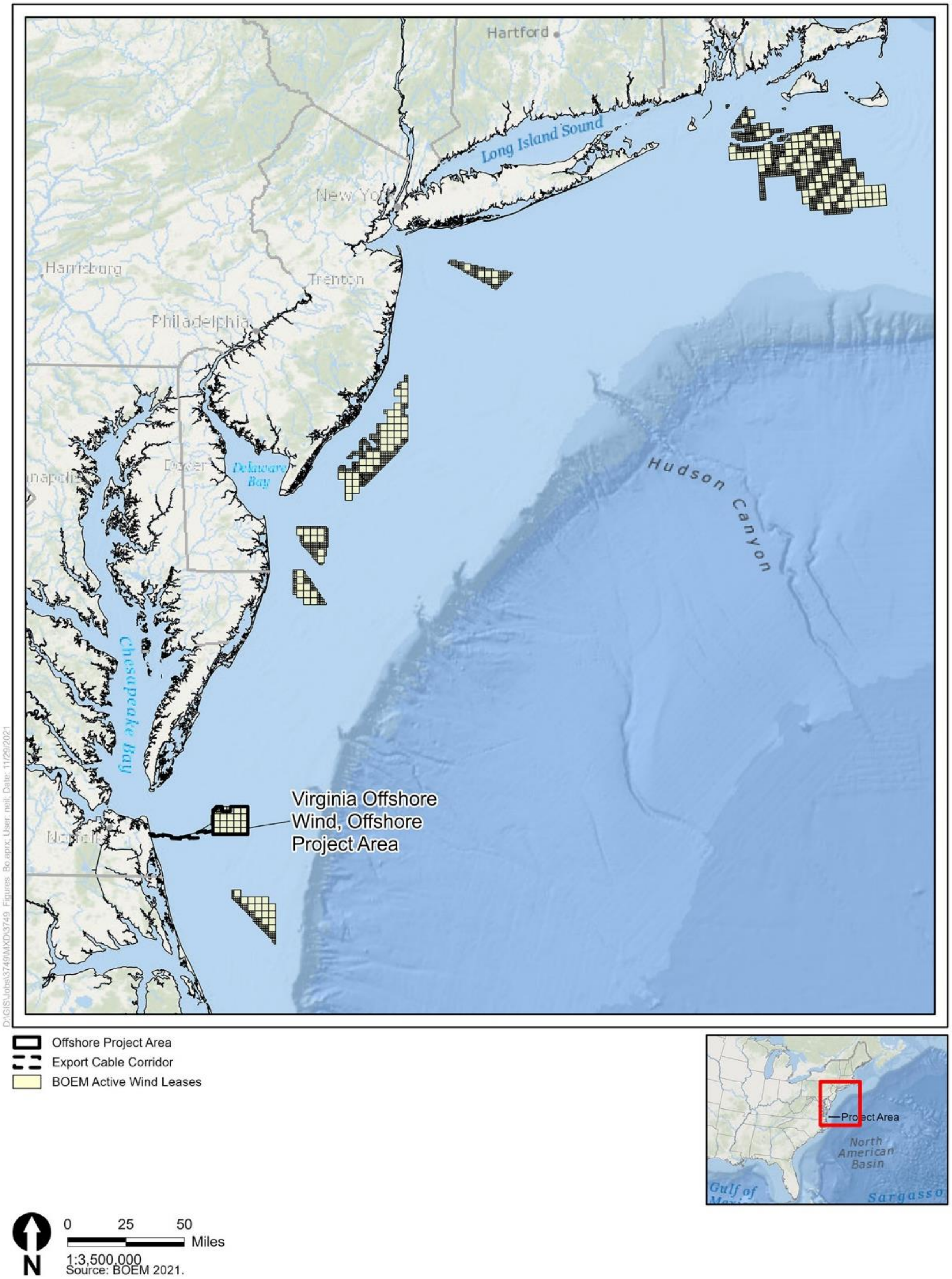


Figure 3.6-4 Renewable Energy Lease Areas Offshore the East Coast

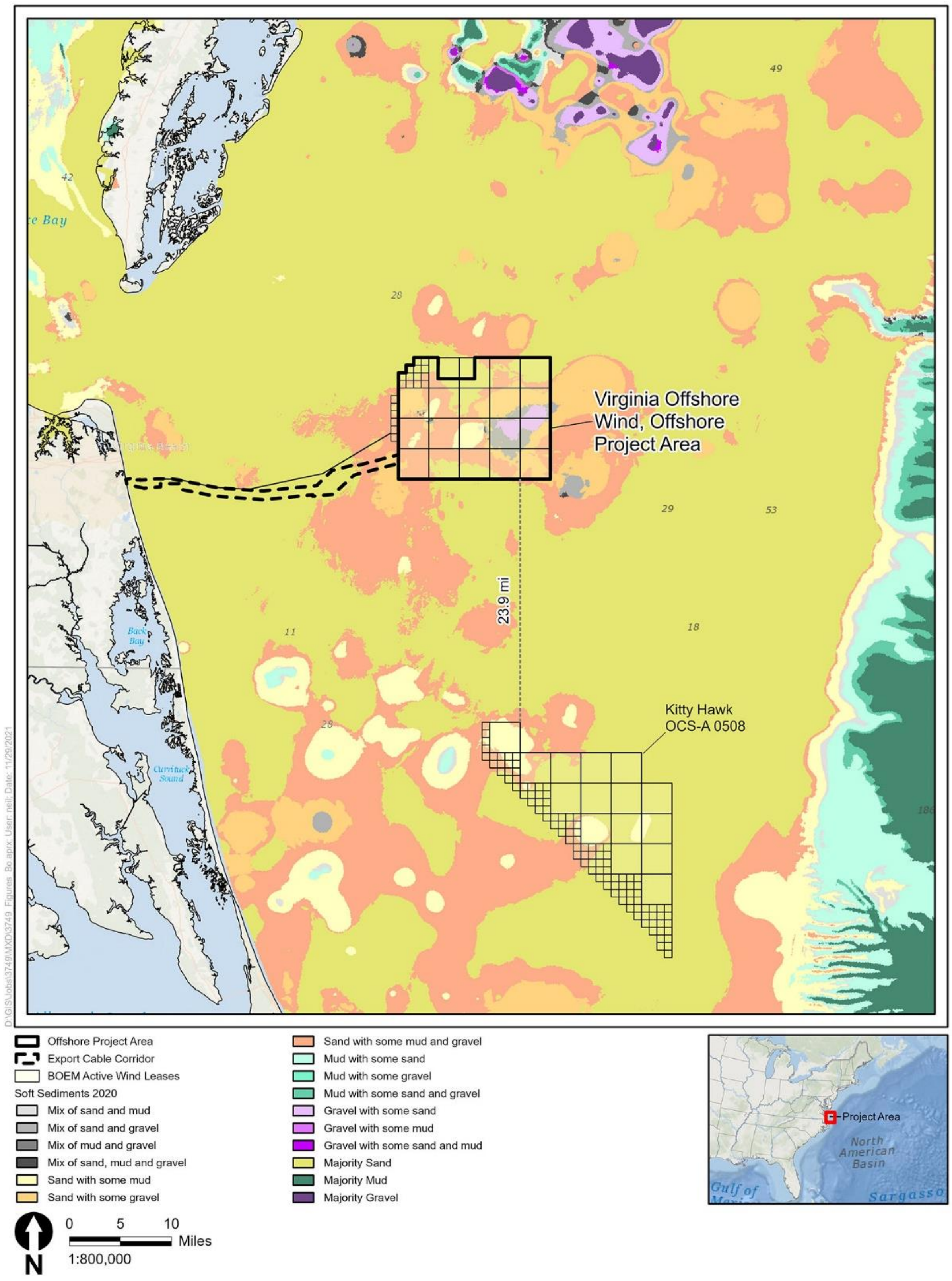


Figure 3.6-5 Kitty Hawk Wind OCS-A 0508 Lease Area, 24 miles (38.4 kilometers) from the Offshore Project Area of the Coastal Virginia Offshore Wind Project and Area Sediment Types

Fuel, fluids, hazardous materials: Accidental releases of hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater; as such accidental releases would occur at or near the ocean surface in association with vessel operations and would be unlikely to contact benthic resources.

Invasive species: Invasive species would be released accidentally, especially during ballast water and bilge water discharges from marine vessels. More than 200 countries around the world use direct and dedicated shipping services to and from Virginia (USCG 2021). More than 40 international commercial vessels use Virginia marine ports (USCG 2021). In 2019 alone, more than 2,500 commercial ships used the Port of Virginia, the second largest exporter on the East Coast (USCG 2021). This volume of vessel traffic implies that accidental releases of invasive species as a result of ongoing and planned trans-oceanic activities would continue to occur.

Trash and debris: Accidental releases of trash and debris as a result of increased vessel traffic with ongoing and planned activities would continue. There is no evidence that anticipated volumes of trash or debris would have measurable impacts on benthic resources.

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

Electromagnetic fields (EMFs): EMF would continue to result from existing and new transmission or communication cables. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. Transitory exposures to magnetic fields at the seabed above the buried cables were found to be at levels below reported thresholds for effects on the behavior of magnetosensitive marine organisms. EMF strength diminishes rapidly with distance, and potentially meaningful EMFs would likely extend less than 50 feet (15.2 meters) from each cable (McCormick et al. 2008). Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to animal movement. Copping et al. (2016) reported that although burrowing infauna may be exposed to stronger EMFs from marine renewable energy devices, there was no evidence that the EMFs anticipated to be emitted from those devices would affect any species. Common subsea power cables of 850 – 1600 Amperes (A) would produce EMF of up to 3.2 milliTesla (mT) (Harsanyi et al. 2022). Although in-situ measurements are insufficient, EMF studies have ranged between 200 microTesla (µT) to 165 mT (Harsanyi et al. 2002). A 2021 study on blue mussels showed that exposure to a direct current of 300 µT did not significantly impair the filter-feeding processes (Albert et al. 2022). Due to the small footprint of existing undersea transmission lines within the geographic analysis area and the fact that EMF decreases rapidly with distance from the cable, impacts from EMF would be negligible.

New cable emplacement and maintenance: There are two pending submarine telecommunications cables for the North Atlantic. If the cable routes enter the geographic analysis area, then benthic impacts would result from installation and routine maintenance. Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season and benthic substrate. Benthic species are generally adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area. Due to the limited footprint of existing cables and short duration of this type of activity, this would be a minor impact.

Should the installation of the 453 miles (729 kilometers) of the Kitty Hawk Wind North and Kitty Hawk Wind South offshore export cables enter into the geographic analysis area, their impacts would be factored in. However, given the distance from the Project area, impacts would likely be negligible.

Noise: Anthropogenic underwater sounds come from many different sources including vessel traffic, seismic surveys, and active sonar used for navigation of large vessels, and chart plotting. Construction noise occurs frequently along populated areas in the Mid-Atlantic nearshore, but infrequently offshore. The extent of the impact depends on equipment used, noise levels, and local acoustic conditions. Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. The intensity and extent of noise from construction is difficult to generalize, but these impacts on benthic communities are local and temporary. Activities from ongoing site characterization surveys and scientific surveys produce noise around sites of investigation, usually offshore. These activities would disturb benthic species in the immediate vicinity of the investigation.

Due to the lack of information regarding basic neurological and physiological responses for most species at realistic exposure levels, inferences about the effects of impulsive sound source activity, like pile driving and G&G survey activities, on marine invertebrates can be challenging and fraught with uncertainty (Carroll et al. 2017). There remains a vast gap in our knowledge about sound thresholds and recovery from impact in almost all invertebrates (Carroll et al. 2017) which confounds the ability to assess potential impacts to benthic species from exposure to noise. English (2017) reported marine invertebrates to be considered less susceptible than mammals and fish to loud noise and vibration as their bodies do not generally possess air-filled spaces, but also reported that noise at high levels can cause short-term behavioral responses in marine invertebrates. A recent summary of knowledge on how marine renewable energy devices affect the benthic environment indicated that the impact of sound on epibenthos is poorly understood and is generally lacking (Dannheim et. al. 2020). Hawkins et al. (2014) identified various informational gaps concerning effects of noise on invertebrates (e.g., mechanisms for sound detection) that suggest assessment of impacts to benthic species from noise is speculative and would likely be negligible.

Port utilization: Port utilization and maintenance are expected to increase from ongoing and planned activities. There are several port improvement projects within the Mid-Atlantic Bight, but none within the geographic analysis area. Ongoing sediment dredging for navigational purposes would occur in shallow and nearshore areas, resulting in localized, short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through sediment deposition. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on the season. There are two active projects along the Virginia Coast with dredge disposal sites located offshore Norfolk, Virginia (Norfolk site) and Virginia Beach, Virginia (Dam Neck site) (USACE 2020; USEPA 2019). Where dredged materials are disposed of, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment-dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Benthic species are generally adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area. Individual projects would have benthic impacts associated with dredging and port construction, which may be moderate but localized.

Presence of structures: The presence of structures including shipwrecks, artificial reefs, and meteorological buoys or towers would lead to impacts on benthic resources through entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation, and habitat conversion. Each is described in subsequent text.

Entanglement, gear loss, gear damage: The presence of structures would increase the risk of gear loss/damage by entanglement. The lost gear, moved by currents, could disturb, injure, or kill benthic resources. The intermittent impacts at any one location would likely be measurable and the risk of occurrence would persist while the structures and debris were present.

Hydrodynamic disturbance: Anthropogenic structures alter local water flow (hydrodynamics) at a fine scale, and would cause wake effects that would concentrate prey and alter larval recruitment dynamics (ICF 2021). The presence of vertical structures in the water column creates turbulence that transports nutrients upward toward the surface, increasing primary productivity at localized scales (Danheim et al. 2020). These changes have been reported to increase food availability for filter-feeders on and near the structures creating a beneficial impact (Degrear et al. 2020). The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be localized, predominantly within tens of meters of each structure. Scouring, caused from these hydrodynamic forces is likely to be most noticeable at the foundation of the structure. Due to their dynamic features, and tidal and seasonal fluctuations, scour features can change by up to 2 feet (0.6 meter) on a monthly average (HDR 2020). Some fluctuation would be alleviated with scour protection measures (HDR 2020). Changes in local water flow are expected to vary seasonally and impacts are expected to be negligible.

Fish aggregation: Structures either natural or artificial create uncommon vertical relief in a predominantly soft-bottom seascape. Structure-oriented fishes would be attracted to these locations as they create reef-like habitats (Mavraki et al. 2021), considered a beneficial impact. However, with an increase in structure-oriented species, predation in the vicinity of these structures also has the potential to increase predation, an adverse impact on the benthic community (Raoux et al. 2017). These impacts are expected to be localized but long term, continuing for as long as the structures remain. Impacts are expected to be moderate due to the temporal scale.

Habitat conversion: These structures provide novel surfaces for colonization and recruitment of marine fauna, creating different benthic community structures. The inclusion of colonizing species would result in a faunal assemblages shift, altering local food web dynamics, and increases in biomass for benthic fish and invertebrates (Kerckhof et al. 2019; Raoux et al. 2017). The addition of new hard-bottom substrate in a predominantly soft-bottom environment will enhance local biodiversity; enhanced biodiversity associated with hard-bottom habitat is well documented (Pohle and Thomas 2001; Fautin et al. 2010). This indicates that marine structures would generate some beneficial impacts on local ecosystems. However, some impacts such as the loss of soft-bottom habitat may be adverse. Although, soft bottom is the dominant habitat type in the region, the species that rely on this habitat are not likely to experience population-level impacts (Guida et al. 2017; Greene et al. 2010). A successional sequence of impacts on benthic resources by the presence of artificial hard substrates is likely but might not be foreseeably defined due to our current lack of knowledge, particularly on long-term changes and large-scale effects (Dannheim et al. 2020). These changes resulting from structure introductions and the loss of soft-bottom habitat may have adverse effects to benthic communities. The impacts to benthic resources would be present as long as the structures remain and would be expected to include moderate adverse impacts to soft-bottom communities and possibly moderate beneficial impacts to hard-bottom benthic assemblages.

Discharges: Discharges would continue to occur as a result of ongoing and planned activities within the geographic analysis area. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, as vessel traffic continues to increase. There is no evidence that the volumes and extent of anticipated discharges would have any impact on benthic resources; impacts of discharges on benthic resources would be negligible.

Regulated fishing effort: Ongoing commercial and recreational fishing would continue within the geographic analysis area. Fishing regulations for finfish and shellfish are implemented and enforced by Virginia municipalities, NOAA, or both depending on jurisdiction. The regulations affect benthic ecosystems by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing). Fishing, in particular the use of bottom-tending gear, has adverse effects to benthic resources and is likely to result in minor impacts if impacts to sensitive habitats are avoided.

Seabed profile alterations: Dredging, mechanical trenching, or both used in the course of offshore construction would cause localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through the sediment deposition IPF. The level of impact from seabed profile alterations would depend on the time of year that they occur, particularly in nearshore locations, and especially if they overlap temporally and spatially with sites characterized by high benthic organism abundance and diversity. Avoiding spring and summer cable burial activities that corresponds with spawning season of some invertebrates, may help minimize potential impacts to benthic species. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance, although full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). Locations, amounts, and timing of dredging for future offshore wind projects are not known at this time. Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), would cause seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line installation in the trench. Therefore, seabed profile alterations, while locally intense, would have limited impact on benthic resources in the geographic analysis area, as a full recovery is expected. Due to the 24-mile (38.4-kilometer) distance of the Kitty Hawk offshore wind lease located outside of the geographic analysis area, impacts on seabed profile alternations expected from offshore wind activities are not expected within the geographic analysis areas.

Sediment deposition and burial: Cable emplacement and maintenance activities (including dredging) in or near the geographic analysis area during construction projects could cause sediment suspension for 1 to 6 hours at a time, after which the sediment is deposited on the seafloor. Sediment deposition would result in adverse impacts on benthic resources, including smothering. Benthic organism tolerance to being covered by sediment (sedimentation) varies among species, with sensitivity to burial determined primarily by infaunal feeding and motility type (Trannum et al. 2010; Jumars et al. 2015). The sensitivity threshold for shellfish varies by species but would be generalized as deposition greater than 0.79 inch (20 millimeters) (Colden and Lipcius 2015; Essink 1999; and Hendrick et al. 2016). Smit et al. (2008) evaluated the significance of depositional thickness on impacts to benthic communities. Estimates from that study indicated median (50 percent) and low (5 percent) effects levels of 2.13 inches (54 millimeters) and 0.25 inch (6.3 millimeters) of sediment deposition, respectively. That is, 2.13 inches (54 millimeters) is the thickness estimated to adversely affect 50 percent of the benthos in the study, and a sediment burial thickness of 0.25 inch (6.3 millimeters) affected 5 percent of the studied benthos. The level of impact from sediment deposition and burial would depend on the time of year that it occurs, especially if it overlaps temporally and spatially with sites characterized by high benthic organism abundance and diversity. The impacts of burial would likely be short term. Due to the 24-mile (38.4-kilometer) distance of the Kitty Hawk offshore wind lease located outside of the geographic analysis area, impacts on seabed profile alternations expected from offshore wind activities exclusive of the Proposed Action would be minor.

Climate change: Benthic resources may be affected by climate change, including ocean acidification and warming, sea level rise, and altered habitat/ecology. Ocean acidification caused by atmospheric carbon dioxide may contribute to reduced growth or the decline of benthic species with calcareous shells (PMEL 2020). Warming of ocean waters is expected to influence the distribution and migration of benthic resources and may influence the frequencies of various diseases (Hoegh-Guldberg and Bruno 2010; Brothers et al. 2016). Because this IPF is a global phenomenon, impacts on benthic resources through this IPF would be very similar to those in the expanded planned action scenario because they would be associated with only ongoing activities. Climate change is having notable and measurable effects on regional benthic resources and the impacts are likely to be moderate.

3.6.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, benthic resources would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts (presence of structures, seabed disturbance) on benthic resources. These effects are primarily related to offshore construction impacts and the presence of structures. BOEM expects the combination of ongoing and planned activities other than offshore wind development to result in **negligible** to **moderate** impacts on benthic resources.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and benthic resources would continue to be affected by natural and anthropogenic IPFs. Planned activities would contribute to impacts on benthic resources due to increased offshore construction.

Ongoing activities, future non-offshore wind activities, and future offshore wind activities would continue to have temporary to long-term impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources, primarily through pile-driving noise, anchoring, new cable emplacement, the presence of structures during operations of future offshore facilities (i.e., cable protection and foundation scour protection), climate change, and ongoing seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear. Throughout the geographic analysis area for benthic resources, as previously discussed, impacts from ongoing activities, especially seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, would be **moderate**. Reasonably foreseeable activities other than offshore wind—including increasing vessel traffic, increasing construction, marine surveys, marine minerals extraction, port expansion, channel deepening activities, and the installation of new towers, buoys, and piers—would result in **minor** benthic impacts. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** adverse impacts on benthic resources and could potentially include **moderate beneficial** impacts. Future offshore wind activities in the geographic analysis area are expected to contribute to several IPFs, primarily new cable emplacement and the presence of structures (i.e., foundations, scour/cable protection).

Considering all the IPFs together, the overall impacts associated with future offshore wind activities in the geographic analysis area are expected to be **moderate** adverse impacts and could potentially include **moderate beneficial** impacts (Figure 3.6-1).

3.6.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The total amount of long-term habitat alteration from scour protection for the foundations, inter-array cables, and export cables.
- The total amount of habitat temporarily altered by the installation method of the export cable in the Project area and inter-array and inter-link cables.

- The number, size, and type of foundations used for the WTGs and OSSs. Dominion Energy could construct a maximum of 205 WTGs using monopile (36 feet [11 meters]) and three OSSs using four piles (11.5-feet [3.5-meter] pins).
- The methods used for cable laying, as well as the types of vessels used.
- The amount of pre-cable-laying dredging, if any, and its location.
- The time of year when foundation and cable installations occur (i.e., the greatest impact would occur if installation activities coincided with sensitive life stages for benthic organisms).
- The number, size, and location of WTGs because the level of hazard related to WTGs is proportional to the number of WTGs installed (i.e., fewer WTGs would result in less impacts on benthic environments).
- Seasonal timing of construction and installation to avoid coinciding with sensitive life stages of benthic organisms.

Variability of the proposed Project design exists as outlined in Appendix E.

3.6.5 Impacts of the Proposed Action on Benthic Resources

Under the Proposed Action and Alternative A-1, the construction, operation and maintenance, and conceptual decommissioning of up to a 3,000-MW wind energy facility consisting of up to 205 WTGs and three OSSs in the Lease Area and associated export cables would occur offshore Virginia in the range of design parameters outlined in the COP (Dominion Energy 2022), subject to applicable mitigation measures. Alternative A-1 would be the same as the Proposed Action except three WTG positions would be removed from the layout to accommodate alignment of the OSSs within the rows of the gridded WTG layout.

Maximum potential short-term and long-term habitat disturbances by the Proposed Action are presented in the COP (COP, Tables 3.3-3, 3.3-4, 3.3-7, 3.3-8, 3.4-4, and 4.2-17; Dominion Energy 2022). The Proposed Action would impact 272.4 acres (110 hectares) of benthic habitat from the WTGs. Alternative A-1, with 3 fewer WTGs, would impact 268 acres (108 hectares) of benthic habitat, or a 1 percent difference. As discussed in Section 3.2.1.1, non-routine events such as oil or chemical spills would have adverse or lethal effects on marine life. Alternative A-1 would slightly reduce the potential short-term and long-term habitat disturbances described for the Proposed Action due to the construction and operation of three fewer WTGs; however, the difference in potential impacts from having three fewer WTGs than the Proposed Action's 205 WTGs is anticipated to be negligible.

As per Dominion Energy's commitment to seasonal restrictions from November through April, no WTG or OSS foundation installation activities are planned for winter. Monopile and OSS pin pile installation is planned for part of spring (May), summer (June, July, and August), and part of fall (September through October) annually. Inter-array and offshore export cable emplacement associated with construction of the WTGs and OSSs would occur during two separate construction seasons, which would provide a recovery period for sand ridge habitats between the installation of the inter-array and offshore export cables. Additionally, there would be an approximate 1- to 2.5-month period between installation of each offshore export cable installation, with the potential for a longer period dependent on weather conditions and operational needs for cable resupply. There would be several months of seafloor rest following the completion of offshore export cable installation at one OSS prior to commencement of inter-array cable emplacement associated with the next OSS (BOEM and Dominion Energy 2022).

Accidental releases: The risk of accidental releases would increase as a result of the Proposed Action, but less so for Alternative A-1, although the two would not be substantively different. The risk of any type of accidental release would be increased primarily during construction or conceptual decommissioning but may also occur during operations and maintenance activities. The increase in the risk of accidental releases attributable to the Proposed Action or Alternative A-1 is expected be negligible in comparison to the risk from ongoing activities.

Fuel, fluids, hazardous materials: As discussed in Section 3.6.3.2, *Cumulative Impacts of the No Action Alternative*, non-routine events such as oil or chemical spills would have adverse or lethal effects on marine life, including benthic resources. However, hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater; consequently, they are unlikely to contact benthic resources with minor exception. Historically, most diesel spills from OCS activities (e.g., from associated vessels or maintenance activities) in the Western and Central Gulf of Mexico Planning Areas are relatively rare and small with the median size for spills ≤1 barrel (42 gallons) to be 0.024 barrels (approximately 1 gallon) (Anderson et al. 2012). Spills of sufficient size to reach shore could affect intertidal and shallow subtidal benthic resources via adsorption and sinking. A large spill the Proposed Action or Alternative A-1 is very unlikely given the fuel storage capacities of Project vessels. Small spills should therefore be expected to be unmeasurable and have a negligible impact on benthic fauna. Larger spills are unlikely but could have a larger impact on benthic fauna due to adverse effects on water quality (Section 3.21, *Water Quality*) and the potential for sinking in shallow marine benthic environments. Effective spill response mitigation would reduce near-term and long-term impacts from an incident. Dominion Energy's proposed Response Plan for oil spills and other marine pollution incidents is presented in Appendix Q of the COP (Dominion Energy 2022), and the increase in risk of a spill related to the Proposed Action is expected to be negligible.

Invasive species: The potential impacts of invasives species on benthic communities are described in Section 3.6.3.2. The increase in the risk of accidental releases of invasive species attributable the Proposed Action or Alternative A-1 is expected be negligible in comparison to the risk from ongoing activities.

Trash and debris: The potential impacts of trash and debris on benthic resources are described in Section 3.6.3.2. The Proposed Action or Alternative A-1 would likely have negligible impacts on benthic resources through the accidental release of trash and debris.

Anchoring: Installation, construction, operation and maintenance, and conceptual decommissioning would be conducted from vessels utilizing spuds, jack-up barges, dynamic positioning, or securing to existing structures; therefore, only minimal anchoring would occur. Impacts on benthic resources from bottom-founded vessels, including spud barges or jack-up vessels, include crushing of soft-bottom communities beneath each spud can or leg. Because the use of anchors is projected to be limited, and the benthic organisms are likely to recover relatively quickly, negligible benthic impacts from anchoring are expected. Impacts on benthic resources from bottom-founded vessels, including spud barges or jack-up vessels, include crushing of soft-bottom communities beneath each spud can or leg.

Electromagnetic fields: As discussed in Section 3.6.3.2, EMF production during the operation of power transmission cables can be detected by some benthic species but does not appear to present a barrier to movement. The weak electric fields induced in seawater and in local electrosensitive marine organisms were found to be below reported detection thresholds (COP, Appendix AA; Dominion Energy 2022). Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015), but alterations of behavior have been documented for benthic species (skates and lobster) near operating up to 65.3 μT emitted from DC cables in a lab setting (Hutchison et al. 2018). The impacts from EMF are localized and affect the animals only while they are relatively close to the EMF source and did not present a barrier to movement. EMFs would be minimized by shielding or by burying cables to the target depth of up to 9.8 feet (3 meters) for inter-array cables and up to 16.4 feet (5 meters) for export cables. Although acknowledging that little is known about potential impacts of EMFs on benthic species, the available information suggests that field strengths expected from the Proposed Action or Alternative A-1 would be below levels shown to cause effects (COP, Appendix AA; Dominion Energy 2022). Therefore, BOEM expects the impacts on benthic species from EMF to be negligible.

New cable emplacement and maintenance: Construction is planned to occur in 2025 and 2027 between May 1 and October 31 (Appendix F, Table F2-1), which would include the inter-array and offshore export cables to support the WTGs and OSSs. Despite unavoidable mortality, damage, or displacement of invertebrate organisms, the estimated area affected by the temporary construction footprint in the Offshore Project area (6,036.6 acres [24.4 square kilometers]) (COP, Table 3.4-4; Dominion Energy 2022) would be 5.3 percent of the total Lease Area (112,799 acres [456 square kilometers]). Sediment type for the Offshore Project area is dominated primarily by fine sand (93.2 percent) followed by gravel (3.7 percent) and silt and clay (3.0 percent). Polychaete worms dominated the fauna numerically and mollusks dominated the fauna by biomass (Section 3.6.1). The seafloor would be disturbed by cable trenches, skid tracks, dredging, and spud prints that could cause temporary sediment suspension in a range of 1 to 6 hours, after which the sediment is deposited on the seafloor (ICF 2021). Dominion Energy only intends to use dredging as a last resort to achieve the adequate burial depth, though no hydraulic dredging operations are anticipated. Only minor variations occur between the cable burial equipment proposed by Dominion Energy (including jet trenching, plowing, chain cutting, trench former).

The sediment texture is strongly linked with the composition of the benthic invertebrate community (Rutecki et al. 2014). The fine- and medium-grained sand that makes up the majority of the Offshore Project area provides uniform and simple (non-complex) habitat (e.g., sand ripples, sand waves, ridges) for benthic infaunal organisms typical of this region. Cable emplacement associated with construction of the WTGs and OSSs would occur during two separate construction seasons with a 12-month recovery period for impacted sand ridge habitats. Disturbance of sand waves and ridges would be temporary, given that sand waves and ridges are changing, mobile features. These sand-dominated substrates are resilient by nature and are capable of tolerating disturbances because the sediment is regularly disturbed by wave action, nor'easters, offshore storms, and hurricanes (Rutecki et al. 2014). The sediment composition from the crest to the trough varies and each microhabitat supports different benthic invertebrates (Rutecki et al. 2014). The overall amount of seafloor disturbance under the Proposed Action is small relative to the total Lease Area, and impacted sand ridges are likely to recover faster than the trough microhabitats (Rutecki et al. 2014). Past studies following sand mining operations showed that the time scales for recolonization also vary by taxonomic group, with polychaetes and crustaceans recovering in the first several months and deep burrowing mollusks recovering within several years (Brooks et al. 2006).

Although active construction would temporarily disturb benthic habitat, the habitat would rapidly return to pre-Project conditions in non-complex habitats shortly after burial is complete (Boyd et al. 2015). Complex habitats may take longer to recover but would likely recover to pre-Project conditions (HDR 2020). Any impacts would likely be short term, considering the natural mobility of sand waves in the Project area and offshore export cable corridor, although full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). BOEM does not expect population-level impacts on benthic species (i.e., generally accepted ecological and fisheries methods would be unable to detect a change in population, which is the number of individuals of a particular species that live within the analysis area) from cable emplacement activities as a result of the Proposed Action or Alternative A-1. Benthic fauna would recolonize disturbed areas over time that have not been displaced by new structures.

Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, and pre-grapnel runs. A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the siting corridor. Additionally, pre-sweeping may be required in areas of the submarine export cable corridor with sand waves. Pre-sweeping involves smoothing the seafloor by removing ridges and edges using a controlled flow excavator from a construction vessel to remove the excess sediment. The cable would be buried using a jet trench, trench former, chain cutting, hydroplow, mechanical trenching plow, or a mechanical cutter to create a trench along the seabed, all mechanisms in which the cable is simultaneously laid and buried in a single pass. Cable burial methods would result in an increase in suspended sediments and an increase in the water content of sediments (i.e., the ratio of the mass of fluid to the mass of solids) within the trench. The silt and clay sediment particles remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized (COP, Appendix J; Dominion Energy 2022). Although no hard-bottom substrate was found in the Offshore Project area, in areas where seabed conditions might not allow for cable burial to the desired depth, other methods of cable protection would be employed, such as rocks, geotextile sand containers, or concrete mattresses. Recovery rates of these disturbed surfaces would depend on species present and their recovery capabilities, the extent of disturbance, and the nature of the protection material.

As the export cables approach the shoreline, the cables will be installed in an offshore trenchless installation punchout conduit located 1,000 to 1,800 feet (305 to 549 meters) from shore. This will avoid adversely affecting sensitive, shallower, nearshore habitats and avoid the high-impact zone of the beach shoreline. Impacts from new cable emplacement and maintenance are expected be notable and measurable but resources would recover completely; impacts on benthic resources from the Proposed Action or Alternative A-1 are expected to be minor.

Offshore operation and maintenance the Proposed Action or Alternative A-1 would require maintenance and inspections (COP, Section 3.5.1; Dominion Energy 2022). All surface maintenance and inspection will not affect benthic communities. The offshore export cables and inter-array cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would be able to provide a real time monitoring of temperature along the offshore export cable corridor, alerting Dominion Energy should the temperature change, which could be the result of scouring of material and cable exposure. Only cable repairs, if required, would temporarily affect benthic communities, and only in a localized area immediately adjacent to the repair. Assuming repairs would be infrequent and affecting only small sections of the cables, impacts are expected to have no detectable effects and would be negligible.

Noise: The Proposed Action or Alternative A-1 would result in noise from G&G surveys, WTG installations, WTG operations and maintenance, pile driving, and cable burial or trenching. Noise would also be generated during conceptual decommissioning activities. The noise may cause mobile fauna to move away from the area for a short while (COP, Section 4.2; Dominion Energy 2022). English (2017) reported marine invertebrates to be considered less susceptible than mammals and fish to loud noise and vibration as their bodies do not generally possess air-filled spaces but noise at high levels to cause short-term behavioral responses in marine invertebrates within approximately 10 meters of the disturbance. Although a noise mitigation design has not been finalized at this time, Dominion Energy is considering mitigation measures, particularly for the noise produced by pile driving. As discussed in Section 3.6.3.2, noise from offshore construction and conceptual decommissioning may have impacts on benthic species but they would most probably be negligible due to the temporal scale and mitigation.

G&G: Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could disturb benthic species in the immediate vicinity of the investigation and cause temporary behavioral changes. However, impacts to benthic species from noise is speculative since there remains a vast gap in our knowledge about sound thresholds and recovery from impact in almost all invertebrates (Carroll et. al. 2017). G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less intense sound waves for shallow penetration of the seabed. Seismic surveys are not expected in the geographic analysis area for benthic resources. G&G surveys were conducted as part of the Marine Site Investigation, EFH Assessment, and Marine Archaeological Resource Assessment (COP, Appendix C, Appendix E, and Appendix F, respectively; Dominion Energy 2022). Benthic impacts resulting from G&G activities are expected to be negligible.

Pile driving: The Proposed Action or Alternative A-1 would produce noise from pile driving during installation of up to 205 foundations for WTGs under the Proposed Action, or up to 202 WTG foundations for Alternative A-1, occurring intermittently in 2025 and 2027 between May 1 and October 31 (Appendix F, Table F2-1). Technical details related to pile-driving noise are analyzed for demersal and benthic fishes and commercially important invertebrates in Section 3.3. A recent summary of knowledge on how marine renewable energy devices affect benthic environment indicated the impact of sound on epibenthos is poorly understood and is generally lacking (Dannheim et al. 2020); impacts to benthic species from construction activities is uncertain and considered speculative.

Contaminated sediments are not known to be a problem in the geographic analysis area for benthic resources. The nearby Dam Neck Ocean Dredge Material Disposal Site has been permitted and in operation since 1967 but there has been no documentation of contaminated sediments in or around the site (USEPA 2009). Dominion Energy also proposes to use appropriate noise mitigation measures in accordance with applicable requirements and in accordance with the tolerance requirements in relation to inclination and elevation.

Although a noise mitigation design has not been finalized at this time, Dominion Energy is committed to the use of a double big bubble curtain (BBC) for far field noise mitigation. Acoustic studies completed by Dominion Energy used two different sound attenuation levels: a 6 decibel (dB) reduction, and a 10 dB reduction (COP, Table 4.2-23; Dominion Energy 2022). The use of noise-reduction technologies during all pile-driving activities to ensure the minimum attenuation of 6 dB would reduce the area of high noise levels during construction and subsequently minimize potential noise-related impacts to benthic species. A BBC system is a compressed air system (air bubble barrier) for sound absorption in water. Sound stimulation of air bubbles at or close to their resonance frequency effectively reduces the amplitude of the radiated sound wave by means of scattering and absorption effects. A BBC functions as follows: air is pumped from a separate vessel with compressors into nozzle hoses lying on the seabed and it escapes through holes that are provided for this purpose. Thus, bubble curtains are generated within the water column due to buoyancy. Noise emitted by pile driving must pass through those ascending air bubbles and is thus attenuated. The BBCs are intended to minimize the potential impact of noise, however the necessity of this mitigation for benthic species is speculative since impact of sound on epibenthos is poorly understood and is generally lacking (Roberts et al. 2016; Dannheim et al. 2020). The overall impact on benthic resources from noise from pile-driving activities under the Proposed Action or Alternative A-1 are uncertain and conservatively expected to be minor.

Operations and Maintenance: There will be noise from WTG operations and maintenance activities but would have limited, if any effect on benthic species. Noise associated with operational WTGs may be audible to some benthic fauna; this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would adversely affect benthic species (English et al. 2017). Impacts on benthic resources from operations and maintenance noise are expected to be negligible.

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

Port utilization: Dominion Energy and the Port of Virginia have executed a lease agreement for a portion of the existing Portsmouth Marine Terminal (PMT) facility in the city of Portsmouth, Virginia, to serve as a construction port. The construction port will be used to store monopiles and transition pieces and to store and pre-assemble wind turbine generation components. Dominion Energy understands that the Virginia Port Authority (VPA) is planning to improve PMT to support broadscale offshore wind development. Dominion Energy anticipates that the port upgrades will meet the needs of Dominion Energy's efforts to construct an offshore wind farm off the coast of Virginia. Dominion Energy currently is evaluating several alternatives to lease portions of existing facilities in the Hampton Roads, Virginia, region for an O&M facility for the Project. The preferred lease location for the O&M facility is Lambert's Point, which is located on a brownfield site in Norfolk, Virginia. Dominion Energy and the Port of Virginia are also evaluating leasing portions of the existing facilities at VPA's PMT or Newport News Marine Terminal (COP, Sections 3.1 and 3.3.2.6; Dominion Energy 2022). Improvements would be made to support broadscale offshore wind development. For both PMT and the O&M facilities, in the event that upgrades or a new, build to suit, facility is needed for any purpose, construction would be undertaken by the lessor and would be separately authorized, as needed (COP, Section 3.3.2.6; Dominion Energy 2022). Temporary laydown and construction port(s) in Europe or North America would be needed during the construction and installation phases of the Project.

Increases in port utilization due to other offshore wind projects would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a period of 4 years and would decrease during operations. Vessel traffic would increase again during conceptual decommissioning. In addition, increased port utilization and vessel traffic would require dredge maintenance, performed periodically by the USACE. Therefore, any port expansion and construction activities related to the additional offshore wind projects (e.g., need for navigation dredging) would also add to the total amount of disturbed benthic area, resulting in disturbance and mortality of benthic organisms and temporary to permanent habitat alteration. Existing ports are heavily modified/impaired benthic environments, and future port projects would likely implement best management practices to minimize impacts (e.g., stormwater management, turbidity curtains). Therefore, the degree of impacts on benthic resources would likely be negligible outside the immediate vicinity of the port expansion activities.

Presence of structures: The presence of structures would lead to impacts on benthic communities through entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic resources, and habitat conversion. The Proposed Action or Alternative A-1 may result in 205 or 202 WTG foundations and 3 OSSs, respectively. Each WTG would require approximately 3.55 acres (14,366.34 square meters) (COP, Table 4.2-17; Dominion Energy 2022) of surface area, most of which is related to the scour protection apron. In total, a maximum of 272 acres (1.1 square kilometers) of seafloor habitat would be permanently affected as a result of the Proposed Action. With 202 WTGs, Alternative A-1 would result in similar but slightly less seafloor disturbance due to the construction of 3 fewer WTGs than the Proposed Action. The moderate impacts from the presence of turbines, foundations, buoys, and met towers are unavoidable but would not create population-level effects on benthic resources.

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

Hydrodynamic disturbance: Human-made structures alter local water flow (hydrodynamics) at a fine scale (Section 3.6.3.2). The presence of vertical structures in the water column creates turbulence that transports nutrients upward toward the surface, increasing primary productivity at localized scales

(Danheim et al. 2020). These changes have been reported to increase food availability for filter-feeders on and near the structures creating a beneficial impact (Degrear et al. 2020). The consequences for benthic resources from such hydrodynamic disturbances are anticipated to be localized, to vary seasonally, and have minor impacts.

Fish aggregation: As subsequently discussed under the *Habitat conversion* IPF, the conversion of soft-bottom habitats to reef-like, hard-bottom areas would increase biomass for benthic fish and invertebrates. Enhanced biodiversity is also expected from the addition of new hard-bottom substrate. This indicates that offshore wind farms and the additional hard-bottom substrate that they provide would result in beneficial impacts on local ecosystems by attracting fishes who prey on benthic organisms (ICF 2021; Degraer et al. 2020). On the contrary, this predator attraction would adversely impact the benthic community (Degraer et al. 2020), though not at a population level. In light of the above information, BOEM anticipates that the impacts associated with the presence of structures would be moderately adverse to beneficial. The impacts on benthic resources resulting from the presence of structures would be permanent, as long as the structures remain.

Habitat conversion: Although the benthic characterization is primarily homogenous sand with little relief, sand ripples, waves, and ridges do occur within the geographic analysis area. Areas of complex habitat and heterogenous seabed contribute to the biodiversity of the benthic community. The Proposed Action or Alternative A-1 would alter some existing benthic habitat by converting soft-bottom substrate to hard surfaces. Construction activities disrupting soft-bottom habitat may injure or kill sessile or slow-moving demersal life stages of fishes and invertebrates, including eggs and larvae (Section 3.13). Direct seafloor disturbance would crush or bury small sessile benthic organisms located directly in the footprint of pile driving or scour protection placement.

Given that most benthic species in the region are planktonic as larvae, disturbed areas would likely be recolonized by species that require hard surfaces within about 1 year (Dernie et. al. 2003). Other benthic species are mobile and can return to these hard-bottom regions. Because hard-bottom habitats in the Project area are relatively limited (COP, Appendix D; Dominion Energy 2022) this change in the benthic community could increase biodiversity.

Analysis of the types and qualities of these conversions is ongoing and will be completed during the EFH consultation and summarized in the Final EIS. Scour protection would be required for the proposed Project. Depending on the material used, the scour protection could produce a reef-like effect that would continue to develop throughout the life of the Project. As the reef matures, deposition of shell hash and other detritus is expected to build up around the monopile foundations (Causon and Gill 2018). The increase in food availability for filter-feeders on and near the structures, which in turn leads to increased densities of mobile invertebrates (e.g., crabs, lobsters), attraction of pelagic and demersal fish, and foraging opportunities for marine mammals (Coates et al. 2014; Danheim et al. 2020; English et al. 2017; Degrear 2020). On the other hand, these hard surfaces also provide additional attachment points for non-native species that may be brought through new shipping activities, and the organic enrichment can be detrimental if they occur in oxygen-deficient sediments (De Mesel et al. 2015; Wilding 2014). These effects would increase long-term benthic habitat complexity around the structures for the duration of the Project. However, in accordance with BOEM requirements (e.g., 30 CFR 585) Dominion Energy would be required to remove, decommission, or both all Project infrastructure and clear the seabed of all obstructions following termination of Project operational activities and the Lease. The conceptual decommissioning process for the WTGs and OSSs is anticipated to be the reverse of construction and installation, with Project components transported to an appropriate disposal or recycling facility. All foundations/Project components would be removed to 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM. In general, this conversion of soft-bottom habitat to a more reef-like structure has potential moderate benefits to the surrounding biological community but also are expected to have moderate adverse impacts on the soft-bottom communities. In context of reasonably foreseeable environmental trends, as with fish aggregations above, new structures on the seafloor would create uncommon relief that would alter the habitat and could create moderate adverse and beneficial impacts.

Transmission cable infrastructure: The potential locations of cable protection for future actions have not been fully determined. The COP (Section 4.2.4.3; Dominion Energy 2022) estimates that approximately 0.1 percent of the length of offshore export and inter-array cables would be covered with cable protection material to ensure that they remain covered during storms and other events that disturb the seafloor. No hard-bottom substrate has been identified in the Offshore Project area, which is composed primarily of soft sediment allowing for the planned burial of inter-array and export cables for 99.9 percent of the cable corridor; cable infrastructure presence is expected to result in negligible impacts on benthic resources. In the context of reasonably foreseeable environmental trends, transmission cables are assumed to be mostly buried during installation with expected benthic impacts to be negligible.

Discharges: The Proposed Action or Alternative A-1 is not anticipated to cause any impacts on benthic resources from discharges that would include uncontaminated bilge water and treated liquid wastes. Uncontaminated ballast water can be discharged or retained onboard as part of the ballast management plan (COP, Table 3.5-1; Dominion Energy 2022). Many discharges are required to comply with permitting standards established to ensure that discharge impacts on the environment are mitigated. There is no evidence that the anticipated volumes and nature of these discharges would have any overall impact on benthic resources; impacts are expected to be negligible.

Regulated fishing effort: Regulated fishing effort would affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). The Proposed Action or Alternative A-1, as well as other future offshore wind development, could influence this IPF. The intensity of impacts on benthic resources under future fishing regulations are uncertain, but would likely be similar to, or less than, under existing conditions, and are expected to recover with mitigation measures and be minor.

Seabed profile alterations: Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples with some isolated patches of mud and gravel. During cable installations of the Proposed Action or Alternative A-1, pre-construction grapnel runs would be conducted as part of the seabed preparations. These runs would be, beyond the area affected by cable emplacement, potentially leading to short-term impacts on benthic organisms including habitat alteration, injury, and mortality. Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples, with some isolated patches of mud and gravel. These features would temporarily be disturbed by pre-construction grapnel runs, seabed preparation, foundation placement, scour protection installation, anchoring, clearing, and trenching for offshore export and inter-array cable installation, and cable protection activities. Sand ripples and waves disturbed by offshore export and inter-array cable installation would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that formed them initially (COP, Appendix C, Dominion Energy 2022; Kraus and Carter 2018). Impacts are expected to be minor, but the majority of the seafloor within the Project area will recover completely, without mitigation to the seabed profile alterations. Recovery in sand ridge habitats is largely a function of sediment transport, and water depth (Rutecki et al. 2014). The rate of sediment migration relates to the shoal type and ranges from 13 feet per year (4 meters/year), observed off the coast of North Carolina (Thieler et al. 2014), to stationary, as observed in the west Florida Shelf and the German Bight (Rutecki et al. 2014). It is presumed that sandy habitats, such as the majority of the Project area, are capable of tolerating disturbances as the substrate is regularly disturbed

Seabed deposition and burial: Foundation types vary in footprint size and depth of penetration into the sediment. The WTG foundations for the Proposed Action or Alternative A-1 encompass less area on the seafloor but penetrate more deeply into the sediment compared to other technologies (ICF 2021). For the

Proposed Action, rock or other hard material would be placed within a 115-foot (35-meter) diameter surrounding each foundation, with an area of 10,387 square feet (965 square meters) of seafloor around each foundation to prevent bottom scour, for a total area of 4198.4 acres (80.3 hectares) within the Lease Area for all WTGs and OSSs combined. Alternative A-1 would result in slightly less scour protection due to the construction of three fewer WTGs and associated inter-array cables. Cable laying and construction would also result in the temporary resuspension and nearby deposition of sediments. In areas where displaced sediment is thick enough, organisms may be smothered, which would result in mortality. (See Section 3.6.3.2for details on sediment burial sensitivity thresholds). Additional protective rock or other hard material would be placed atop 0.1 percent of the offshore export and inter-array cables for added protection where cable burial is insufficient. Because most lightly sedimented areas would recover naturally, and most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area, impacts on benthic resources would be minor.

Climate change: This IPF would contribute to alterations in ecological relationships, alterations in migration patterns, changes to disease frequency, and the reduced growth or decline of invertebrates that have calcareous shells. Because this IPF is a global phenomenon, the impacts through this IPF from planned actions, including the Proposed Action or Alternative A-1, would be very similar to those in Section 3.6.3.2. The intensity of impacts resulting from climate change are uncertain but with notable and measurable effects on regional benthic resources are anticipated to qualify as moderate.

In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be moderate.

3.6.5.1 Cumulative Impacts of the Proposed Action

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

Accidental releases: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be localized, temporary, and unlikely; therefore the impacts would be negligible.

Fuel, fluids, hazardous materials: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF on ongoing and planned activities, including the Proposed Action are expected to be negligible.

Invasive species: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be negligible.

Trash and debris: In the context of reasonably foreseeable environmental trends for accidental releases, a gradual increase in vessel traffic would increase the risk of releases, but impacts are still expected to be negligible.

Anchoring: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be localized and temporary, and thus negligible.

Electromagnetic fields: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative

A-1, are expected to be negligible assuming submarine cables are shielded, buried, or covered for all projects.

New cable emplacement and maintenance: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would result in minor seafloor disturbance from required subsea cables. Effects are expected to be localized and temporary, with recovery in a relatively short time, resulting in minor impacts.

Noise: The combined noise impacts from the Proposed Action and ongoing and planned activities are anticipated to remain the same as the Proposed Action and would be negligible on benthic resources due to temporal scale and mitigation.

G&G: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to have be negligible on benthic resources.

Pile driving: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be localized and temporary, and therefore minor.

Operations and Maintenance: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, from operations and maintenance noise are expected to be negligible.

Cable laying or trenching: In the context of reasonably foreseeable environmental trends, new or expanded submarine cables and pipelines are likely to occur in the geographic analysis area, but noise impacts on benthic resources are expected to be negligible.

Port utilization: In the context of reasonably foreseeable environmental trends, global shipping traffic is expected to continue to increase with modest port activity expected in Virginia. Although the degree of impacts on benthos would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on certain fish and invertebrate species could occur beyond the port but with expected negligible impacts on benthic resources.

Presence of structures: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be moderate as there could be over 3,000 WTGs along the Atlantic coastline (COP, Appendix F; Dominion Energy 2022). These structures would remain in place throughout the duration of each project (up to 33 years for the Proposed Action). Overall, there are both adverse and beneficial impacts that would occur, as discussed in the subsequent sub IPFs.

Entanglement, gear loss, gear damage: In the context of reasonably foreseeable environmental trends, future new cables, and turbine structures would present additional risk of gear loss, resulting in small, short-term, localized impacts but are still expected to have negligible impacts on benthic resources.

Hydrodynamic disturbance: In the context of reasonably foreseeable environmental trends, future structures would present additional alterations to the hydrodynamics near those structures. The Planned Activities Scenario (Appendix F) indicates that there could be over 3,000 WTGs along the Atlantic coastline. Due to the spatial separation of these planned turbines, it is expected that the hydrodynamic disturbance will remain minor as long as the structures remain.

Fish aggregation: In the context of reasonably foreseeable environmental trends, any new cable, or scour protections, towers, buoys, or piers would create uncommon relief with expected local and lasting impacts as long as the structures remain, which would be a moderate impact.

Habitat conversion: In the context of reasonably foreseeable environmental trends, the combined impacts from the presence of structures and the associated environmental modifications from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be moderate, and permanent as long as the structures remain.

Transmission cable infrastructure: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be negligible.

Discharges: In the context of reasonably foreseeable environmental trends, there is the potential for regulated new ocean dumping/dredge disposal sites in the northeastern United States to create short-term impacts on benthic resources that are typically recolonized naturally. Benthic impacts are expected to be negligible.

Regulated fishing effort: In the context of reasonably foreseeable environmental trends, no future activities were identified within the geographic analysis area other than ongoing activities. Section 3.9 provides additional details.

Seabed profile alterations: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be minor, as the impacts would be short term in nature due to the dynamic environment.

Seabed deposition and burial: In context of reasonably foreseeable environmental trends, USACE, private ports, or both may undertake dredging projects periodically. Where dredged materials are disposed, benthic resources are buried but are expected to recolonize naturally in the short term with expected minor benthic impacts.

Climate change: In the context of reasonably foreseeable environmental trends, no future activities were identified in the geographic analysis area other than ongoing activities.

3.6.5.2 Conclusions

Impacts of the Proposed Action. Proposed Action or Alternative A-1 construction activities would likely result in impacts from accidental releases, anchoring, EMFs, new cable placement, underwater noise generated primarily by pile driving, port utilization, presence of structures, discharges, seabed profile disturbances, sediment deposition and burial, and climate change. Construction activities would occur during two separate construction seasons with a 12-month recovery period for the impacted sand ridge habitats. Routine operation and maintenance impacts would have minimal impacts on benthic communities and result primarily from localized activities that disturb the seafloor. The benthic impacts resulting from the Proposed Action or Alternative A-1 alone to range from **negligible** to **moderate**. However, overall benthic impacts from the Proposed Action or Alternative A-1 would be **minor** because the effect would be localized, and the benthic environment would recover completely over time without remedial and mitigation actions. In addition, **moderate beneficial** impacts could result from habitat alteration from soft-bottom to hard-bottom "reefing" habitats.

Cumulative Impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action or Alternative A-1, would range from **negligible** to **moderate** adverse with potentially **moderate beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would range from **minor** to **moderate** benthic impacts in the geographic analysis area, depending on the IPFs. The main drivers for the moderate impact rating are seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, and the addition of physical structure, which will modify benthic ecosystems. Minor impacts are expected from the noise from active construction, sediment disturbance, and turbidity from burying or protecting the inter- array and offshore export cables, changing the profile of the seafloor, the hydrodynamic disturbances from these structures, marine minerals extraction, and dredging activities. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through the permanent impacts associated with the presence of structures. Therefore, the overall benthic impacts would likely qualify as **moderate** because a measurable impact is anticipated, but the resource would likely recover completely when the WTGs are removed, with less time for recovery if remedial or mitigating actions are taken.

3.6.6 Impacts of Alternatives B and C on Benthic Resources

Impacts of Alternative B and C. The primary difference between Alternatives B and C and the Proposed Action is that the fish haven area within the northern portion of the Lease Area would be excluded from development under Alternatives B and C. Alternative B, the Revised Layout to Accommodate the Fish Haven and Navigation Alternative, would avoid impacts on artificial reefs, shipwrecks, and complex habitats. The fish haven along the northern boundary would be an exclusion zone. Alternative B, in conjunction with excluding the fish haven, reduces the number of WTGs to up to 176 (29 fewer WTGs than the Proposed Action), and 3 OSSs. This alternative would use 14-MW turbines. The number and length of inter-array cables would also change based on this configuration, further reducing benthic habitat impacts. Assuming a maximum 66-foot (20-meter) pre-lay grapnel run width, 1,837.7 acres (743.6 hectares) of benthic habitat would be temporarily disturbed. Permanent seafloor impacts from Alternative B would affect 234 acres (95 hectares), a 14 percent decrease from the Proposed Action.

Alternative C, the Sand Ridge Impact Minimization Alternative, was developed to minimize impacts on offshore benthic habitats. NMFS has identified the sand ridge habitat within the Lease Area as a significant and unique benthic resource to be avoided to reduce the Project impact on invertebrates and on fish that use these resources. Offshore shoal complexes support diverse invertebrate assemblages with faunal differences found between the ridge crest and trough habitats (Rutecki et al.2014). These habitats serve important ecological functions for the benthic community and the complex food web they support. The sand ridge habitat area encompasses 17 WTG locations, 1 OSS location, and associated inter-array and offshore export cables.

Along with micrositing of infrastructure (WTGs, OSSs, and associated cabling), Alternative C would remove up to 500 feet (152 meters) of cabling, and four WTGs would be removed from priority sand ridge habitat, with one additional WTG being relocated to a spare position. This configuration reduces seafloor disturbance, including the cross-cutting and trenching of sand ridges. As under the Proposed Action, the cross-cutting trenching activities would occur during two separate construction seasons with a 12-month recovery period for the impacted sand ridge habitats. This sequence of construction activities would reduce multiple disturbances to individual sand ridge features that would otherwise occur in a single construction season. Overall Alternative C would have a total of up to 172 WTGs, a reduction of 33 WTGs from the Proposed Action, and 3 OSSs. This reduction of WTGs and the associated inter-array cables and cable length would impact 228 acres (92 hectares), a 16 percent reduction in the amount of disturbed benthic habitat from the Proposed Action.

Avoidance of the north-central fish haven area (i.e., containing artificial shipwrecks and additional reef habitats) (Section 3.6.1) under Alternatives B and C would decrease benthic impacts, and Alternative C would offer additional avoidance and minimization of impacts on complex habitat in the southern portion of the Lease Area where sand ridge habitat occurs. However, the overall expected minor impacts and potential moderate beneficial impacts on benthic resources would not be expected to be substantially different for Alternatives B and C than those described under the Proposed Action.

Impacts from installation and construction, O&M, and conceptual decommissioning would be similar to those described under the Proposed Action, with the exception that fewer total WTGs would reduce the amount of disturbed benthic habitat, displacement of soft-bottom organisms from habitat conversion, duration of pile driving and the associated noise impacts, and jet-plowing.

There would be a reduction in the amount of seafloor disturbed, differing under Alternatives B and C, from that described under the Proposed Action, and the impact level would remain minor. The benthic community would not undergo population-level impacts, though habitat conversion is unavoidable. The impacts on the benthic community would be unavoidable and permanent as long as the structures remain.

Cumulative Impacts of Alternative B and C. In context of reasonably foreseeable environmental trends, the impacts contributed by these alternatives to the overall impacts on benthic resources would be similar to those under the Proposed Action, with some differences in the amount of seafloor disturbed.

3.6.6.1 Conclusions

Impacts of Alternative B and C. Alternatives B and C would decrease the number and size of WTGs, and avoid complex habitat, shipwrecks, and artificial reefs, which would have an associated decrease in potential impacts on benthic resources, including priority habitat. BOEM expects that the impacts resulting from Alternatives B and C would be similar to the Proposed Action in a lesser degree and would range from temporary to long term with individual IPFs leading to impacts ranging from **negligible** to **moderate** with potentially **moderate beneficial** impacts, and overall impacts being **minor**.

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

3.6.7 Impacts of Alternative D on Benthic Resources

Impacts of Alternative D. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same. Alternatives D-1 and D-2 differ from the Proposed Action only with respect to onshore routing of the interconnection cable. Interconnection Cable Route Option 1 would be an entirely overhead route, while Hybrid Interconnection Cable Route Option 6 would involve installation of the interconnection cable using a hybrid of overhead and underground construction methods. Impacts on benthic resources under Alternatives D-1 and D-2 would be the same as those under the Proposed Action and would range from negligible to moderate adverse and moderate beneficial benthic impacts in the geographic analysis area, depending on the IPFs. The overall benthic impacts would likely remain moderate because a measurable effect is anticipated, but the resource would likely recover completely when the WTGs are removed, with less time for recovery if remedial or mitigating actions are taken.

Cumulative Impacts of Alternative D. For the same reason, the overall impacts on benthic resources in the context of reasonably foreseeable environmental trends and planned actions would be the same under Alternatives D-1 and D-2 as the Proposed Action and would remain moderate.

3.6.7.1 Conclusions

Impacts of Alternative D. Although Alternatives D-1 and D-2 would minimize impacts on onshore habitats, BOEM does not anticipate a measurable benefit for benthic resources in the geographic analysis area. Therefore, potential impacts would be same as the Proposed Action and would range from **negligible** to **moderate** with potentially **moderate beneficial** impacts, for an overall **moderate** impact.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on benthic resources from ongoing and planned actions, including Alternatives D-1, and D-2, would be the same as those described under the Proposed Action, with individual IPFs ranging from **negligible** to **moderate**, and the potential for **minor** to **moderate beneficial** impacts. While Alternatives D-1, and D-2 are designed to minimize impacts on onshore habitats, the overall impacts on benthic resources would be the same as under the Proposed Action and would remain **moderate** adverse and **moderate beneficial**.

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3.7 Birds

This section discusses existing bird resources in the geographic analysis area for birds, as described in Appendix F, *Planned Activities Scenario,* Table F-1 and shown on Figure 3.7-1. Specifically, the geographic analysis area for birds includes the East Coast, from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. The geographic analysis area was established to capture resident species and migratory species that winter as far south as South America and the Caribbean, and those that breed in the Arctic or along the Atlantic coast that travel through the area. The offshore limit was established to cover the migratory movement of most species in this group. The onshore limit was established to cover onshore habitats used by the species that may be affected by onshore and offshore components of the proposed Project.

3.7.1 Description of the Affected Environment for Birds

This section addresses potential impacts on bird species that use onshore and offshore habitats, including both resident bird species that use the geographic analysis area during all (or portions of) the year and migrating bird species with the potential to pass through the proposed Project area during fall and/or spring migration. Detailed descriptions of birds occurring in and offshore Virginia can be found in COP Section 4.2.3.1, and Section 2.1 of Appendix O-1 (Dominion Energy 2022); in Section 4.5 and Appendix L of the *Virginia Offshore Wind Technology Advancement Project Research Activities Plan* (RAP) (BOEM 2015); and in Section 3.2.3.1 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment* (BOEM 2015). Additional descriptions of bird species in the geographic analysis area can be found in several BOEM wind project documents (BOEM 2012, 2014) and Williams et al. (2015).

Bird species with the potential to occur in the vicinity of Onshore and Offshore Project components are shown in COP Section 4.2.3.1, Tables 4.2-10 and 4.2-11 (Dominion Energy 2022). Given the differences in life history characteristics and habitat use between offshore and onshore bird species, the sections below provide a separate discussion of each group. This section also discusses bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*). In addition, this section addresses federally listed threatened and endangered birds; further information regarding listed species is provided in the *Coastal Virginia Offshore Wind Commercial Project Biological Assessment* prepared for USFWS (BOEM 2022).

3.7.1.1 Offshore Birds

The Offshore Project area is located approximately 27 miles (23.75 nautical miles) offshore Virginia Beach. Waters in the Offshore Project area may provide seasonal habitat for loons, grebes, sea ducks, gulls, terns, pelagic birds (e.g., shearwaters, storm-petrels, allies), and alcids (e.g., dovekie [*Alle alle*], murre [*Alca* spp.]) according to the Mid-Atlantic Baseline Studies (Williams et al. 2015; Dominion Energy 2022). Some avian species, such as the peregrine falcon (*Falco peregrinus*), shorebirds, and passerines, occur primarily on the mainland and on barrier islands, but may also occur in the Offshore Project area, primarily during migration. Generally, a high diversity of marine birds may use the Offshore Project area because it is located at the southern end of the Mid-Atlantic Bight, an area of overlap between northern and southern species assemblages. A total of 83 marine bird species are known to regularly occur off the Mid-Atlantic Bight (Nisbet et al. 2013). Additionally, offshore and onshore avian surveys were conducted near the Project area that further describe the avian resources (RAP 2015, Appendix L). Survey data indicated that, compared to other areas in the Atlantic OCS, relatively low numbers of nearshore, pelagic, and gull species are predicted to occur in the vicinity of the Project area (Dominion Energy 2022, Figure 4.2-8; BOEM 2015).

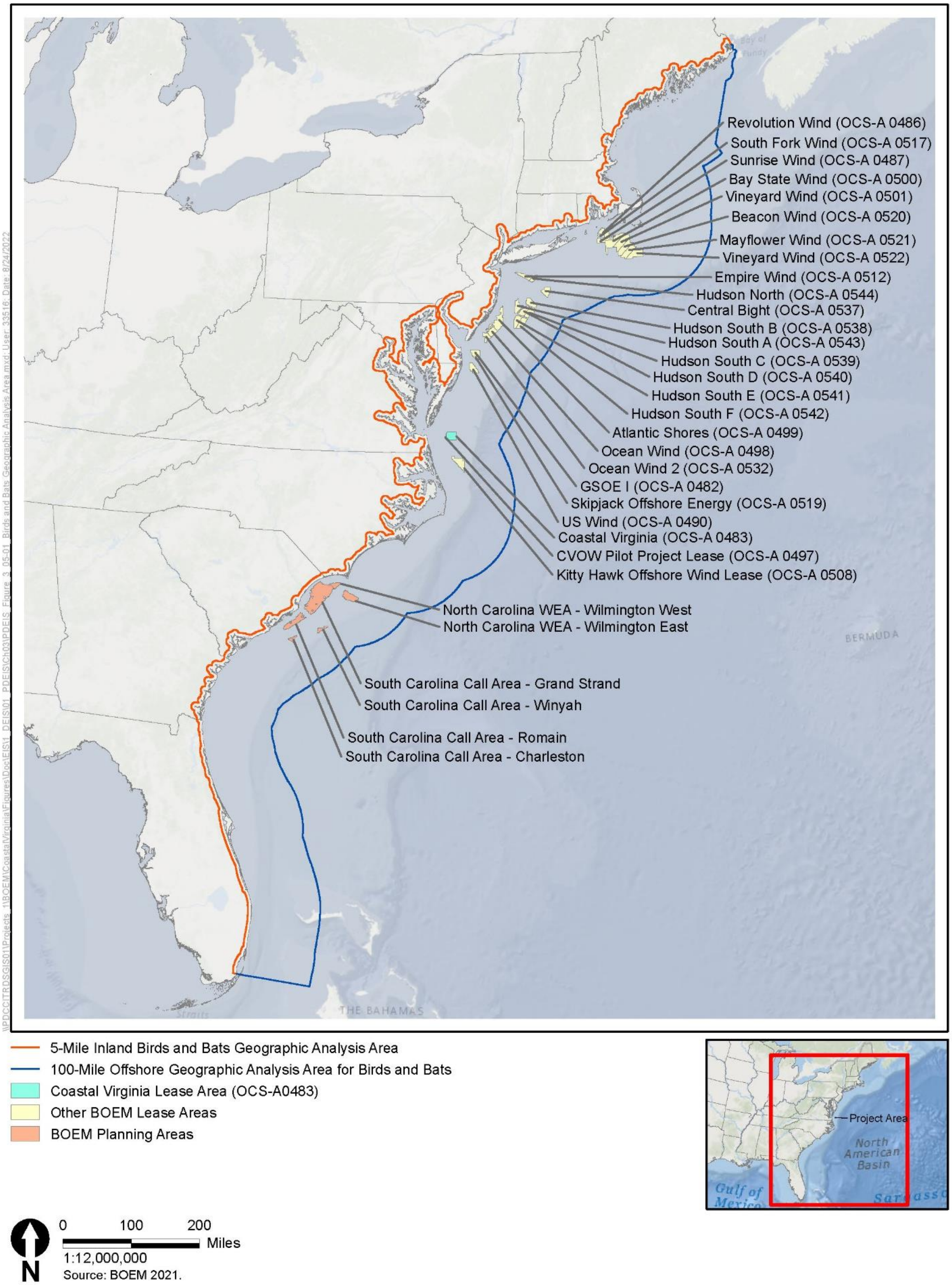


Figure 3.7-1 Birds and Bats Geographic Analysis Area

In the offshore environment, bird abundance generally declines as distance from shore increases (Petersen et al. 2006; NJDEP 2010; Paton et al. 2010). A study offshore New Jersey showed bird densities dropping precipitously a few nautical miles from shore with avian densities highest near shore during all seasons, further noting that this trend was much more pronounced in winter than summer (NJDEP 2010). In addition, the number of bird species also declines with distance from shore. For example, of the 164 waterbird species that use the Atlantic Flyway, 58 species use offshore (3 to 11 nautical miles [5 to 20 kilometers from shore]) and pelagic environments, and the remaining 106 species use bays, coastlines, and nearshore environments (Watts 2010). Therefore, for marine birds, the Offshore Project area is generally located in low bird abundance due to its distance from shore (COP, Figure 4.2-8; Dominion Energy 2022; BOEM 2015), while the offshore export cable corridor likely would have higher abundances related to proximity to shore. This is supported by COP Appendix O-1 (Dominion Energy 2022), which provides a detailed qualitative exposure assessment (minimum, low, medium, and high) using available literature and data for birds that have the potential to pass through the Offshore Project area. The exposure assessment indicated that the proposed Project is unlikely to affect coastal or marine bird populations because, with the exception of storm-petrels, exposure for most species is minimal to low. The Offshore Project area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species; Project activities would also avoid marine bird concentration areas. Federally protected species, a category that includes golden eagle, bald eagle, red knot (*Calidrus canutus rufa*), piping plover (*Cheradrius melodus*), and roseate tern (*Sterna dougallii dougallii*), as well as the black-capped petrel (*Pterodroma hasitata*) which is a candidate species, are expected to have limited exposure and, thus, risk to individuals is unlikely.

3.7.1.2 Onshore Birds

Due to the mobility of birds, a variety of species have the potential to use the habitats within or adjacent to the Onshore Project area throughout the year. A list of the most common (75th quantile) bird species identified in the eBird database within a 12-mile (20-kilometer) buffer of the Onshore Project area included 61 different species (COP, Section 4.2.3.1 and Table 4.2-10; Dominion Energy 2022). At the cable landing location, dunes and dune grass, scrub-shrub, artificial wetlands, and residential areas may support avian species, including the double-crested cormorant (*Phalacrocorax auritus*), ring-billed gull (*Larus delawarensis*), great-blue heron (*Ardea herodias*), and brown pelican (*Pelecanus occidentalis*). Along the onshore export cable and interconnection cable routes, mixed forest, wetlands, agricultural areas, and residential areas may support avian species, including the American crow (*Corvus brachyrhynchos*), American robin (*Turdus migratorius*), European starling (*Sturnus vulgaris*), northern mockingbird (*Mimus polyglottos*), northern cardinal (*Cardinalis cardinalis*), mourning dove (*Zenaida macroura*), and blue jay (*Cyanocitta cristata*). The woods adjacent to Rifle Range Road, near the cable landing, would support a variety of species throughout the year, including the northern cardinal, Carolina chickadee (*Poecile carolinensis*), mourning dove, and blue jay. Additionally, the areas adjacent to or encompassing the potential switching station locations may provide breeding, wintering, and migratory stopover habitat due to the mix of forest, field, and wetland habitat. Additionally, onshore avian surveys were conducted near the Project area that further describe the avian resources (RAP 2015, Appendix L). In those surveys, where a total of 79 species represented by 3,578 individuals were observed, the most abundant were common grackles (*Quiscalus quiscula*) followed by tree swallows (*Tachycineta bicolor*) and laughing gulls (*Leucophaeus atricilla*) (RAP 2015, Appendix L). COP Section 4.2.3.1, Table 4.2-10 (Dominion Energy 2022) lists the most common (75th quantile) birds identified in the eBird database within a 12-mile (20-kilometer) buffer of the Onshore Project area. COP Appendix O-1 (Dominion Energy 2022) provides a list of the Species of Greatest Conservation Need and their associated habitats and all birds identified in the eBird database within 12 miles (20 kilometers) of the Onshore Project area.

3.7.1.3 Migratory Birds

Despite the level of human development and activity present, the Mid-Atlantic coast plays an important role in the ecology of many bird species. The Atlantic Flyway, which encompasses all of the areas that could be affected by the proposed Project, is a major route for migratory birds, which are protected under the MBTA. Chapter 4 of the Atlantic Final Programmatic Environmental Impact Statement (BOEM 2014) discusses the use of Atlantic coast habitats by migratory birds.

The official list of migratory birds protected under the MBTA, and the international treaties that the MBTA implements, is found at 50 CFR 10.13. The MBTA makes it illegal to "take" migratory birds, their eggs, feathers, or nests. Under Section 3 of Executive Order 13186, BOEM and USFWS established a Memorandum of Understanding (MOU) on June 4, 2009, which identifies specific areas in which cooperation between the agencies would substantially contribute to the conservation and management of migratory birds and their habitats (MMS and USFWS 2009). The purpose of the MOU is to strengthen migratory bird conservation through enhanced collaboration between the agencies (MMS and USFWS 2009, Section A). One of the underlying tenets identified in the MOU is to evaluate potential impacts on migratory birds and design or implement measures to avoid, minimize, and mitigate such impacts as appropriate (MMS and USFWS 2009, Sections C, D, E(1), F(1-3, 5), G(6)).

The offshore waters and adjacent coastal areas of Virginia provide habitat for migratory avian species with special state and federal conservation status. Many of these species use coastal, estuarine, and nearshore marine habitats, including Important Bird Areas, National Wildlife Refuges, and other conservation areas (e.g., the Maryland-Virginia Barrier Islands Western Hemisphere Shorebird Reserve Network site). Portions of the Mid-Atlantic coast are considered critical stopover habitat for many species of waterfowl, shorebirds, raptors, and wading birds migrating between breeding sites in the northern latitudes and wintering areas farther south (Steinkamp 2008). Migration routes for pelagic species are difficult to define and may depend on a variety of factors and interactions (Drewitt and Langston 2006; Gonzalez-Solis et al. 2009; Amélineau et al. 2021).

Within the Atlantic Flyway along the North American Atlantic coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the shoreline and several kilometers out onto the OCS, whereas land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). Although both groups may occur over land or water within the flyway and may extend considerable distances from shore, the highest diversity and density are centered on the shoreline. The qualitative exposure assessment conducted for the Project area, as presented in COP Appendix O-1 (Dominion Energy 2022), is supported by the assessment of Normandeau Associates, Inc. (2014) where the sensitivity of bird populations to collision and/or displacement due to future wind development on the Atlantic OCS was evaluated. In many cases, high collision sensitivity was driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the RSZ. Many of the bird populations addressed in Normandeau Associates, Inc. (2014) had low collision sensitivity and included passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ.

Bird populations in the Offshore Project area that are more susceptible to impacts from collision with WTGs include gulls, terns, jaegers, phalaropes, cormorants, northern gannet, and scoters (*Melanitta* spp.). These populations are more susceptible because of their higher occurrence in the OCS, their at-risk population status, and/or their relatively high proportion of flights in the RSZ, although exposure for most species is still expected to be minimal to low (COP, Appendix O-1; Dominion Energy 2022; RAP 2015) because these species are most abundant within 1 to 2 nautical miles of the shoreline (Northeast Regional Ocean Council 2021). Populations with the lowest vulnerability to collision risk include passerines that would only cross the OCS during migration and would typically fly above the RSZ, i.e., approximately 869 feet (265 meters).

3.7.1.4 Special-Status Species

There are no critical habitats for birds listed in the ESA in the Project area (offshore or onshore), and no ESA-listed bird species were previously detected during offshore and onshore surveys in the vicinity of the Project area (RAP 2015, Appendix L). Three species of federally endangered or threatened birds can occur onshore and in coastal and marine waters offshore during part of the year, although these species are expected to have limited exposure to the Project and, thus, risk to individuals is unlikely (COP, Appendix O-1; Dominion Energy 2022). The northeastern United States population of roseate tern is listed as endangered, and the piping plover and red knot are listed as threatened. These species use coastal habitats including beaches, marshes, and intertidal wetlands. Two additional avian species, either listed or candidates for listing, may occur in the Offshore Project area. The Bermuda petrel (*Pterodroma cahow*; also known as cahow) is federally listed as endangered (35 *Federal Register* 6069) and can occur offshore Virginia. The black-capped petrel is a candidate species to be listed as threatened or endangered and may also occur offshore Virginia. The roseate tern, piping plover, and red knot may pass through the marine portion of the Project area during migration while the cahow and black-capped petrel could pass through the marine part of the Project area during the non-breeding season.

The Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. § 668 et seq.) prohibits the "take" and trade of bald and golden eagles. However, golden eagles are not expected to occur within or adjacent to the Project area because golden eagles do not nest in Virginia and migrate mostly along the Appalachian ridgelines that are located far from the Project area. Thus, the Project would have no effect on golden eagles. Bald eagles occur near wetlands such as seacoasts, rivers, large lakes, or marshes but not in the open ocean, thus the marine portion of the Project would have no effect on bald eagles, but they could be affected by activities slated to occur in the onshore portion.

BOEM has prepared a BA to address Project effects on federally listed species under USFWS jurisdiction, pursuant to Section 7 of the ESA (BOEM 2022). The BA also provides detailed accounts for each of these species.

Birds in the geographic analysis area are subject to pressure from ongoing activities, particularly accidental releases, new cable emplacement, interactions with fisheries and fishing gear, and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). Data have shown that since 1970, 30 percent of North American species have disappeared with 90 percent coming from just 12 bird families, including sparrows, warblers, finches, and swallows (NABCI 2019; Rosenberg et al. 2019). This is likely representative of the conditions of birds within the geographic analysis area. The geographic analysis area is also home to more than one-third of the human population of the United States. As a result, species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including 1) hunting pressure, e.g., from 2016 to 2020, an average of 85,000 sea ducks were harvested annually (Roberts 2021); 2) commercial fisheries by-catch, e.g., approximately 2,570 seabirds are killed annually on the Atlantic (Hatch 2018; Sigourney et al. 2019); and 3) climate change, which has the potential to have adverse impacts on bird species and habitats (National Audubon Society 2019).

According to the North American Bird Conservation Initiative (NABCI), more than half of the offshore bird species (57 percent, 31 species) have been placed on the NABCI watch list as a result of small ranges, small and declining populations, and threats to required habitats (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015) including those that forage, breed, and migrate over the Mid-Atlantic OCS. Trend analyses of North American shorebird populations indicated that many species were in decline through the 1980s and 1990s, but that some populations appear to have stabilized since that time (Andres et al. 2012). Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch list. Many of these coastal species have small population size and/or restricted distributions, making them especially vulnerable to habitat loss/degradation and other stressors (NABCI 2016). Assessments of vulnerability to climate change of all species present have estimated that, throughout Virginia, 69 out of 182 species are climate vulnerable in summer under the 3 degrees Celsius (°C) temperature increase scenario; under the 1.5°C temperature increase scenario, the number of vulnerable species is reduced to 36. Impacts are lessened in winter with 17 out of 179 species vulnerable under the 3°C temperature increase scenario and 7 species vulnerable in the 1.5°C temperature increase scenario (National Audubon Society 2019). These ongoing impacts on birds would continue regardless of regional development associated with the offshore wind industry.

Some of the main drivers of bird population declines include habitat loss; habitat fragmentation; collisions with glass windows and power lines, communication towers, power transmission lines, and cars; exposure to pesticides; losses due to domestic and feral cats (Klem 1989, 1990; Dunn 1993; Erickson et al. 2005, Longcore et al. 2013; Loss et al. 2013b; Loss et al. 2015); and effects of climate change (National Audubon Society 2019). Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are additionally vulnerable to sea-level rise and the increasing frequency of strong storms.

3.7.2 Environmental Consequences

3.7.2.1 Impact Level Definitions for Birds

Definitions of impact levels are provided in Table 3.7-1.

Table 3.7-1 Impact Level Definitions for Birds

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

3.7.3 Impacts of the No Action Alternative on Birds

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

3.7.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for birds described in Section 3.7.1, *Description of Affected Environment for Birds*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing offshore and non-offshore wind activities within the geographic analysis area that contribute to impacts on birds are generally associated with onshore impacts (including onshore construction and coastal lighting), activities in the offshore environment (e.g., vessel traffic, commercial fisheries), and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bird species through temporary and permanent habitat removal or conversion, temporary noise impacts related to construction, collisions (e.g., presence of structures), and lighting effects, which could cause avoidance behavior and displacement as well as potential injury to or mortality of individual birds. However, population-level effects would not be anticipated. Activities in the offshore environment could result in bird avoidance behavior and displacement, but population-level effects would not be anticipated. Increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, sea-level rise, and increased erosion and sediment deposition have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on birds include:

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

Ongoing O&M of the Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect birds through the primary IPFs of light, noise, presence of structures, and cable emplacement and maintenance. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.7.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.7.3.2 Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that may affect birds include installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, military use, marine transportation, port expansions, and installation of new structures on the OCS (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on birds including disturbance, displacement, injury, mortality, habitat degradation, and habitat conversion. See Appendix F, Table F1-4 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for birds.

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

Accidental releases: Offshore, future wind and non-wind activities could result in accidental releases of contaminants or trash into the water (see Section 3.21, *Water Quality*, for quantities and details). Following ingestion, blockages caused by both hard and soft plastic debris could result in mortality (Roman et al. 2019) or adverse health effects, such as decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Vessel compliance with USCG regulations would minimize accidental releases of trash or other debris; therefore, BOEM expects accidental trash releases from offshore wind vessels to be rare. Small exposures that result in the oiling of feathers can lead to adverse effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities (Maggini et al. 2017). Based on estimated volumes of oils, lubricants, and diesel fuel needed for other offshore wind projects (Section 3.21) and the low risk of spills due to implementation of safe handling, storage, and cleanup procedures, impacts from accidental spills and trash would represent a nominal impact on birds.

Light: Nighttime lighting associated with offshore structures and vessels could also represent a source of bird attraction. Under the No Action Alternative, over 3,287 WTGs OSSs, and meteorological towers that could be constructed would have navigational and Federal Aviation Administration (FAA) hazard lighting in accordance with BOEM's lighting and marking guidelines and would be placed on the OCS where few lighted structures currently exist. The resulting structure-related lighting impacts would be localized but long term. Construction vessels are also a source of artificial lighting. Attraction to project vessels by birds would not be expected to result in increased risk of collision with vessels. The resulting vessel-related lighting impacts would be localized and temporary. In a maximum-case scenario, lights could be on 24 hours per day during construction. This could attract birds, and/or potential prey species, to construction zones, potentially exposing them to greater harm from other IPFs associated with construction. Lighting has some potential to result in long-term impacts and may pose an increased collision risk to migrating birds (Hüppop et al. 2006), though this risk would be minimized through the use of red-flashing FAA lighting (BOEM 2021a; Kerlinger et al. 2010). While small due to the use of red-flashing FAA lighting, some potential exists for WTG lighting to result in new collision risk, particularly to night flying migrants during low-visibility weather conditions where few lighted structures currently exist on the OCS.

New cable emplacement and maintenance: Generally, emplacement of submarine cables would result in increased suspended sediments that may impact diving birds and result in displacement of foraging individuals or decreased foraging success and have impacts on some prey species (Cook and Burton 2010). However, impacts would be temporary and localized, and no individual fitness or population-level impacts would be expected to occur because birds would be expected to successfully forage in adjacent areas not affected by increased suspended sediments. Migrating birds that are not actively foraging would not be affected. Similar impacts, but at a lesser scale, are expected for maintenance activities.

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

Aircraft flying at low altitudes may cause birds to flush, resulting in increased energy expenditure though many species have been shown to habituate to the noise and exhibit no effects on reproductive success (Black et al. 1984; Andersen et al. 1986; Conomy et al. 1998). Disturbance to birds would be temporary and localized, with impacts dissipating once the aircraft has left the area. No individual or population-level effects on birds would be expected.

During pile-driving activities, noise transmitted through water could temporarily displace diving birds in a limited space around each pile and could cause short-term stress and behavioral changes ranging from mild annoyance to escape behavior (Turnpenny and Nedwell 1994). Vessel noise could also disturb some individual diving birds, but they would acclimate to the noise or move away due to their restricted hearing range relative to ship noise (Dooling and Popper 2007), potentially resulting in temporary displacement. Collectively, these noise sources would be temporary and localized, resulting in a minor impact on these birds.

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on birds through fish aggregation and the associated increase in foraging opportunities, as well as entanglement and gear loss/damage, migration disturbances, and WTG strikes and displacement. These impacts may arise from buoys, meteorological towers, foundations, scour/cable protections, and transmission cable infrastructure. BOEM anticipates that structures would be added intermittently from 2023 through 2030 (Appendix F, Attachment 2, Table F2-1) and that they would remain until conceptual decommissioning of each facility is complete, approximately 33 years following construction.

The primary threat to birds from the presence of structures would be from collision with WTGs. As discussed above, the Atlantic Flyway is an important migratory pathway for up to 164 species of waterbirds (58 pelagic species and 105 species using bays, coastlines, and nearshore environments), and a similar number of land bird species, with the greatest volume of birds using the Atlantic Flyway during annual migrations between wintering and breeding grounds (Watts 2010). However, the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (COP, Appendix O-1; Dominion Energy 2022; BOEM 2015, 2021b, 2021c). Of these 58 waterbird species occurring on the Atlantic OCS from Florida to Maine, 47 taxa have sufficient survey data to calculate the modeled percentage of a species population that would overlap with the anticipated offshore wind development on the OCS (Winship et al. 2018); the relative seasonal exposure is generally very low, with the highest percentage being 5.2 percent (Winship et al. 2018, Appendix D). BOEM assumes that the 47 species with sufficient data to model the relative distribution and abundance are representative of the 55 taxa that may overlap offshore wind development on the Atlantic OCS.

The primary operational impact on bird resources from offshore wind activities would be collision with rotating turbine blades. In the contiguous United States, bird collisions with operating WTGs are a relatively rare event, with an estimated 140,000 to 328,000 birds killed annually by 44,577 onshore turbines (Loss et al. 2013a). Based on a mortality rate of 6.9 birds per turbine in the eastern United States (Loss et al. 2013a), an estimated 21,459 birds could be killed annually under the No Action Alternative. This represents a worst-case scenario that does not consider mitigating factors such as landscape and weather patterns, or bird species that are expected to occur. The actual mortality rate attributed to bird collisions with operating WTGs would be expected to be much lower. The majority (75 percent) of the documented onshore mortality is composed of bird groups (small passerines, diurnal raptors, doves, pigeons, and upland game birds) that would not frequently encounter offshore WTGs in large numbers. Secondly, factors such as landscape features and weather patterns that influence collision risk are different on the OCS compared to onshore wind facilities. Thirdly, empirical studies suggest that bird fatalities due to collision with offshore turbines is low. Unlike in Europe, offshore wind activities on the Atlantic OCS will be further offshore away from nesting colonies and not placed between large land masses, thus, limiting the likelihood of exposure. Given that the relative density of birds on the OCS is low, relatively few birds are likely to encounter wind turbines (COP, Appendix O-1: Dominion Energy 2022; Normandeau Associates, Inc. 2014; RAP 2015; Northeast Regional Ocean Council 2021).

Additionally, with the proposed 1-nautical mile (1.9-kilometer) spacing between structures associated with offshore wind development and the distribution of these anticipated projects, only a small percentage of bird species migrating over the OCS would encounter WTGs, with most flying above or below spinning turbines (Mizrahi et al. 2010, 2013; Tetra Tech, Inc. 2012; Normandeau Associates, Inc. 2014). Additionally, the spacing between turbines would also permit birds to fly through individual lease areas without changing course or only making minor course corrections to avoid operating WTGs. Any additional flight distances would be trivial when compared with the overall migratory distances traveled by migratory birds. Therefore, impacts would be minor, and no population-level effects would be expected.

The addition of WTGs to the offshore environment could result in increased functional loss of habitat for those bird species with higher displacement sensitivity. However, substantial foraging habitat for resident birds would remain available (Section 3.6, *Benthic Resources*, for information about impacts on benthic habitats). Therefore, impacts would be minor, and no population-level impacts would occur.

In the Northeast and Mid-Atlantic waters, it is estimated that there are 2,570 seabird fatalities through interaction with commercial fishing gear each year; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2018). The addition of new WTGs could also increase the risk of entanglement with fishing gear due to the potential increase in recreational fishing activity around the structures, which could lead to bird injury or mortality. Impacts from fishing gear would be localized; however, the risk of occurrence would remain as long as structures remain. In contrast, abandoned or lost fishing nets from commercial fishing may get tangled with foundations, reducing the chance that abandoned gear would cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013). WTGs and foundations could also increase pelagic productivity in local areas (English et al. 2017; Slavik et al. 2019), and new structures may also create habitat for structure-oriented and/or hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity within the first year or two after construction (English et al. 2017; Causon and Gill 2018; Degraer et al. 2020), indicating that offshore wind farms can generate beneficial long-term impacts on local ecosystems, translating to increased foraging opportunities for individuals of some marine bird species. Therefore, the presence of structures may also result in moderate beneficial impacts for the duration of the Project (Dierschke et al. 2016). For details on the effects of WTGs on benthic habitat and recreational fishing, see Section 3.6 and Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

Traffic: From 1990 to 2020, general aviation accounted for 229,551 bird strikes (Dolbeer et al. 2021). Because aircraft flights associated with offshore wind development are expected to be minimal compared to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic would not be expected to appreciably contribute to overall impacts on birds.

Land disturbance: Onshore construction noise from other human activities could result in localized, minor, and temporary impacts on birds, including avoidance and displacement, though no population-level effects would occur. Onshore land development or port expansion activities could also result in limited loss or fragmentation of nesting and/or foraging habitat for some bird species. However, such minor impacts would be limited in extent, and would not measurably affect bird population abundance or viability as most construction would be expected to generally occur in previously disturbed habitats. Overall, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities.

Climate change: Several sub-IPFs related to climate change, including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, sea-level rise, and increased erosion and sediment deposition, have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing. Section 3.4, *Air Quality*, provides more details on the expected contribution of offshore wind to climate change.

3.7.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, birds would continue to be affected by existing environmental trends and ongoing activities.

Ongoing activities and offshore wind activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion, habitat loss) on birds primarily through accidental releases, anthropogenic noise, presence of structures, and climate change. Ongoing activities, especially interactions with commercial fisheries, anthropogenic light in the coastal environment, and climate change, would be **moderate**. In addition to ongoing activities, the impacts of planned actions other than offshore wind development, including new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and the installation of new structures on the OCS would be **minor**. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** impacts on birds in the geographic analysis area.

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

3.7.4 Relevant Design Parameters and Potential Variances in Impacts

The proposed Project design parameters that would influence the magnitude of the impact on birds are provided in Appendix E, *Project Design Envelope and Maximum-Case Scenario*, and include the following.

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

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

- WTG number, size, and location: The level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to birds.
- Season of construction: The active season for birds in this area is generally during spring and fall migrations. Construction outside of this window would have a lesser impact on birds than construction during the active season.

3.7.5 Impacts of the Proposed Action on Birds

Accidental releases: Some potential for mortality, decreased fitness, and health effects exists due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with the Proposed Action or Alternative A-1 (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016; Roman et al. 2019). The risk of accidental releases under Alternative A-1 would be slightly less than the Proposed Action due to the construction and operation of three fewer WTGs, and, therefore, potential impacts on birds and habitats would be slightly less. However, the difference in potential impacts from accidental releases is anticipated to be negligible when compared to the Proposed Action.

Vessels associated with the Proposed Action or Alternative A-1 could generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris; while operational controls, monitoring equipment, and industry best practices would be applied, accidental losses could occur. All vessels associated with the Proposed Action or Alternative A-1 would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of best management practices proposed for waste management and mitigation of marine debris would be required of Project personnel, reducing the likelihood of occurrence to a very low risk. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time. As such, BOEM expects localized and temporary impacts on birds to constitute a negligible impact. Offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazardous materials exposure. The contribution from offshore wind and the Proposed Action or Alternative A-1 would be a low percentage of the overall spill risk from ongoing activities.

Light: The Proposed Action's incremental contribution of 205 WTGs ranging from 14 MW to 16 MW and three OSSs would all be lit with navigational and FAA hazard lighting. Per BOEM guidance (2021a) and outlined in COP Section 3.5.3 (Dominion Energy 2022), each WTG would be lit in accordance with USCG, FAA, and BOEM requirements; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). However, red-flashing aviation-obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010; Orr et al. 2013). Additionally, marine navigation lighting would consist of multiple flashing-yellow lights on each WTG and on the corners of each OSS. To further reduce impacts on birds, when practicable, Dominion would use lighting technology (e.g., low-intensity strobe lights, flashing red aviation lights) that minimize impacts on birds. As such, BOEM expects impacts to be long term but negligible from lighting. Vessel lights during construction, operations, and conceptual decommissioning would be minimal and likely limited to vessels transiting to and from construction areas. While Alternative A-1 would construct and operate three fewer WTGs than the Proposed Action, the difference in potential impacts on birds from light associated with construction and operations is anticipated to be nominal, and, therefore, BOEM expects impacts to be long term but negligible from lighting when compared to the Proposed Action.

The expected negligible impact of the Proposed Action or Alternative A-1 would not noticeably increase the impacts of light beyond the impacts described under the No Action Alternative (Section 3.7.3, *Impacts of the No Action Alternative on Birds*). Under the expanded planned action scenario, over 3,135 offshore structures would have lights, which would be incrementally added over time beginning in 2023 and continuing through 2030. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021a) guidance.

New cable emplacement and maintenance: The Proposed Action would result in the disturbance of up to 13,243 acres (54 square kilometers) of seafloor via cable installation (including pre-lay grapnel run and cable protection), resulting in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species (COP, Table 4.2-17; Dominion Energy 2022). Alternative A-1 would result in slightly less seafloor disturbance than the Proposed Action due to the construction of three fewer WTGs and associated inter-array cables. Cable emplacement disturbance under the Proposed Action or Alternative A-1 is expected to be temporary and localized to the emplacement corridor. However, individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement. Only negligible impacts on individuals or populations would be expected, given the localized and temporary nature of the potential impacts. Based on the assumptions in the planned activities scenario (Appendix F), no other offshore wind project cable installation has the potential to overlap in time with the Proposed Action or Alternative A-1. Therefore, given the localized nature of these impacts, impacts associated with the emplacement of the Proposed Action or Alternative A-1 export and inter-array cabling would be negligible. Suspended sediment concentrations during activities would be within the range of natural variability for this location.

The expected negligible incremental impact of the Proposed Action or Alternative A-1 combined with the planned actions would result in seafloor disturbance from the offshore export cable and inter-array cables.

Noise: The expected negligible impacts of aircraft, G&G survey, construction, and pile-driving noise associated with the Proposed Action or Alternative A-1 alone would not increase the impacts of noise beyond the impacts described under the No Action Alternative (Section 3.7.3). Effects on onshore and offshore bird species could occur during the construction phase of the Proposed Action or Alternative A-1 because of equipment noise (including pile-driving noise). The pile-driving noise impacts would be minimized and mitigated through a combination of soft starts, shut-down procedures, and real-time monitoring systems (COP, Section 4.2; Dominion Energy 2022). While Alternative A-1 would result in a slightly reduced duration of noise due to the construction of three fewer WTGs, the difference in potential impacts from noise on birds would be nominal. Vessel and construction noise could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (Black et al.1984; Andersen et al. 1986; Conomy et al. 1998; BOEM 2012).

Onshore construction for the Proposed Action and Alternative A-1 could also disturb birds. Noise associated with use of DSPT for the installation of the offshore export cables to the cable landing location would result in temporary noise impacts from installation of the cofferdam, from DSPT in the sea-to-shore transition, and at beach work areas, and could result in temporary, localized disturbance or displacement of birds. Disturbance impacts at the cable landing location would be short term and limited because the landing is located in a proposed parking lot. The onshore export cable predominately follows developed corridors and previously disturbed land to a common location north of Harpers Road. The onshore export cable route would pass through several habitat types, including open space, developed, forested, agricultural, and wetlands (Tables 3.8-2, 3.8-3, and 3.22-3) that may support avian species, resulting in temporary disturbance impacts on birds. From that point, onshore clearing and construction (and associated noise) would be required at the Harpers Switching Station and for the overhead lines from Harpers Switching Station to Fentress Substation, resulting in impacts on varying acreages of wetlands and NLCD land cover classes, as shown in Tables 3.8-2 and 3.22-3. The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the

Harpers Switching Station (BOEM and Dominion Energy 2022). Impacts at the Harpers Switching Station would be on previously developed areas within the Aeropines Golf Club (Section 3.8; Table 3.8-2 and 3.8-3). Interconnection Cable Route Option 1 would culminate at the onshore substation, which would also require land clearing and result in impacts on wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3) and subsequent disturbance impacts on birds. Overall, noise from onshore clearing and construction would be localized and temporary. While the noise could disturb birds, they would likely acclimate to the noise or temporarily move away, potentially from preferred habitats (i.e., wetlands, trees). BOEM expects that no individual fitness or population-level impacts would be expected to occur, resulting in minor impacts on birds from the Proposed Action or Alternative A-1, with no lasting impacts on local breeding populations.

Because only temporary impacts, are expected to occur, BOEM anticipates impacts from the construction and installation of the offshore components to be negligible and impacts from the construction and installation of the onshore components to be minor. Normal operation of the onshore substation would generate localized continuous noise, but BOEM expects negligible associated long-term impacts when considered in the context of the other commercial, agricultural, and industrial noises near the proposed substation. Similar impacts are expected relative to normal operation of the selected switching station as anticipated noise levels would be localized and low, and the Harpers Switching Station is located in an industrial district.

Placement of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, as well as entanglement and fishing gear loss/damage, migration disturbances, and WTG strikes and displacement, are described in detail in Section 3.7.3. The impacts of the Proposed Action or Alternative A-1 alone as a result of the presence of structures would be minor and may include minor beneficial impacts. Due to the anticipated use of flashing red tower lights, the restricted time period of exposure during migration, and a small number of migrants that could cross the WDA, BOEM and USFWS conclude that the effects of the Proposed Action or Alternative A-1 would be negligible for federally listed species (e.g., red knot, piping plover, and roseate tern), the protected bald eagles, and the black-capped petrel, which is a candidate species (COP, Appendix O-1; Dominion Energy 2022). See the Project BA (BOEM 2022) for a complete discussion of the potential collision risk to ESA-listed species as a result of operation of the proposed Project.

As described above and depicted for the Offshore Project area in COP Figure 4.2-8 (Dominion Energy 2022), the Project was sited to minimize impacts on all resources, including birds. Operation of the Proposed Action would result in impacts on some individuals of offshore bird species, and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs and/or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Millman 2016; Fox and Petersen 2019). Dominion Energy would reduce perching opportunities on offshore structures to the extent practicable and, where possible, on the WTGs and OSSs. Impacts under Alternative A-1 would be slightly less than the Proposed Action due to the construction and operation of three fewer WTGs. The predicted activity of bird populations that have a higher sensitivity to collision, as defined by Robinson Willmott et al. (2013), is low in the Offshore Project area during all seasons of the year (COP, Figure 4.2-8 and Appendix O-1; Dominion Energy 2022; BOEM 2015; Winship et al. 2018, Appendix D), suggesting that bird fatalities due to collision are likely to be low. When turbines are present, many birds would avoid the turbine site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid wind turbines by flying above, below, or between them (Plonczkier and Simms 2012; Cook et al. 2018; Skov et al. 2018), and others may take extra precautions to avoid turbines when the turbines are moving (Johnston et al. 2014; Cook et al. 2018). Several species have very high avoidance rates; for example, the northern gannet (*Morus bassanus*), black-legged kittiwake (*Rissa tridactyla*), herring gull (*Larus argentatus*), and great black-backed gull (*Larus marinus*) have measured avoidance rates of at least 99.6 percent (Skov et al. 2018). Dominion Energy performed an exposure assessment to estimate the risk of various offshore bird species encountering the Offshore Project area (COP, Appendix O-1; Dominion Energy 2022). Based on the analysis provided in the assessment, activities occurring in the Lease Area are unlikely to affect the populations of coastal or marine birds because, with the exception of storm-petrels, annual exposure risk for most species is minimal to low; storm-petrels were rated at medium exposure risk. The risk for some species changed with the seasons but generally remained minimal to low, except gannets and loon where risk was medium in the spring. Based on the results of the exposure assessment (COP, Appendix O-1; Dominion Energy 2022), the Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species, with avoidance of marine bird concentration areas resulting in limited exposure or collision potential.

During migration, many bird species, including songbirds, likely fly at heights well above the RSZ (approximately 869 feet [265 meters]) (Mizrahi et al. 2010, 2013; Tetra Tech, Inc. 2012; Normandeau Associates, Inc. 2014). As shown in Robinson Willmott et al. (2013), species with low sensitivity scores include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ. Inclement weather and reduced visibility can cause changes to migration altitudes (Ainley et al. 2015) and could lead to large-scale mortality events (Newton 2007). However, this has not been shown to be the case in studies of offshore wind facilities in Europe, with oversea migration completely, or nearly so, ceasing during inclement weather including fog (Fox et al. 2006; Hüppop et al. 2006; Panuccio et al. 2019). Further, many of these passerine species, while detected on the OCS during migration as part of BOEM's Acoustic/Thermographic Offshore Monitoring project (Normandeau Associates, Inc. 2014), they were documented in relatively low numbers. Further, most carcasses of small migratory songbirds found at land-based wind energy facilities in the northeast were within 7 feet (2 meters) of the turbine towers, suggesting that they are colliding with towers rather than moving turbine blades (Choi et al. 2020); therefore, it is possible that migrating passerines could collide into offshore structures such as the WTG towers and OSSs. Given that the relative density of birds in the OCS is low, avoidance of the WTGs by some birds, and that many passerines fly well above the RSZ, relatively few birds are likely to encounter wind turbines and BOEM expects that no individual fitness or population-level impacts would be expected to occur resulting in moderate impacts on birds from the Proposed Action or Alternative A-1.

The presence and operation of the Project may result in displacement of some waterbirds, waterfowl, seabirds, and phalaropes that use the area for foraging, resting, or nighttime roosting, leading to an effective loss of habitat (COP, Appendix O-1; Dominion Energy 2022; Drewitt and Langston 2006; Petersen et al. 2006; Dierschke et al. 2016; Welcker and Nehls 2016). While the Lease Area would no longer provide foraging opportunities to those species with high displacement sensitivity, suitable foraging habitat exists in the immediate vicinity of the proposed Project and throughout the region. BOEM expects this loss of habitat to be not notable and population-level, long-term impacts resulting from habitat loss would likely be negligible.

Traffic: The expected negligible impacts of aircraft traffic associated with the Proposed Action or Alternative A-1 alone would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative (Section 3.7.3).

Land disturbance: The expected impacts of onshore construction associated with the Proposed Action or Alternative A-1 would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative. Dominion's commitment to the use of DSPT technology to install the offshore export cables under the beach and dune and bring them to shore through a series of conduits would avoid beach habitat for nesting shorebirds. As such, temporary impacts on birds, particularly nesting shorebirds resulting from the landfall location, would be negligible. BOEM could further reduce potential impacts on nesting shorebirds near the cable landfall by implementing the mitigation measure of avoiding the installation of export cable conduits between April 1 and August 31. This would avoid impacts on nesting shorebirds, such as the piping plover. Given that the closest areas of designated critical habitat for piping plovers are located in North Carolina, no effects to designated piping plover critical habitat would be expected to occur as a result of the proposed Project.

Collisions between birds and vehicles or construction equipment have some limited potential to cause mortality. However, these temporary impacts would be negligible because most individuals would avoid the noisy construction areas (Bayne et al. 2008; Goodwin and Shriver 2010; McLaughlin and Kunc 2013). The Proposed Action or Alternative A-1 would require temporary habitat alteration within or adjacent to existing public utility right-of-way. Clearing, grading, and excavations would temporarily alter existing habitat, which is primarily small areas of mixed forest and woody wetland. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for birds or result in masking effects on bird communication for those that remain in the area (Dooling et al. 2019). Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on bird species that frequent this mixed forest and woody wetland ecosystem are not expected to be measurable and, as such, would be considered negligible.

Long-term habitat loss or alteration is expected to result from the Proposed Action or Alternative A-1. Minimal clearing is anticipated as the majority of Onshore Project components (cable landing station, switching station, and substation) are located in previously developed areas and the interconnection cable route would be constructed as an overhead transmission line. These changes would be expected to have a minimal effect on birds because the fragmented forest habitat is common across coastal Virginia. Tree/vegetation clearing would be conducted outside of the breeding season to avoid nesting bird locations to the extent practicable. Under the Proposed Action, Interconnection Cable Route Option 1 would impact various acreages of a variety of habitat types (Tables 3.8-2 and 3.22-3). The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the Harpers Switching Station, and would result in impacts predominantly on previously disturbed habitats within the Aeropines Golf Club (Tables 3.8-2 and 3.22-3; BOEM and Dominion Energy 2022). Interconnection Cable Route Option 1 would culminate at the onshore substation, which is located in an existing developed area and is associated with fragmented habitat; expansion of the parcel would require clearing within forested areas and wetlands (Tables 3.8-2 and 3.22-3), resulting in subsequent impacts on birds through habitat loss/fragmentation. Refer to Sections 3.21, 3.14, and Section 3.22 for additional details of potential impacts on surface waters, land use, and wetlands. No individual fitness or population-level effects would be expected from onshore construction and associated habitat loss/fragmentation. Therefore, BOEM anticipates minor impacts.

Dominion would likely leave onshore facilities in place for future use. There are no plans to disturb the land surface or terrestrial habitat during the course of the Proposed Action or Alternative A-1 conceptual decommissioning. Therefore, onshore temporary impacts of conceptual decommissioning would be negligible.

3.7.5.1 Cumulative Impacts of the Proposed Action

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

The expected negligible to moderate impacts of the Proposed Action or Alternative A-1 alone would not increase beyond the impacts described under the No Action Alternative. Appendix F indicates that there could be 3,135 WTGs in the geographic analysis area. The Proposed Action or Alternative A-1 would add up to 205 WTGs or 202 WTGs, respectively. The structures associated with the Proposed Action or Alternative A-1 and the consequential impacts would remain at least until conceptual decommissioning is complete (33 years). In the context of reasonably foreseeable environmental trends, the combined impacts arising from the presence of structures from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to range from negligible to moderate based on the sub-IPFs and may result in moderate beneficial impacts due to the large number of structures. A majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action, because the Proposed Action would account for approximately 6.6 percent (205 of 3,135 WTGs) of the new WTGs on the Atlantic OCS.

The cumulative impacts on birds would likely be moderate because, although bird abundance on the OCS is low, there could be unavoidable impacts offshore and onshore; however, BOEM does not anticipate the impacts to result in population-level effects or threaten overall habitat function. In the context of reasonably foreseeable environmental trends, the Proposed Action would not contribute substantially to the cumulative accidental releases, light, new cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance impacts on birds.

3.7.5.2 Conclusions

Impacts of the Proposed Action. Project construction and installation and conceptual decommissioning would introduce noise, lighting, human activity, debris and contaminants, and new structures and vessels (increasing potential collision risk) to the geographic analysis area, as well as alter existing bird habitat affecting birds to varying degrees depending on the location, timing, and species affected by an activity. Some species of birds migrating through the Lease Area have the potential to be disturbed or displaced temporarily during construction and operation of the offshore wind facilities. Onshore, permanent habitat loss/fragmentation and conversion would occur and include wetland areas of high ecological value; onshore conceptual decommissioning is not likely to have a noticeable effect but would require further evaluation at the Project’s conceptual decommissioning. Noise, lighting, and human activity impacts from Project O&M would occur, although at lower levels than those produced during construction and conceptual decommissioning. Offshore structures would also represent a long-term collision risk, although that risk is low. BOEM anticipates the impacts resulting from the Proposed Action or Alternative A-1 alone would range from **negligible** to **moderate**. Therefore, BOEM expects the overall impact on birds from the Proposed Action or Alternative A-1 alone to be **moderate** because the effects would be small, no population-level effects are expected, and the resource would be expected to recover completely without remedial or mitigating action.

Cumulative Impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action or Alternative A-1, would range from **negligible** to **moderate**, but could include **moderate beneficial** impacts. Considering all of the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1 would result in **moderate** impacts on birds in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and the potential for direct mortality resulting from fatal interactions with operating WTGs associated with the expanded planned action scenario. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures. Therefore, the overall impacts on birds would likely qualify as **moderate** because a notable and measurable impact is anticipated, but birds would likely recover completely when the WTGs are removed and/or remedial or mitigating actions are taken.

3.7.6 Impacts of Alternatives B and C on Birds

Impacts of Alternatives B and C. With the exception of the number and size of WTGs, the impacts of construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternatives B and C would be similar to those described under the Proposed Action. IPFs associated with the construction and installation of up to 176 WTGs under Alternative B (each 14 MW) and up to 172 WTGs under Alternative C (each 14 MW), including accidental releases, pile-driving noise, temporary avoidance and displacement, turbidity, and sediment deposition, would be decreased by approximately 14 percent under Alternative B and up to approximately 16 percent under Alternative C when compared to the Proposed Action.

Although there is some correlative evidence from inland studies that bird mortality increases with tower height (Barclay et al. 2007; Thaxter et al. 2017), Thaxter et al. (2017) showed that deploying a smaller number of large turbines with greater energy output reduced total collision risk per unit energy output. Therefore, fewer WTGs may allow greater opportunity for birds to avoid WTGs. Overall, the expected moderate impacts on birds would not be materially different than those described under the Proposed Action. The use of smaller 14 MW WTGs under Alternatives B and C may have some potential to decrease collision risk based on studies of terrestrial wind facilities (Barclay et al. 2007), and use of fewer WTGs in Alternatives B and C may also decrease collision risk compared to the Proposed Action (Johnston et al. 2014; Thaxter et al. 2017). Functional habitat loss to those species populations with higher displacement sensitivity would also be slightly smaller due to the reduced Project area. More recent research indicates that avian mortality rate is correlated with the amount of energy produced (a metric that accounts for both turbine size and operating time), rather than simply the size or spacing, indicating the need for additional research (Huso et al. 2021). Nevertheless, the overall expected moderate impacts and potential moderate beneficial impacts on birds would not be expected to be materially different for Alternatives B and C than those described under the Proposed Action.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.7.6.1 Conclusions

Impacts of Alternatives B and C. Although Alternatives B and C would decrease the number and potential size of WTGs, which would have an associated decrease in potential collision risk, BOEM expects that the impacts resulting from Alternatives B and C would be similar to the Proposed Action and would range from temporary to long term with individual IPFs leading to impacts ranging from **negligible** to **moderate** with **minor beneficial** impacts and with overall impacts being moderate.

Cumulative Impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on birds from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action, with individual IPFs leading to impacts ranging from **negligible** to **moderate** and potentially **moderate beneficial** impacts. While Alternatives B and C may be slightly less impactful to birds due to the reduction in number and potential size of WTGs than described under the Proposed Action, the overall impacts of these alternatives on birds would be the same as under the Proposed Action and would remain **moderate**. This impact rating is driven primarily by ongoing activities, such as climate change, as well as the presence of operating WTGs on the OCS. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.7.7 Impacts of Alternative D on Birds

Impacts of Alternative D. All offshore components of Alternative D are the same as the Proposed Action (205 WTGs and 3 OSSs) and impacts on birds from the Offshore Project components would be the same as evaluated under the Proposed Action. Onshore, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same.

In contrast to the Proposed Action, Alternative D-2 involves approval of only Hybrid Interconnection Cable Route Option 6 (Alternative D-2), which would be approximately 14.2 miles (22.8 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods including open trench, micro tunneling, and HDD. The route would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation (Fentress).

Noise and land disturbance from onshore construction activities of Interconnection Cable Route Option 6 would result in behavioral and habitat loss/fragmentation impacts on birds as a result of temporary disturbance and clearing of a total of 77.16 acres (31.23 hectares) of NLCD land cover classes (Tables 3.8-4 and 3.8-5) whereas the Proposed Action would result in impacts on a total of 77.24 acres (31.26 hectares) (Tables 3.8-2 and 3.8-3). While the NLCD does include wetland land cover classes, refer to Section 3.22 (Table 3.22-4) for wetland impacts on the Onshore Project components based on wetland delineation survey data. Approximately 76 percent of Interconnection Cable Route Option 1 (Proposed Action) and 70 percent of Interconnection Cable Route Option 6 (Alternative D-2) would be collocated with existing linear development. The Chicory Switching Station (Interconnection Cable Route Option 6) is in an area identified as general ecological integrity (C5), and would be built within a forested parcel, with potential for habitat loss/fragmentation for birds due to tree clearing within multiple forest NLCD land cover classes (Table 3.8-4). The Chicory Switching Station would have a footprint of 35.5 acres (14.4 hectares) but would result in a greater area of impact on undeveloped NLCD land cover classes than the Harpers Switching Station, which would be located entirely within the existing Aeropines Golf Club. Overall, impacts at the Chicory Switching Station (Alternative D-2) would predominantly occur on previously undisturbed forest/wetland habitats (Tables 3.8-4 and 3.8-5), whereas impacts at the Harpers Switching Station (Proposed Action) would be on portions of developed areas (Tables 3.8-2 and 3.8-3). Similar to the Proposed Action, impacts associated with onshore clearing and construction would be localized and temporary. While Alternative D-2 would result in a slight increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates the difference in potential impacts on birds would be nominal.

The impacts resulting from noise and land disturbance under Alternative D-1would be the same as those described under the Proposed Action. Alternative D-2 would have a slightly increased potential to permanently affect forested and wetland habitats when compared to the Proposed Action. As described for the Proposed Action, and based on wetland and NLCD cover class mapping, Alternative D-1 (Interconnection Cable Route Option 1) would have the least potential to permanently affect forested and wetland habitats as compared to Alternative D-2 (Hybrid Interconnection Cable Route Option 6). No individual fitness or population-level effects would be expected from onshore construction and associated loss/fragmentation of foraging associated with Alternative D-1 or D-2, and as a result, BOEM anticipates minor impacts. While Alternative D-2 would result in an increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates impacts of Alternative D-1 or D-2 to be similar on birds to those described under the Proposed Action: negligible to moderate impacts with overall moderate impacts on birds.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.7.7.1 Conclusions

Impacts of Alternative D. The Proposed Action only considers Interconnection Cable Route Option 1 while Alternatives D-1 and D-2 consider Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2). BOEM anticipates the impacts on birds resulting from Alternative D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be slightly greater than under the Proposed Action due to construction and clearing occurring on a larger area of undisturbed forest/wetland habitats; however, the impacts are not expected to change under Alternatives D-1 or D-2 relative to the Proposed Action. Impacts on birds would result in the same impacts on birds as those of the Proposed Action and would remain **moderate** with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternatives D-1 or D-2, would be the same as those described under the Proposed Action, ranging from temporary to long term (with individual IPFs leading to impacts ranging from **negligible** to **moderate** but that could include **moderate beneficial** impacts). The overall impacts on birds of ongoing and planned actions, including Alternative D-1 or D-2, would be the same as those under the Proposed Action, with impacts remaining **moderate**. This impact rating is driven primarily by ongoing activities, such as climate change, as well as the presence of operating WTGs on the OCS. As described for the Proposed Action, Dominion's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.8 Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the Proposed Action, alternatives, and ongoing and planned activities in the coastal habitat and fauna geographic analysis area. Coastal habitat includes flora and fauna within state waters (which extend 3 nautical miles [5.6 kilometers] from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The coastal habitat and fauna geographic analysis area, as shown on Figure 3.8-1, includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the export cable landfalls, onshore export cable routes, the onshore substation, and the connection from the onshore substation to the point of interconnection at the Fentress Substation. BOEM expects the resources in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges.

This section analyzes the affected environment and environmental consequences of the Proposed Action and alternatives on coastal flora and fauna, including special-status species. The affected environment and environmental consequences of Project activities that are within the geographic analysis area and extend into state waters (i.e., HDD for cable landfalls and cable laying within 1 mile [1.6 kilometers] of cable landfalls) are presented in Sections 3.6, *Benthic Resources*; 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.15, *Marine Mammals*; 3.19, *Sea Turtles*; and 3.21, *Water Quality*. Additional information on birds, bats, and wetlands is presented in Section 3.7, *Birds*; Section 3.5, *Bats*; and Section 3.22, *Wetlands*, respectively.

3.8.1 Description of the Affected Environment for Coastal Habitat and Fauna

This section discusses existing coastal habitat and fauna resources in the geographic analysis area, The geographic analysis area for coastal habitat, as described in Appendix F, *Planned Activities Scenario,* Table F-1, includes the coastal shoreline and submerged habitat extending out 3 miles (5 kilometers) (the boundary of state territorial waters of the Commonwealth of Virginia), and the onshore geographic analysis area is shown in Figure 3.8-1.

Detailed descriptions of coastal habitat and fauna occurring in and offshore Virginia can be found in COP Section 4.2.1.2, Section 4.2.2.1, and Appendix U (Dominion Energy 2022). A more detailed discussion of potential impacts on aquatic and marine habitat and fauna is provided in Sections 3.6, *Benthic Resources;* 3.7, *Birds*; 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.15, *Marine Mammals;* 3.19, *Sea Turtles;* 3.21, *Water Quality*, and 3.22, *Wetlands*, of this Draft EIS. In addition, future information on federally listed Threatened and Endangered (T&E) species potentially present in coastal habitat is provided in the BA prepared for the USFWS (BOEM 2022).

3.8.1.1 Coastal Habitat

Shorelines in the geographic analysis area consist of barrier islands, sand spits, beaches, dunes, tidal and non-tidal wetlands, mudflats, and estuaries (Bilkovic et al. 2019). Much of the Virginia shoreline has been altered to some degree due to development, agriculture, vessel and ground traffic, industry, agriculture, beach replenishment, and shore protection activities such as jetties (MMS 2007). One fundamental property of the Virginia coastal zone is that it is composed entirely of unconsolidated sediments, such as sand and silt, with no exposures of bedrock or hard, consolidated sediments (Hobbs 2008). Consequently, sedimentary processes (i.e., erosion, transport, and deposition) are active on timescales of minutes to millennia and are constantly reshaping the coast. There is no record of submerged aquatic vegetation habitats along Virginia Beach. Rates of local sea level rise in the Atlantic Coastal Plain, especially in the Chesapeake Bay region, are greater than the global average, and ecosystems adjacent to the Chesapeake Bay are already heavily degraded and vulnerable to climate related impacts. Global sea level is conservatively projected to rise by at least 1 foot above 2000 levels by 2100 (Cassotta et al. 2019), whereas sea level in Chesapeake Bay is predicted to rise another 1.3 to 5.2 feet [0.4 to 1.6 meters] over the next 100 years (Chesapeake Bay Program 2020). Sea level rise in the mid-Atlantic region may cause flooding and erosion that could affect coastal infrastructure including ports and harbors (EPA 2009).

Submerged habitats seaward to 3 miles (5 kilometers) from the shoreline are representative of the Mid-Atlantic Bight with primarily soft-bottom sediments characterized as fine sand punctuated by gravel and silt/sand mixes (Steimle and Zetlin 2000). Within the offshore export cable route corridor, substrates are typically fine- to medium-grain sand, with some gravel and small sand ridges and waves no higher than 8.2 feet (2.5 meters) in the deeper portions. No hard-bottom habitats were observed or detected within the offshore survey area (COP, Appendix D; Dominion Energy 2022).

3.8.1.2 Land Cover

Land use within and adjacent to the Onshore Project area was assessed using the 2016 NLCD. NLCD land cover classifications for the entire Onshore Project area and vicinity are shown on COP Figure 4.2-6 (Section 4.2; Dominion Energy 2022; BOEM and Dominion Energy 2022). The NLCD demonstrates that the northeastern portion of the Onshore Project area is composed predominantly of urban developed areas, with agricultural lands dedicated to cultivated crops becoming increasingly more frequent to the southwest. Large swathes of woody wetlands associated with the Chesapeake Albemarle Canal, Gum Swamp, Northwest River, Pocaty River, and West Neck Creek also are present. Temporary and permanent impacts of each onshore component to NLCD land cover classes are provided in Table 3.8-2.

The Virginia Department of Conservation and Recreation Division of Natural Heritage (VDCR-DNH) Program performed a Virginia Natural Landscape Assessment in 2017, which used NLCD to identify large patches of natural land with at least 100 acres (41 hectares) of interior cover, and small patches with 10–99 acres (4–40 hectares) of interior cover, identified as “ecological cores.” The ecological cores were ranked using a variety of parameters into five categories representing ecological integrity. Ecological core areas of all rankings may occur within the Onshore Project area (VDCR-DNH 2018a). Locations ranked as C1, C2, and C3 generally correspond with various significant natural heritage communities. Locations ranked as C4 and C5 correlate to areas of moderate and general ecological integrity, respectively. The North Landing River and surrounding wetland communities are ranked C1; lower West Neck Creek and surrounding wetland communities on the east side of the North Landing River are ranked C2; Gum Swamp and surrounding wetland communities to the north and south of the Chesapeake Albemarle Canal are ranked C2 (east side) and C3 (west side); and the Pocaty River and adjacent wetland communities are ranked C3, as are the upper sections of West Neck Creek. Temporary and permanent impacts of each onshore component to ecological core areas are provided in Table 3.8-3.

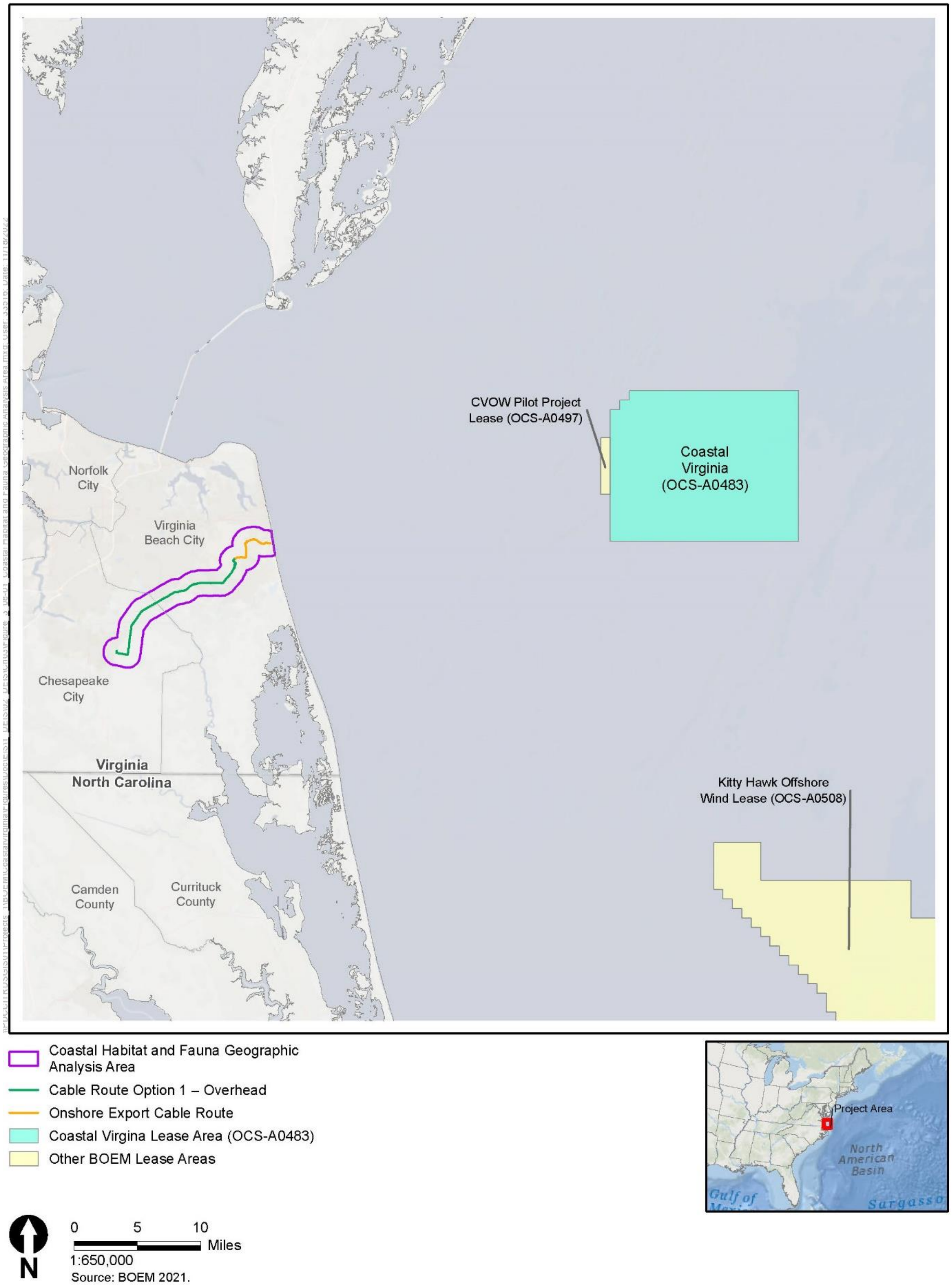


Figure 3.8-1 Onshore Coastal Habitat and Fauna Geographic Analysis Area

3.8.1.3 Terrestrial Flora and Fauna

Terrestrial vegetation and wildlife are discussed in COP Section 4.2.2 (Dominion Energy 2022). Vegetation can be found in urban areas, agricultural areas, and natural areas. Urban vegetation within the Onshore Project area consists predominantly of mowed/maintained turf areas, roadside and median landscape trees and shrubs, and mixed shrubs and herbaceous vegetation typical of disturbed easements. Active and fallow agricultural fields are common throughout the rural areas within and surrounding the Onshore Project area. Active fields in the area are most commonly used for cultivating commercial crops such as soybean, cotton, corn, and wheat. Vegetation in natural areas in or around the Onshore Project area consists predominantly of mixed forested uplands, wetlands typical of the region, and freshwater tidal marshes. Dominant vegetation typically includes species such as red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), willow oak (*Quercus phellos*), loblolly pine (*Pinus taeda*), bald cypress (*Taxodium distichum*), tulip poplar (*Liriodendron tulipifera*), and wax myrtle (*Morella cerifera*) (COP, Section 4.2.2.1; Dominion Energy 2022). Notable natural habitats and/or rare natural communities (as defined by VDCR-DNH [2018a]) are located within or adjacent to the Onshore Project components. These include areas of the North Landing River, Gum Swamp, Pocaty River, and West Neck Creek (COP, Section 4.2.2.1; Dominion Energy 2022).

Terrestrial wildlife within the developed areas of the Onshore Project area may typically consist of species adapted to living in urban environments. These species are commonly encountered in previously altered landscapes prone to noise, lights, and other disturbances. The most common interactions with urban wildlife reported to VDWR generally involve fur-bearing mammals, including fox (*Vulpes* and *Urocyon cinereoargenteus*), raccoon (*Procyon lotor),* coyote (*Canis latrans*), bobcat (*Lynx rufus*), skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), beaver (*Castor canadensis*), weasel (*Mustela* spp.), mink (*Neovison vison*), nutria (*Myocastor coypus*), and muskrat (*Ondatra zibethicus*) (COP, Section 4.2.2.1; Dominion Energy 2022).

Portions of the Onshore Project area cross large contiguous forested wetland areas that also may provide valuable habitat for various species of insects, reptiles, amphibians, birds, and mammals. Fur-bearing mammals such as beaver, black bear (*Ursus americanus*), bobcat, river otter (*Lontra canadensis*), mink, common muskrat, and other small mammals are known to occur regionally (Chesapeake Bay Program 2020). Additional mammals known to occur at the Back Bay National Wildlife Refuge, which is located east of the Onshore Project area, include eastern cottontail (*Sylvilagus floridanus*), marsh rabbit (*Sylvilagus palustris*), white-tailed deer (*Odocoileus virginianus*), gray squirrel (*Sciurus carolinensis*), rice rat (*Oryzomys palustris*), and a variety of mice, voles, shrews, and bats (COP, Section 4.2.2.1; Dominion Energy 2022).

3.8.1.4 Exemplary Natural Communities and Rare, Threatened and Endangered Terrestrial Species

The VDCR-DNH Program manages an inventory of exemplary natural communities as well as rare T&E plant and animal species across the Commonwealth of Virginia. The relative density of these natural heritage resources, or elemental occurrences, in Virginia Beach has been found by VDCR- DNH to be very high, and the relative density in the city of Chesapeake has been found to be high (VDCR- DNH 2018b). This high diversity is associated with the mosaic of large undisturbed wetland habitats that spread contiguously across the two cities (COP, Section 4.2.2; Dominion Energy 2022).

3.8.1.5 Coastal Fauna

Coastal habitat including beaches and dunes provide habitats for many different types of fauna and flora. Sea turtles are commonly found off the shores of Virginia Beach with loggerhead sea turtle (*Caretta caretta*) as the primary species that has been documented nesting in Virginia (Parker 2020); there has been a single green turtle nest observed in Virginia in 2005 and two Kemp's ridley nests observed in 2012 and 2014. Most of the turtles in the area are most likely migrating or foraging and spending the majority of their time below the surface rather than on the beach.

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

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

Three species of federally T&E species of birds can occur onshore and in coastal and marine waters offshore Virginia Beach during part of the year. The northeastern U.S. population of the roseate tern (*Sterna dougallii dougallii*) is listed as Endangered, and the piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) are listed as Threatened. These species use coastal habitat including beaches, marshes, and intertidal wetlands (Section 3.7, *Birds*).

Coastal habitat and fauna in the geographic analysis area are subject to pressure from ongoing activities, generally associated with onshore development activities, military uses, and climate change. Potential impacts from these activities have the potential to cause mortality, alter habitat and vegetation, encroach with structures, generate noise, cause accidental releases, affect water quality, and influence sea level rise. Sandy beaches in the geographic analysis area are subject to erosion and vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015) including ocean acidification and ocean warming. Coastal habitat and fauna would be expected to decline in line with current trends related to the effects of climate change. If sea levels rise approximately 2 feet (0.6 meter) by the end of the century, over 167,000 acres (67,582 hectares) of undeveloped dry land and approximately 161,000 acres (65,154 hectares) of brackish marsh would be lost, replaced in part by over 266,000 acres (107,646 hectares) of newly open water and 50,000 acres (20,234 hectares) of saltmarsh; ocean and estuarine beaches also fare poorly, declining by 58 and 69 percent, respectively, by 2100 (Glick et al. 2008).

Onshore development activities and associated impacts are expected to continue at current trends and have the potential to result in impacts on coastal habitat and fauna. Mainland coastal habitat in the geographic analysis area for coastal habitat and fauna mostly consists of sandy beach and dune vegetation; much of this is developed for the public beach and private residences. Any new structures along the coast, including developments, roads, utilities, marinas and ports, and shoreline protection measures, are anticipated to increase incrementally over the next 37 years, altering coastal habitat. Development is likely to continue as resident and vacationer populations expand. Noise generated from ongoing onshore construction of commercial and residential developments and at military installations is a frequent occurrence in the coastal habitat. Noise generated from construction nearshore is expected to gradually increase over the next 37 years in line with human population growth along the coast of the geographic analysis area.

If the Project is not approved, then impacts from the proposed Project (Section 3.8.2, *Environmental Consequences*) would not occur. Impacts from ongoing, future non-offshore wind, and offshore wind activities would likely still occur resulting in similar impacts on coastal habitat and fauna, but the nature and extent of the impacts would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area.

3.8.2 Environmental Consequences

3.8.2.1 Impact Level Definitions for Coastal Habitat and Fauna

Definitions of impact levels are provided in Table 3.8-1 . There are no beneficial impacts on coastal habitat and fauna.

Table 3.8-1 Impact Level Definitions for Coastal Habitat and Fauna

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

3.8.3 Impacts of the No Action Alternative on Coastal Habitat and Fauna

When analyzing the impacts of the No Action Alternative on coastal habitat and fauna, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind activities and ongoing offshore wind activities on the baseline conditions for coastal habitat and fauna. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.8.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for coastal habitat and fauna described in Section 3.8.1, *Description of the Affected Environment for Coastal Habitat and Fauna*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing offshore wind and non-offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on coastal habitat and fauna are generally associated with onshore impacts, including onshore residential, commercial, and industrial development, and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect coastal flora and fauna through temporary and permanent habitat removal or conversion, temporary noise impacts during construction, and lighting, which could cause avoidance behavior and displacement of animals, as well as injury or mortality to individual animals or loss and alteration of vegetation and individual plants. However, population-level effects would not be anticipated. Climate change and associated sea level rise results in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides (Sacatelli et al. 2020). Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive species. Warmer temperatures will cause plants to flower earlier, will not provide needed periods of cold weather, and will likely result in declines in reproductive success of plant and pollinator species. Reptile and amphibian populations may experience shifts in distribution, range, reproductive ecology, and habitat availability. Increased temperatures could lead to changes in mating, nesting, reproductive, and foraging behaviors of species, including a change in the sex ratios in reptiles with temperature-dependent sex determination.

There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on coastal habitat and fauna.

3.8.3.2 Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that may affect coastal habitat and fauna primarily include increasing onshore development activities (see Appendix F, Section F.2 for a description of ongoing and planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on animals and vegetation, including disturbance, displacement, injury, mortality, habitat and plant degradation and loss, and habitat conversion. See Appendix F, Attachment 1, Table F1-5 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for terrestrial and coastal fauna.

Appendix F, Table F-3 depicts future construction of offshore wind projects from Maine to North Carolina. Also included are all of the projects that are currently in various stages of planning within BOEM's offshore leases in the U.S. Exclusive Economic Zone (EEZ) from Massachusetts to North Carolina. A total of 36 offshore wind projects with construction start dates after 2022 are projected, all of which will require a NEPA process with an EIS or EA. However, the only planned offshore wind activities within the geographic analysis area likely to affect coastal habitat and fauna would be those associated with the operation and maintenance of the CVOW-Pilot Project; and site characterization surveys, construction, and operation and maintenance of Avangrid Renewables, LLC – Kitty Hawk Offshore Wind Projects (Appendix F, Tables F-9 and F2-1).

BOEM expects offshore wind activities to affect coastal habitat and fauna through the following primary IPFs.

Accidental releases: Accidental releases may increase as a result of offshore wind activities. Section 3.21, *Water Quality*, discusses the nature of releases anticipated. Accidental releases of fuels, lubricating oils, and other petroleum compounds may increase as a result of offshore wind activities, specifically the Kitty Hawk Offshore Wind Projects. The risk of any type of accidental release would increase primarily during construction, but also could occur during operations and conceptual decommissioning of offshore wind facilities.

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

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

There is no evidence that the anticipated volumes and extents combined with cleanup measures would have measurable impacts on coastal habitat and fauna. See Section 3.21.1, *Description of the Affected Environment for Water Quality*, for quantities and details.

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

EMFs: EMFs continuously emanate from existing telecommunications and electrical power transmission cables. EMFs would emanate from offshore export cables of offshore wind. The Kitty Hawk Wind North and South Projects export cable routes are within Commonwealth of Virginia state waters with a proposed cable landing location on Sandbridge Beach (Virginia Beach). However, potential EMF effects would be reduced by cable shielding and burial to an appropriate depth. The maximum magnetic field expected for an offshore wind energy project’s export cable EMF is about 165 milligauss, dropping to 40 milligauss 3.26 feet (1 meter) above the cable, a decrease in field strength of 76 percent (CSA and Exponent 2019). EMF strength diminishes rapidly with distance, and potentially meaningful EMF would likely extend less than 50 feet (15.2 meters) from each cable (McCormick et al. 2008). Export cables would be buried during installation, shielding the adverse impacts of EMF emissions on coastal fauna. Since EMFs decrease rapidly with distance from the cable, cable burial significantly reduces the extent of impacts from the cable EMF, and the intensity of impacts on coastal habitat would likely be unmeasurable.

Light: Nighttime lighting associated with offshore structures (e.g., the existing CVOW-Pilot Project and the proposed Kitty Hawk Wind North and Kitty Hawk South projects) and navigation and deck lighting on vessels would result in lighting impacts in the geographic analysis area. Light emissions from vessels are expected to continue to increase gradually with increasing marine transportation and vessel traffic over the next 37 years. Lights from offshore wind projects (Kitty Hawk Wind North and Kitty Hawk South) would produce short-term and localized light emissions from vessels transiting and working in nearshore coastal areas; however, this vessel lighting would be intermittent and negligible at a distance of 20 miles (32 kilometers) from the geographic analysis area. The extent of impacts would likely be limited to the immediate vicinity of the vessels, and the intensity of impacts on coastal habitat would likely be unmeasurable.

New cable emplacement and maintenance: New cable emplacement and maintenance would result from offshore wind projects (the Kitty Hawk Wind North and South Projects and existing CVOW-Pilot Project). Maintenance activities for offshore transmission and telecommunications cables would infrequently disturb bottom sediments; these disturbances are local and limited to the areas of cable repair within the emplacement corridor. The proposed ocean-to-land cable transition at the landfall for the Kitty Hawk Wind North (parking lot at Sandbridge Beach, Virginia) and South (City of Virginia Beach, Virginia, and Dare, Carteret and Craven Counties in North Carolina) will be installed using HDD, which will avoid or minimize impacts on the beach, intertidal zone, and nearshore areas and achieve a burial significantly deeper than any expected erosion (Kitty Hawk North COP Chapter 3, *Description of Proposed Activity*; Avangrid Renewables 2021; Kitty Hawk South COP Chapter 3, *Description of Proposed Activity*).

The cable landing location for the CVOW-Pilot Project is located within the State Military Reservation along Rifle Ridge Road (adjacent Camp Pendleton Beach). Maintenance of the export cable within coastal habitat for the CVOW-Pilot Project may infrequently disturb bottom sediments but would be localized and limited to the areas of cable repair within the emplacement corridor.

Noise: Noise generated from offshore wind activities (Kitty Hawk Wind North and South Projects) would not likely produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area. The intensity and extent of noise from construction is difficult to generalize but impacts on coastal fauna would be temporary and localized, as the land-based construction noise is likely sufficient to drive away local motile fauna such as wading birds from the immediate area.

G&G surveys and scientific surveys are proposed for the Kitty Hawk Wind North and South Projects and for the CVOW-Pilot Project. The intensity and extent of the resulting noise impacts on coastal fauna are difficult to generalize but would be temporary and localized. These site characterization surveys and scientific surveys are anticipated to occur infrequently over the next 37 years. High-resolution geophysical surveys employed during site characterization (shallow and medium-penetration sub-bottom profilers, side-scan sonar, multibeam echosounder, and magnetometer) technologies generate sound waves that are similar to common deep-water echosounders. Impacts from vessel and equipment noise, including geotechnical sampling (e.g., coring), are expected to be unmeasurable. Noise generated from G&G activities associated with offshore wind activities (Kitty Hawk Wind North and South Projects) would not produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area. G&G surveys of cable routes in nearshore coastal habitat would be performed intermittently over the assumed 4-year construction period. The intensity and extent of the resulting noise impacts on coastal fauna from G&G surveys are difficult to generalize but would likely be temporary and localized.

Noise from pile driving would not occur in nearshore areas as part of offshore wind construction projects. Noise generated from pile driving associated with offshore wind activities (Kitty Hawk Wind North and South Projects) would not produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area.

Noise generated from installation and trenching of offshore export cables associated with offshore wind activities (Kitty Hawk Wind North and South Projects) would not likely produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area. The noise generated from installation and trenching would be temporary and localized and would extend only a short distance beyond the emplacement corridor.

Presence of structures: Offshore wind activities (Kitty Hawk Wind North and South Projects) would not include the construction of any aboveground structures within coastal habitat (Kitty Hawk Wind North and South COP Chapter 3: Avangrid Renewables 2021). These existing structures may or may not alter the function of the coastal habitat. The result of the habitat conversion is either habitat loss or creation an artificial reef effect, attracting a different community of organisms.

Offshore wind activities (Kitty Hawk Wind North and South Projects) conservatively estimate that up to 8 percent of the offshore export cable route will require additional cable protection. This translates into approximately 9.5 acres (38,445 square meters) of seabed disturbance under the maximum design scenario (Kitty Hawk COP Chapter 3; Avangrid Renewables 2021). Where cables are buried deeply enough that protection is not used, presence of the cable has no impact on coastal habitat.

Land disturbance: Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but usually not to a degree that affects coastal fauna, assuming that industry standard best management practices are implemented. Land disturbance from erosion and sedimentation associated with offshore wind activities (Kitty Hawk Wind North and South Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 7 miles (11 kilometers) from the geographic analysis area.

Land disturbance from onshore construction associated with offshore wind activities (Kitty Hawk Wind North and South Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 7 miles (11 kilometers) from the geographic analysis area.

Land disturbances related to the onshore construction of facilities associated with offshore wind projects periodically cause removal of vegetation and conversion of natural coastal habitat to developed space. These land use changes are a frequent occurrence in coastal habitat. Land disturbance that results in onshore land use changes associated with offshore wind activities (Kitty Hawk Wind North and South Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at distance of 7 miles (11 kilometers) from the geographic analysis area.

Seabed profile alterations: Seabed profile alterations associated with offshore wind activities can result in temporary and localized impacts on coastal habitat. These activities typically occur in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance (Wilber and Clarke 2007). Therefore, such impacts, while locally intense, would have an unmeasurable effect on the general character of coastal habitat. Seabed profile alterations associated with offshore wind activities (Kitty Hawk Wind North and South Projects) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 20 miles (32 kilometers) from the geographic impact analysis area.

Sediment deposition and burial: Sediment deposition and burial during offshore wind activities results in fine sediment deposition in coastal habitat. Sediment deposition can result in adverse impacts on coastal habitat, including smothering. Benthic organisms' tolerance to being covered by sediment (sedimentation) varies among species (Section 3.6, *Benthic Resources*). The level of impact from sediment deposition and burial could depend on the time of year that it occurs, especially if it overlaps with times and places of high benthic organism abundance. Maintenance of existing submarine cables also infrequently disturbs bottom sediments; these disturbances are local and limited to the areas of repair within the emplacement corridor. Seabed deposition and burial resulting from installation of export cables associated with offshore wind activities (Kitty Hawk Wind North and South Projects) would not produce water quality or turbidity impacts on coastal habitat and fauna that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area.

Climate change: Human accelerated climate change, influenced in part by GHG emissions, is expected to continue to contribute to a widespread loss of shoreline habitat from rising seas and erosion. Ocean acidification caused by atmospheric CO_2 may contribute to reduced growth or the decline of reefs and other habitats formed by shells. Warming, sea level rise, and altered habitat/ecology could also affect coastal habitat and fauna. Because climate change is a global phenomenon, impacts on coastal habitat and fauna resources would be practically the same in the expanded planned action scenario as they would be with only ongoing activities. See Section 3.4, *Air Quality*, for details on the expected contribution of offshore wind development to climate change.

3.8.3.3 Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that may affect coastal habitat and fauna include increasing onshore construction and the infrequent installation of new structures on the OCS (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). These activities may result in temporary and permanent onshore habitat impacts. See Appendix F, Attachment 1, Table F1-2 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for coastal habitats and fauna.

3.8.3.4 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, coastal habitat and fauna would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continued temporary and permanent impacts on coastal habitat and fauna. Coastal habitat and fauna would continue to be subject to current regional development and encroachment pressures, and impacts are anticipated to gradually increase over the next 30 years in line with human population growth along the coast of the geographic analysis area. The impacts of ongoing activities, especially climate change, new cable emplacement and maintenance, and land disturbance, would be **moderate**, as climate change is predicted to cause notable impacts to coastal habitat. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** impacts on coastal habitat and fauna in the geographic analysis area.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and coastal habitat and fauna would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on coastal habitat and fauna due to habitat loss from increased onshore construction.

Considering all of the IPFs and due to the extent and distance away from the Proposed Action, the impacts on coastal habitat and fauna of offshore wind activities would be **negligible**. The overall impacts associated with offshore wind activities in the geographic analysis area would generally result in **negligible** adverse impacts on coastal habitat and fauna. Offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures, namely cable protection, but would occur over 20 miles (32 kilometers) away and would not overlap with impacts in the geographic analysis area of the Proposed Action.

3.8.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The routing variants within the selected export cable corridor, which could require the disturbance of coastal habitat and cable landing location.
- The total amount of long-term habitat alteration from offshore export cable and associated cable-protection measures.
- The total amount of habitat temporarily altered by construction and operation of onshore facilities (within coastal zone), and installation method of the export cables.
- The extent of pre-cable-laying operations (pre-lay grapnel run, sandwave removal, and boulder removal), if any, and its location.

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

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

3.8.5 Impacts of the Proposed Action on Coastal Habitat and Fauna

The construction, operation, maintenance, and conceptual decommissioning of the offshore export cable would be the same under the Proposed Action or Alternative A-1 and would occur within the geographic analysis area for coastal habitat and fauna (Figure 3.8-1).

Maximum potential short-term and long-term habitat disturbances by the Proposed Action are presented in the COP (Tables 4.2-6, 4.2-7, and 4.2-17; Dominion Energy 2022).

Accidental releases: The Proposed Action would increase the risk of accidental releases of fuels, lubricating oils, and other petroleum compounds, primarily during construction but also during operations and conceptual decommissioning. The risk of spills under Alternative A-1 would be slightly less than under the Proposed Action due to the construction and operation of three fewer WTGs, and, therefore, potential impacts on coastal habitat and fauna would be slightly less. However, the difference in potential impacts from accidental releases is anticipated to be negligible when compared to the Proposed Action. Accidental releases of fuel, fluids, or hazardous materials nearshore may cause habitat contamination from releases and/or cleanup activities and harm to the species that build biogenic coastal habitat. Accidental releases of chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach nearshore coastal habitat. Larger spills, though unlikely, could have larger impacts on coastal habitat and fauna due to adverse impacts on water quality (Appendix F, Attachment 1, Table F1-3). Onshore, the use of heavy construction equipment could result in releases of fuel and lubricating and hydraulic oils during equipment use or refueling. As such, the potential accidental releases would be low and of small quantity, and combined with the cleanup measures in place, the impacts of accidental releases of fuel, fluids and hazmat on coastal habitat and fauna are expected to be minor.

Trash and debris may be released from vessels primarily during construction of the Proposed Action or Alternative A-1 but also during operations and conceptual decommissioning. All vessels would be required to comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of Project activities. There is a higher likelihood of trash and debris from nearshore Project activities (e.g., transmission cable installation, transportation of equipment and personnel to and from ports). However, there does not appear to be evidence that the volumes and extents anticipated would have any measurable impact on coastal habitat and fauna. Therefore, the expected impacts of trash and marine debris on coastal habitat and fauna would be negligible.

Additionally, construction vessels would comply with USCG regulations and the discharge limits outlined by the Vessel Incidental Discharge Act of 2018. Vessel chemical releases are considered unlikely and would yield only short-term, localized impacts.

Anchoring: Vessel anchoring to assist with positioning and stabilization could occur during survey activities and during the construction, installation, maintenance, and conceptual decommissioning of offshore construction activities. Anchoring could cause temporary turbidity, permanent impacts, or both where anchors and chains meet the seafloor. For the Proposed Action or Alternative A-1, the COP states construction vessels will use spud- or jack-up barges or DP systems (COP, Section 3.4.1.1; Dominion Energy 2022); therefore, the impacts of anchoring on coastal habitat and fauna would be negligible.

EMFs: The Proposed Action would include the installation of nine 230-kV offshore export cables. EMFs would emanate from operating transmission cables within coastal habitat. Alternative A-1 would have slightly less inter-array cabling than the Proposed Action because three fewer WTGs would be constructed; however, EMFs produced under Alternative A-1 are not anticipated to be substantively different than the Proposed Action. Although acknowledging that little is known about potential impacts of EMF on coastal resources, conservative calculations of magnetic-field and induced electric-field levels based on the Project's cable specifications and peak and average load levels indicate that the fields produced by the Project's cables would be below the detection thresholds for magnetosensitive and electrosensitive marine organisms (COP, Appendix AA; Dominion Energy 2022). EMF strength diminishes rapidly with distance, and potentially meaningful EMF would likely extend less than 50 feet (15.2 meters) from each cable (McCormick et al. 2008). EMFs would be further minimized by shielding and by burying the offshore export cables to the target depth of 3.3 to 16.4 feet (1 to 5 meters). Based on the extent and the intensity, the impacts from EMF on coastal fauna would be expected to be negligible.

Light: The Proposed would involve light emissions from vessels transiting and working in nearshore coastal areas. These light emissions would be highly localized and would exist only as long as the lights were in use. While Alternative A-1 would construct and operate three fewer WTGs than the Proposed Action, the difference in potential impact from light associated with construction and operations is anticipated to be negligible. Navigation lights during construction, operations, and conceptual decommissioning would be minimal. Therefore, the impacts of light emissions from vessels on coastal fauna would be negligible.

The Proposed Action or Alternative A-1 would also involve light emissions from construction equipment and operational lighting associated with construction at the cable landing location. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal fauna would likely be unmeasurable at a distance. Therefore, the impacts from light emissions from structures on coastal habitat and fauna would be expected to be negligible.

New cable emplacement and maintenance: Installation of the offshore export cable would be the same for the Proposed Action and Alternative A-1, and HDD or DSPT methods would be used to install the nine 230-kV offshore export cables under the beach and dune and avoid affected sensitive, shallower, nearshore intertidal coastal habitat. Trenchless installation would occur from an offshore trenchless installation punch-out location approximately 730 to 3,280 feet (223 to 1,000 meters) offshore of the cable landing location. The offshore export cables would be brought to shore through a series of conduits at the cable landing location. These conduits would be established at depths ranging from 10 to 125 feet (3 to 38 meters) below grade under the shoreline. The cable landing location would be within a previously disturbed area west of the firing range at State Military Reservation (east of Regulus Avenue and north of Rifle Range Road) adjacent to Camp Pendleton Beach. In addition, construction vehicles would not be driven on the beach or dunes.

Temporary disturbance to the seabed sediment would occur during installation of the offshore export cables. The nine offshore export cables would be installed within corridors ranging in size from approximately 9,400 feet (2,865 meters) down to 1,970 feet (600 meters) wide. The offshore export cables would be buried approximately 3.3 feet (1 meter) to 16.4 feet (5 meters) below stable seabed elevation to minimize the risk of cable exposure or damage. Cable-laying speed of the nearshore cables would be approximately 656 feet per hour (200 meters per hour) (COP, Sections 3.4.1.4 and 3.4.2; Dominion Energy 2022). The offshore export cable route within coastal habitat would run parallel to the CVOW-Pilot Project export cable (in-service since October 2020), as well as cross three in-service telecommunications cable systems (MAREA, BRUSA, and DUNANT). All three of the telecommunications cable systems approach from the east and land at the Croatan Beach parking lot (COP, Section 2.1.1.2: Dominion Energy 2022). The impacts from new cable emplacement and maintenance on coastal habitat and fauna would be expected to be minor.

Operation would require maintenance and inspections (COP, Section 3.5.1; Dominion Energy 2022). The offshore export cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would provide real-time monitoring of temperature along the offshore export cables, alerting Dominion Energy should the temperature changes, which could be the result of scouring of material and cable exposure. Cable repairs, if required, would temporarily affect coastal habitat and fauna in a localized area. Assuming repairs would be infrequent and affecting small sections of the cables, impacts are expected to be minor.

The expected negligible incremental impact of the Proposed Action or Alternative A-1 combined with the planned actions would result in temporary seafloor disturbance from the offshore export cables approach and landing.

Noise: The Proposed Action would generate noise during construction of both onshore and offshore facilities. Onshore construction noise levels would be the same for the Proposed Action and Alternative A-1 and would primarily be limited to daytime hours. The construction sound levels during the trenchless installation operations at the cable landing location could reach 58 decibels (COP, Appendix Y; Dominion Energy 2022). Onshore construction noise and vibration could lead to the disturbance and temporary displacement of mobile species. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for fauna or result in masking effects on communication for fauna that remain in the area (Dooling et al. 2019). However, Dominion Energy states that the results of the underwater acoustic assessment (COP, Appendix Z; Dominion Energy 2022) would be used to inform development of noise mitigation measures that would be applied during construction and operation of the Proposed Action or Alternative A-1, in consultation with BOEM and NMFS to address potential impacts on marine mammals, sea turtles, and fisheries resources from underwater noise, which would include some coastal fauna. Impacts would be short term and occur in the daytime only from onshore construction noise resulting in minor impacts on coastal fauna. Noise generated by construction of the WTGs and OSS are not expected to reach the geographic analysis area; therefore, would have no impact on coastal habitat.

The Proposed Action or Alternative A-1 would produce noise from vibratory pile driving during installation of nearshore cofferdams at the associated offshore trenchless installation punch-out location. In general, vibratory pile driving is less noisy than impact pile driving and would cause temporary and localized acoustic impacts. In-air noise levels from the vibratory pile driving would reach 66 decibels at the nearest onshore receptor (COP, Appendix Y; Dominion Energy 2022). Fish and invertebrates in the nearshore Project area may be directly and indirectly affected by operational noise and vibrations (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). This vibratory pile driving noise impact on coastal fauna is expected to be minor. Noise from offshore pile driving associated with the WTG and OSS platform foundations is not expected to be noticeable in the geographic analysis area and would have no impact on coastal fauna.

Noise from G&G surveys during inspection, monitoring, or both of the offshore export cable may occur during construction and operations. G&G noise resulting from cable route surveys can disturb coastal habitat in the immediate vicinity of the investigation high-resolution geophysical surveys include high-frequency sound sources from medium-penetration sub-bottom profilers (e.g., sparkers, boomers) and shallow-penetration, non-parametric sub-bottom profilers (e.g., Compressed High-Intensity Radiated Pulses) that generate less-intense sound waves than the seismic surveys used for oil and gas exploration that create high-intensity impulsive sound that penetrates deep into the seabed (Erbe and McPherson 2017). Impacts from vessel and equipment noise from these geophysical surveys of cable routes could disturb coastal fauna in the immediate vicinity of the investigation and cause temporary behavioral changes (Sivle et al. 2014). Impacts from vessel and equipment noise, including geotechnical sampling (e.g., coring) are expected to be unmeasurable. The intensity and extent of the resulting noise impacts from G&G surveys are difficult to generalize but would likely be temporary and localized; therefore, the impacts of G&G surveys on coastal fauna would be temporary and minor.

Noise from trenching of offshore export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. The jet plowing method also creates noise. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise would typically be less prominent than the impacts of physical disturbance and sediment suspension. The noise impacts from cable laying or trenching on coastal fauna would be expected to be negligible.

Onshore construction for the Proposed Action and Alternative A-1 could also disturb coastal habitat and fauna. Noise associated with the use of DSPT for the installation of the offshore export cables to the cable landing location would result in temporary noise impacts from installation of the cofferdam, from DSPT in the sea-to-shore transition, and at beach work areas and could result in temporary, localized disturbance or displacement of fauna. Disturbance impacts at the cable landing location would be short term and limited because the landing is located in a proposed parking lot. The onshore export cable predominately follows developed corridors and previously disturbed land to a common location north of Harpers Road. The onshore export cable route would pass through several habitat types, including open space, developed, forested, agricultural, and wetlands (Table 3.8-2 and Table 3.22-3), that support several species resulting in temporary disturbance impacts on coastal habitat and fauna. From that point, onshore clearing and construction (and associated noise) would be required at the Harpers Switching Station and for the overhead lines from Harpers Switching Station to Fentress Substation, resulting in impacts on varying acreages of wetlands and NLCD land cover classes as shown in Table 3.8-2. Onshore clearing and construction would result in disturbance to coastal habitat and fauna at the Harpers Switching Station. The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the Harpers Switching Station (BOEM and Dominion Energy 2022).

Interconnection Cable Route Option 1 would be approximately 14.2 miles (22.9 kilometers) long and would result in approximately 77.24 acres (31.26 hectares) of temporary disturbance to various NLCD land cover classes (Table 3.8-2). While the NLCD does include wetland land cover classes, refer to Section 3.22 (Table 3.22-3) for wetland impacts on the onshore Project components based on wetland delineation survey data. The interconnection cable route would culminate at the onshore substation, which would also require land clearing and result in impacts on various NLCD land cover classes and wetlands (Table 3.8-2 and Table 3.22-3) and related disturbance impacts on fauna and associated habitats. Overall, noise from onshore clearing and construction would be localized and temporary. While the noise could disturb fauna, they would likely acclimate to the noise or temporarily move away, potentially from preferred habitats. BOEM expects that no individual fitness or population-level impacts would be expected to occur, resulting in minor impacts on coastal habitat and fauna from the Proposed Action or Alternative A-1; lasting impacts on local breeding populations are not anticipated.

Because only temporary noise impacts are expected to occur, BOEM anticipates impacts from the construction and installation of the offshore components to be negligible and impacts from the construction and installation of the onshore components to be minor. Normal operation of the onshore substation would generate localized continuous noise, but BOEM expects negligible associated long-term impacts when considered in the context of the other commercial, agricultural, and industrial noises near the proposed substation. Similar impacts are expected relative to normal operation of the selected switching station because anticipated noise levels would be localized and low, and the Harpers Switching Station is located in an industrial district while Chicory Switching Station is located in an agricultural district.

Presence of structures: The Proposed Action or Alterative A-1 would not include the construction of any aboveground structures within coastal habitat; therefore, the impacts of habitat conversions in coastal habitat are expected to be negligible.

Installation of cable protection (dumped rocks, geotextile sand containers, and/or concrete mattresses) atop cables that can create uncommon hard-bottom habitat may be necessary under the Proposed Action. Where cables are buried deeply enough that protection is not used, presence of the cable would have no impact on coastal habitat. Approximately 0.1 percent of the offshore export and inter-array cables would be covered with cable-protection material (dumped rocks, geotextile sand containers, and/or concrete mattresses) to ensure that they remain covered during storms and other events that disturb the seafloor (COP, Section 4.2.4.3; Dominion Energy 2022). Although some of this would occur outside of the geographic analysis area for coastal habitat, cable protection could remain permanently after cable installation. The conversion of soft-bottom habitat to a more reef-like structure would have potential minor beneficial impacts on the surrounding biological community but would also have minor adverse impacts on the soft-bottom coastal habitat and fauna.

Land disturbance: Land disturbance, especially shoreline parcels, can cause short-term erosion and sedimentation impacts in coastal habitat. Altering dune and beach habitat could increase erosion and sedimentation because dune habitat serves as a crucial buffer zone against flooding. The Proposed Action or Alternative A-1 would use DSPT to install the offshore export cables (nine) through a series of conduits under the beach and dune to avoid impacts on these sensitive coastal resources (COP, Section 3.2; Dominion Energy 2022). These conduits would be established at depths ranging from 10 to 125 feet (3 to 38 meters) below grade under the shoreline. The cable landing location would be within a previously disturbed area west of the Firing Range at Sate Military Reservation (east of Regulus Avenue and north of Rifle Range Road) adjacent to Camp Pendleton Beach. In addition, construction vehicles would not be driven on the beach or dunes (COP, Section 3.3.2.1; Dominion Energy 2022). The Proposed Action or Alternative A-1 would include installing erosion control devices in accordance with the Dominion Energy's Erosion and Sediment Control Plan to minimize impacts of erosion and sedimentation on coastal habitat (COP, Sections 3.4.2.3 and 4.1.2.2; Dominion Energy 2022). Therefore, the impacts of erosion and sedimentation on coastal habitat are expected to be negligible.

Land disturbance associated with onshore construction (clearing, grading and excavations), especially shoreline parcels, could cause removal of vegetation, temporary disturbance to adjacent land uses (light, noise, and traffic) and disruption of shoreline access. The Proposed Action or Alternative A-1 would include land disturbance from onshore construction at the cable landing location within coastal habitat. The maximum area of temporary disturbance associated with construction at the cable landing location would be 11.1 acres (4.5 hectares), the maximum temporary workspace at the Nearshore Trenchless Installation Area is approximately 8.8 acres (3.6 hectares), and the maximum temporary workspace at the offshore trenchless installation punch-out would be approximately 80 acres (32.4 hectares) (COP, Section 3.4.2; Dominion Energy 2022; BOEM and Dominion Energy 2022). The final footprint for the cable landing location would be 2.8 acres (1.1 hectares).

Under the Proposed Action and Alternative A-1, Interconnection Cable Route Option 1 would be installed entirely overhead from Harpers Switching Station to the Fentress Substation. Interconnection Cable Route Option 1 passes through a variety of habitat types, including freshwater wetlands (Table 3.22-3). The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Course. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the Harpers Switching Station, which are all within the existing Aeropines Golf Club in NLCD land cover classes of open space (developed), forested and woody wetland habitats (Table 3.8-2; BOEM and Dominion Energy 2022). The onshore substation, which is located in an existing developed area and is associated with fragmented habitat would require expansion and clearing within forested and wetland NLCD land cover classes (Table 3.8-2) resulting in subsequent impacts on coastal habitat and fauna through habitat loss/fragmentation. While portions of Interconnection Cable Route Option 1 would be located within areas of very high (C2) and high (C2) ecological integrity, the majority of permanent impacts from the onshore components would either occur outside of ecological core areas or within areas of moderate and general ecological integrity (Table 3.8-3). Refer to Section 3.21, *Water Quality*, Section 3.14, *Land Use and Coastal Infrastructure*, and Section 3.22, *Wetlands,* for additional details of potential impacts on surface waters, land use, and wetlands. No individual fitness or population-level effects would be expected from onshore construction and associated habitat loss/fragmentation. Furthermore, given the nature of the existing coastal habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on coastal habitat and fauna are expected to be moderate.

Collisions between fauna and vehicles or construction equipment have some limited potential to cause mortality. However, these impacts, if any, would be infrequent, as most individuals would avoid the noisy construction areas (Bayne et al. 2008; Goodwin and Shriver 2010; McLaughlin and Kunc 2013). Therefore, the impacts of land disturbance from onshore construction on coastal habitat and fauna would be short term and minor.

Table 3.8-2 Land Cover Types and Estimated Impacts within Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Overhead Route					
1	14.2	253.9	Planted/Cultivated Crops	77.24	0.11
			Forest	0	11.02
			Open Space	0	0.06
			Woody Wetlands	0	109.22
			Total:	**77.24**	**120.41**
Switching Station					
Harpers	N/A	45.4	Open Space	0	8.96
			Forest	0	1.34
			Woody Wetlands	0	3.39
			Total:	**0**	**13.69**
Onshore Export Cable Route					
Cable Landing to Harpers	4.41	57.9	Planted/Cultivated Crops	2.25	0.01
			Forest	0	2.16
			Developed	12.20	3.16
			Open Space	9.02	1.45
			Woody Wetlands	0	5.60
			Total:	**23.48**	**12.38**
Onshore Substation					
Fentress Substation and Proposed	N/A	26.9	Open Space	0	0.75
			Emergent Herbaceous Wetlands	0	0.28
			Forest	0	5.31

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Expansion			Woody Wetlands	0	7.74
			Total:	**0**	**14.08**
Cable Landing Location					
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	Developed	0	0.16
			Open Space	0	0.74
			Total:	**0**	**0.90**
Laydown Area					
	N/A		**Total:**	**0**	**0**

Source: BOEM and Dominion Energy 2022.
[1] NA = not applicable; OH = overhead; UG = underground.
[2] From the NLCD.
[3] Comparison of permanent and temporary impacts was estimated based on cross referencing NLCD class with feature type. These are strictly estimations that will be further refined upon development of design specifications.

Table 3.8-3 Ecological Cores and Estimated Impacts within Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Overhead Route					
1	14.2	253.9	C1	0.00	0.00
			C2	0.00	3.62
			C3	0.00	0.36
			C4	0.00	0.01
			C5	0.00	13.07
			Total:	**0.00**	**17.06**
Switching Station					
Harpers	N/A	45.4	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**
Onshore Export Cable Route					
Cable Landing to Harpers	4.41	57.9	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
			C4	0.00	4.67
			C5	0.00	1.12
			Total:	**0.00**	**5.79**
Onshore Substation					
Fentress Substation and Proposed Expansion	N/A	26.9	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**
Cable Landing Location					
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**
Laydown Area					
Laydown Area	N/A	0	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**

Source: BOEM and Dominion Energy 2022.
[1] OH = overhead; UG = underground
[2] From the VDCR Natural Heritage Program Virginia Natural Landscape Assessment ecological cores. C1=Outstanding, C2=Very High, C3=High, C4=Moderate, C5=General.
[3] Comparison of temporary and permanent impacts is estimated strictly based on feature type (route, laydown area, switching station, etc.). Because ecological cores encompass multiple parameters (abiotic and biotic), the ecological core ranking was not cross referenced against the feature type. This estimation assumes the most impact possible within the routing and may not be indicative of actual impacts.

Seabed profile alterations: Installation of the offshore export cable would be the same under the Proposed Action or Alternative A-1 and would involve preconstruction grapnel runs, seafloor preparation, and plowing or trenching for cable installation and armoring that would alter seabed profiles.

As is standard practice when installing submarine cabling, pre-lay grapnel runs would be completed prior to cable installation to clear any unknown obstructions along the route. Towing this equipment along the seafloor would result in localized seabed profile alternations but impacts would expect to recover completely naturally without mitigation.

Prior to installation of the offshore export cables, seabed preparation activities would also include sandwave removal to create a flat surface for the cable installation tools and stable seabed elevation to prevent cable exposure occurring over time. Sandwave removal would require clearing the area, most likely using subsea excavation methods or controlled flow excavation. Controlled flow excavation would employ a tool suspended above the seabed from a vessel, to induce a controlled flow of water directed at the seabed to be displaced. Induced water currents would, therefore, force the local seabed into suspension, where it would be directed into the immediately surrounding area and, in the absence of the induced flow, the suspended sediment would settle back to the seabed around the area of excavation (COP, Section 3.4.1.4; Dominion Energy 2022). Alterations to seabed profiles would be expected to occur but would recover completely naturally without mitigation.

Short-term disturbance to the seabed sediment would occur during installation of the offshore export cables within coastal habitat. The offshore export cables would be buried approximately 3.3 to 16.4 feet (1 to 5 meters) below stable seabed elevation to minimize the risk of cable exposure or damage. In addition, the Proposed Action or Alternative A-1 would use trenchless installation (HDD or DSPT) to install the nine export cables that would occur from an offshore trenchless installation punch-out location approximately 1,000 to 1,800 feet (305 to 549 meters) offshore of the cable landing location, further reducing seabed profile alterations in the nearshore area.

As stated previously, the Proposed Action or Alternative A-1 would include approximately 0.1 percent of the offshore export and inter-array cables be covered with cable-protection material (dumped rocks, geotextile sand containers, and/or concrete mattresses) to ensure that they remain covered during storms and other events that disturb the seafloor (COP, Section 4.2.4.3; Dominion Energy 2022). Although some of this would occur outside of the geographic analysis area for coastal habitat, cable protection could remain permanently after cable installation. Therefore, such impacts, while locally intense, would have unmeasurable effect on the general character of coastal habitat. Overall, the impacts of seabed profile alternations on coastal habitat and fauna would be expected to be minor.

Seabed deposition and burial: Cable laying and construction would result in the temporary resuspension and nearby deposition of sediments. In areas where displaced sediment is thick enough, organisms may be smothered, which would result in mortality (see Section 3.6, *Benthic Resources,* for additional details on benthic resources). Additional protective rock or other hard material would be placed atop 0.1 percent of the offshore export and inter-array cables for added protection where cable burial is insufficient. Because most lightly sedimented areas would recover naturally, and most coastal benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally, impacts on coastal resources would be minor.

The Proposed Action or Alternative A-1 would include installation of the offshore export cable that would involve preconstruction grapnel runs, seafloor preparation, and plowing or trenching for cable installation and armoring. These activities in coastal habitat would cause temporary and localized increases in turbidity and total suspended sediment in the water column.

The installation of the offshore export cable would mostly be done by jet or mechanical plow. Each of the nine offshore export cables would be installed separately in space and time during construction with enough time between installations for disturbed sediment to resettle on the seafloor. Cable installation activities would cause short-term disturbance of nearshore coastal habitat and an increase in suspended sediments along the cable trench. The silt and clay sediment particles are predicted to remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized (COP, Appendix J; Dominion Energy 2022). Based on the predicted results of the sediment transport modeling for the Proposed Action or Alternative A-1, the suspended sediment concentrations would diminish rapidly away from the offshore export cable trench and at most stations, over 85 percent of the suspended particles would deposit within 16.4 feet (5 meters) of the trench centerline. In addition, the suspended sediment concentrations would drop rapidly with time. At most locations, the concentration would drop by 75 percent or greater within 4 minutes of jet plowing activity (COP, Appendix J; Dominion Energy 2022). Although turbidity is likely to be high in the affected areas, sediment deposition would have no long-term impact on coastal habitat or fauna.

Mobile benthic species are anticipated to move out of the area and return once installation activities are complete. Because most lightly sedimented areas would recover naturally, and most benthic coastal habitat and fauna are adapted to the turbidity and periodic sediment deposition that occur naturally. Therefore, the impacts of sediment deposition and burial on coastal habits and fauna are expected to be minor.

3.8.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities and other planned offshore wind activities (of which there are none). Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on coastal habitat and fauna through the IPFs of accidental releases, anchoring, emfs, light, new cable emplacement and maintenance, noise, presence of structures, land disturbance, seabed profile alterations, and seabed deposition and burial. BOEM is not aware of any future offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna.

The cumulative impact on coastal habitat and fauna would likely be minor. Offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures, namely cable protection, but would occur over 20 miles (32 kilometers) away.

3.8.5.2 Conclusions

Impacts of the Proposed Action. The Proposed Action or Alternative A-1 would likely result in local impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) that would not alter the overall character of coastal habitat and fauna resources in the geographic analysis area.

Project construction, installation, and conceptual decommissioning would result in new cable emplacement, noise, land disturbance, seabed profile alterations, and sediment deposition and burial to the geographic analysis area, as well as alter existing coastal habitat affecting fauna to varying degrees depending on the location, timing, and species affected by an activity. Noise, lighting, and human activity impacts from Project operation and maintenance would occur, although at lower levels than those produced during construction and conceptual decommissioning. The impacts resulting from the Proposed Action or Alternative A-1 alone would range from **negligible** to **moderate**. Therefore, the overall impacts on coastal habitat and fauna from the Proposed Action or Alternative A-1 alone are expected to be **minor** because the effects would be small, and the resources would be expected to recover completely without remedial or mitigating action.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action or Alternative A-1, would range from **negligible** to **moderate**, but could include **minor beneficial** impacts. Considering all of the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be **minor** on coastal habitat and fauna in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and the associated impacts on coastal habitat from ocean acidification, warming, sea level rise and altered habitat/ecology. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through the impacts of new cable emplacement and maintenance, the presence of structures (cable-protection measures). Therefore, the overall impacts on coastal habitat and fauna would likely be **minor** because some of the impacts are measurable, but the resource would likely recover completely when construction is completed and best management practices and mitigating actions are taken. While recovery can begin in 1 to 2 years, a time span of 15 to 20 years is recommended to specifically measure parameters that describe ecological recovery of the ecosystem (including vegetation structure and diversity) as well as the associated functions (including ecological processes) and services (Bayraktarov et al. 2016).

3.8.6 Impacts of Alternatives B and C on Coastal Habitat and Fauna

Impacts of Alternatives B and C Alternatives B and C would decrease the number and size of WTGs and result in reduced impacts from the associated decrease in construction and installation, O&M, non-routine activities, and conceptual decommissioning compared to the Proposed Action. However, Alternatives B and C would have the same impact determinations on coastal habitat and fauna as those described under the Proposed Action. The decreased number and size of WTGs (up to 176 WTGs for Alternative B, each 14 MW; up to 172 WTGs under Alternative C, each 14 MW) would not influence impacts on coastal habitat and fauna when compared to the Proposed Action. The elements of Alternatives B and C would be at the same distance from the boundary of the geographic analysis area as the Proposed Action (approximately 20 miles [32 kilometers]). As a result, BOEM does not anticipate impacts to be different than those described under the Proposed Action and anticipates that impacts would remain minor.

Cumulative Impacts of Alternatives B and C. The cumulative impacts on coastal habitat and fauna would be minor for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, impacts contributed by Alternatives B and C to the cumulative impacts on coastal habitat and fauna would be the same as those described for the Proposed Action.

3.8.6.1 Conclusions

Impacts of Alternatives B and C. The impacts potentially resulting from Alternatives B and C would be practically identical to those associated with the Proposed Action. The overall impacts on coastal habitat and fauna of ongoing and planned actions, Alternatives B and C, would be the same as under the Proposed Action and would remain **minor**.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternatives B and C, would be no different than to those described under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and potentially **minor beneficial** impacts).

3.8.7 Impacts of Alternative D on Coastal Habitat and Fauna

Impacts of Alternative D. All offshore components of Alternative D are the same as the Proposed Action (205 WTGs and 3 OSSs), and impacts on coastal habitat and fauna from the Offshore Project components would be the same as evaluated under the Proposed Action. Onshore, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same.

In contrast to the Proposed Action, Alternative D-2 involves approval of only Hybrid Interconnection Cable Route Option 6 (Alternative D-2), which would be approximately 14.2 miles (22.9 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods and installed via open trench, micro tunneling, and HDD. It would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles

(7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation (Fentress).

Noise and land disturbance from onshore construction activities of Interconnection Cable Route Option 6 would result in behavioral and habitat loss/fragmentation impacts on coastal habitat and fauna as a result of temporary disturbance and clearing to a total of 77.16 acres (31.23 hectares) of NLCD land cover classes (Table 3.8-4 and Table 3.8-5) whereas the Proposed Action would result in temporary impacts on a total of 77.24 acres (31.26 hectares) (Table 3.8-2 and Table 3.8-3). While the NLCD does include wetland land cover classes, refer to Section 3.22 (Table 3.22-4) for wetland impacts on the onshore Project components based on wetland delineation survey data. Approximately 76 percent of Interconnection Cable Route Option 1 (Proposed Action) and 70 percent of Interconnection Cable Route Option 6 (Alternative D-2) would be collocated with existing linear development. The Chicory Switching Station (Interconnection Cable Route Option 6) is in an area identified as having general ecological integrity (C5), and would be built within a forested parcel, with potential for habitat loss/fragmentation on coastal habitat and fauna due to tree clearing within multiple forest NLCD land cover classes (Table 3.8-4). The Chicory Switching Station would have a footprint of 35.5 acres (14.4 hectares) but would result in a greater area of impact on undeveloped NLCD land cover classes than the Harpers Switching Station, which would be located entirely within the existing Aeropines Golf Club. Overall, impacts at the Chicory Switching Station (Alternative D-2) would predominantly occur on previously undisturbed forest/wetland habitats (Table 3.8-4 and Table 3.8-5), whereas impacts at the Harpers Switching Station (Proposed Action) would be on portions of developed areas (Table 3.8-2 and Table 3.8-3). Similar to the Proposed Action, impacts associated with onshore clearing and construction would be localized and temporary. Alternative D-2 would result in greater permanents impacts to ecological cores (approximately 42.67 acres) than Alternative D-1 (approximately 22.85 acres) (BOEM and Dominion Energy 2022). While Alternative D-2 would result in an increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates the difference in potential impacts on coastal habitat and fauna would be nominal.

No individual fitness or population-level effects would be expected from onshore construction and associated loss/fragmentation of foraging associated with Alternative D-1 or D-2, and, as a result, BOEM anticipates minor impacts. Therefore, BOEM anticipates impacts of Alternative D-1 or D-2 to be the same on coastal habitat and fauna as those described under the Proposed Action, with impacts remaining minor.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

Table 3.8-4 Land Cover Types and Estimated Impacts Within the Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Hybrid Route					
6	14.2 (OH = 9.7; UG = 4.5)	240.5	Planted/Cultivated Crops	66.81	2.10
			Forest	0	11.02
			Developed	3.31	0.81
			Open Space	7.04	0.76

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
			Woody Wetlands	0	92.04
			Total:	**77.16**	**106.73**
Switching Station					
Chicory	N/A	35.5	Planted/Cultivated Crops	0	0.22
			Forest	0	11.17
			Open Space	00	0.25
			Shrub/Scrub	0	1.42
			Woody Wetlands	0	22.27
			Total:	**0**	**35.33**
Onshore Export Cable Route					
Cable Landing to Harpers	4.41	57.9	Planted/Cultivated Crops	2.25	0.01
			Forest	0	2.16
			Developed	12.20	3.16
			Open Space	9.02	1.45
			Woody Wetlands	0	5.60
			Total:	**23.48**	**12.38**
Onshore Substation					
Fentress Substation and Proposed Expansion	N/A	26.9	Open Space	0	0.75
			Emergent Herbaceous Wetlands	0	0.28
			Forest	0	5.31
			Woody Wetlands	0	7.74
			Total:	**0**	**14.08**
Cable Landing Location					
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	Developed	0	0.16
			Open Space	0	0.74
			Total:	**0**	**0.90**
Laydown Area					
	N/A		**Total:**	**0**	**0**

Source: Dominion Energy 2022.
[1] NA = not applicable; OH = overhead; UG = underground.
[2] From the NLCD.
[3] Comparison of permanent and temporary impacts was estimated based on cross referencing NLCD class with feature type. These are strictly estimations that will be further refined upon development of design specifications.

Table 3.8-5 Ecological Cores and Estimated Impacts within Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Hybrid Route					
6	14.2 (OH=9.7; UG=4.5)	240.5	C1	0.00	0.00
			C2	0.00	3.62
			C3	0.00	0.36
			C4	0.00	0.01
			C5	0.00	6.39
			Total:	**0.00**	**10.38**
Switching Station					
Chicory	N/A	35.5	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	26.50
			Total:	**0.00**	**26.50**
Onshore Export Cable Route					
Cable Landing to Harpers	4.41	57.9	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	4.67
			C5	0.00	1.12
			Total:	**0.00**	**5.79**
Onshore Substation					
Fentress Substation and Proposed Expansion	N/A	26.9	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**
Cable Landing Location					
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Laydown Area					
Laydown Area	N/A	0	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**

Source: Dominion Energy 2022.
[1] OH = overhead; UG = underground
[2] From the VDCR Natural Heritage Program Virginia Natural Landscape Assessment ecological cores. C1=Outstanding, C2=Very High, C3=High, C4=Moderate, C5=General.
[3] Comparison of temporary and permanent impacts is estimated strictly based on feature type (route, laydown area, switching station, etc.). Because ecological cores encompass multiple parameters (abiotic and biotic), the ecological core ranking was not cross referenced against the feature type. This estimation assumes the most impact possible within the routing and may not be indicative of actual impacts.

3.8.7.1 Conclusions

Impacts of Alternative D. The Proposed Action only considers Interconnection Cable Route Option 1 while Alternatives D-1 and D-2 consider Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2). BOEM anticipates the impacts on coastal habitat and fauna resulting from Alternative D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be slightly greater than under the Proposed Action due to construction and clearing occurring on a larger area of undisturbed forest/wetland habitats; however, the impacts are not expected to change under Alternatives D-1 or D-2 relative to the Proposed Action. Impacts on coastal habitat and fauna would result in the same impacts on coastal habitat and fauna as the Proposed Action and would remain **minor**. Impact ratings associated with individual IPFs would not change.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternative D-1 or D-2, would be the same as those described under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** but could include **minor beneficial** impacts). The overall impacts on coastal habitat and fauna of ongoing and planned actions, including Alternative D-1 or D-2, would be the same as those under the Proposed Action, with impacts remaining **minor**. This impact rating is driven primarily by ongoing activities such as climate change, as well as limited disturbance and habitat removal associated with onshore construction.

3.9 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial fisheries and for-hire recreational fishing from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for commercial fisheries and for-hire recreational fishing. The commercial fisheries and for-hire recreational fishing geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.9-1 and Figure 3.9-2. The geographic analysis area boundaries include the management areas of the South Atlantic Fishery Management Council (SAFMC) from the South Carolina/Georgia border northward, the Mid-Atlantic Fishery Management Council (MAFMC), and the New England Fishery Management Council (NEFMC) for all federal fisheries within the EEZ (from 4 to 230 miles [6 to 370 kilometers] from the coastline) and all adjacent state waters (from 0 to 4 miles [0 to 6 kilometers] from the coastline). For for-hire recreational fisheries, this includes all areas managed by the NEFMC south of Cape Cod, Massachusetts, the MAFMC, and the SAFMC to Cape Hatteras, North Carolina, including all adjacent state waters (from 0 to 4 miles [0 to 6 kilometers] from the coastline). The boundaries for the geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and U.S. EEZ waters surrounding the proposed Project.

Due to size of the geographic analysis area, the analysis for this EIS focuses on the commercial fisheries and for-hire recreational fishing that would likely occur in the Project area or be affected by Project-related activities, while providing context within the larger geographic analysis area.

3.9.1 Description of the Affected Environment for Commercial Fisheries and For-Hire Recreational Fishing

Commercial fisheries refer to fishing activities that sell catch for profit, whereas for-hire recreational fishing boat owners charter fishing trips to anglers. The boundaries for the commercial fisheries geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and EEZ waters surrounding the proposed Project, vessels from the Project area that may transit to fishing grounds in other Atlantic regions, as well as potential impacts on federally managed species of commercial importance that have ranges that overlap with the Project area. The boundaries for the for-hire recreational fishing geographic analysis area were developed to consider impacts on charter and other for-hire vessels operating in and around the proposed Project area, those transiting to other known fishing grounds along the Atlantic coast, and those potentially displaced by other WEA development activities.

3.9.1.1 Regional Setting

Fisheries in the geographic analysis area are managed at the federal, state, and regional level. At the federal level, there are three councils designated by the Magnuson Fishery Conservation and Management Act of 1976 (later renamed the Magnuson-Stevens Fishery Conservation and Management Act): the NEFMC for Connecticut, Massachusetts, Maine, New Hampshire, and Rhode Island; the MAFMC for Delaware, Maryland, North Carolina, New Jersey, New York, Pennsylvania, and Virginia; and the SAFMC for North Carolina and South Carolina (included in the geographic analysis area) as well as Georgia and Florida (not included in the geographic analysis area).

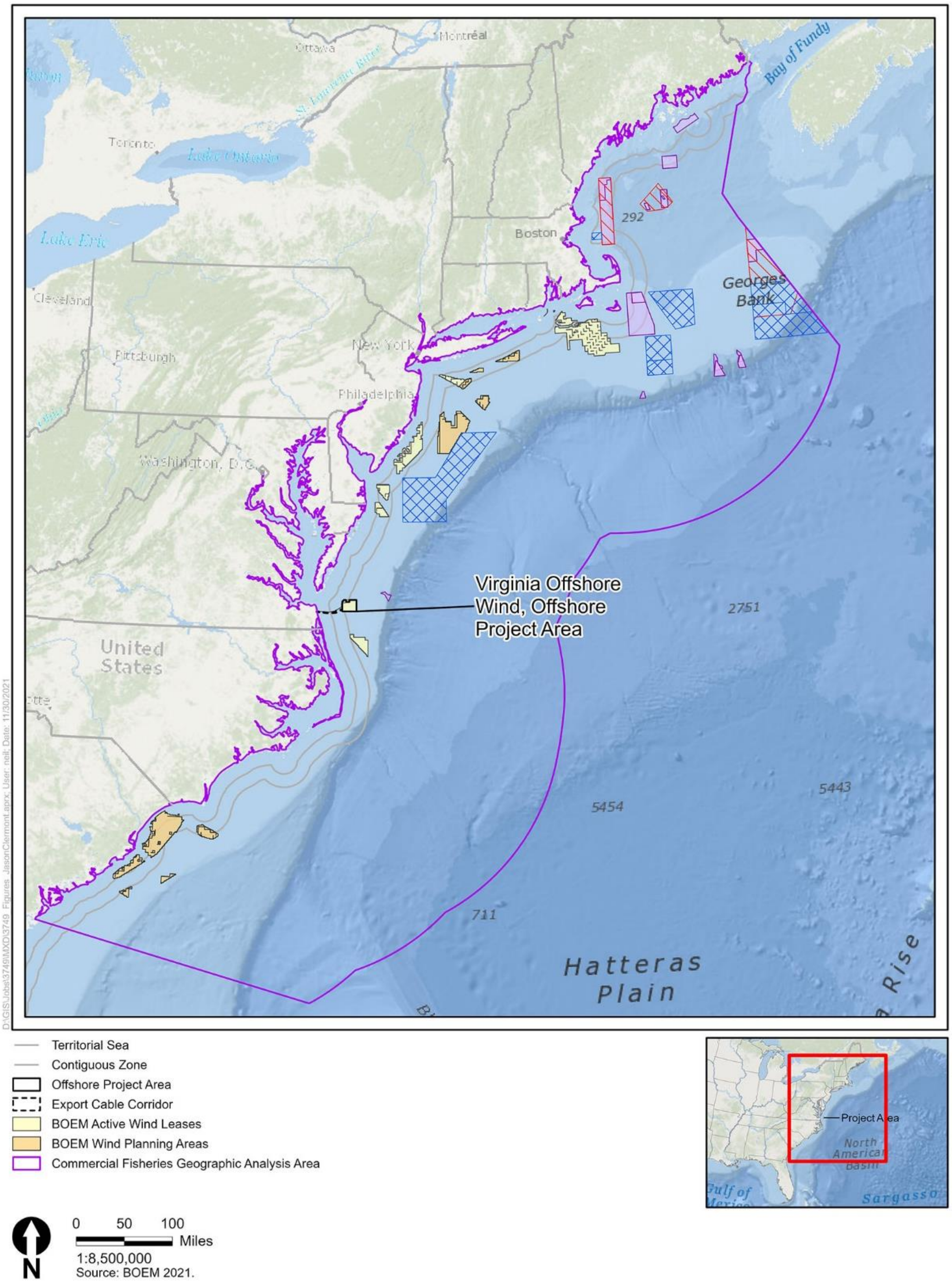


Figure 3.9-1 Commercial Fisheries Geographic Analysis Area

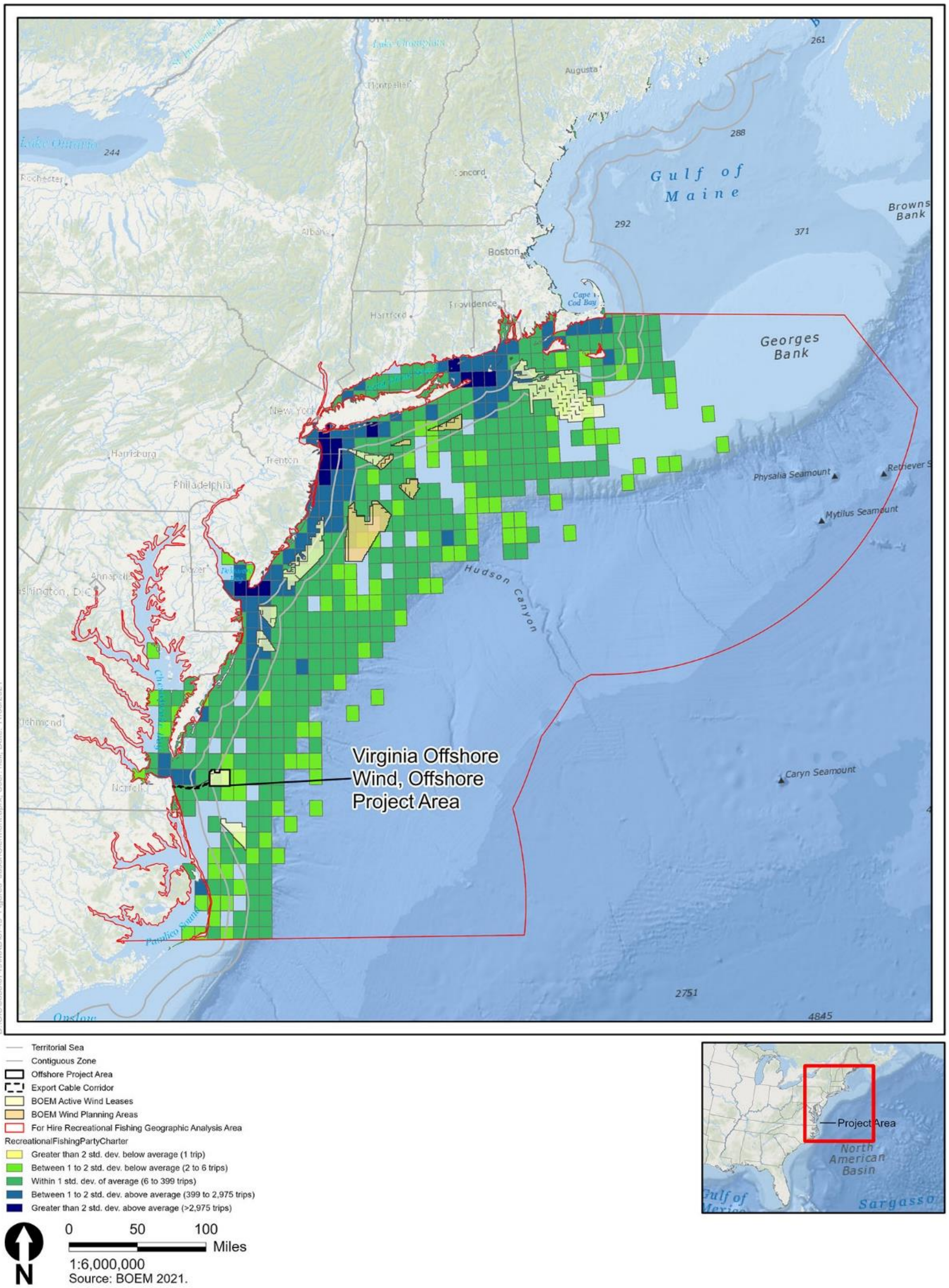


Figure 3.9-2 For-Hire Recreational Fishing Geographic Analysis Area

At the regional level, the 15 Atlantic states form the Atlantic States Marine Fisheries Commission. Species managed at the federal level include Atlantic salmon (*Salmo salar*), groundfish (flounders, Atlantic cod [*Gadus morhua*], white hake [*Urophycis tenuis*], haddock [*Melanogrammus aeglefinus*], Atlantic pollock [*Pollachius virens*], Acadian redfish [*Sebastes fasciatus*], Atlantic halibut [*Hippoglossus hippoglossus*], Atlantic wolffish [*Anarhichas lupus*], and ocean pout [*Zoarces americanus*]), sea scallop (*Placopecten magellanicus*), skates (Rajidae), herring (*Clupea harengus*), whiting (*Merlangius merlangus*), and red crab (*Chaceon quinquedens*) by the NEFMC; summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), black seabass (*Centropristis striata*), mackerel (Scombridae), squid (*Illex* sp.), butterfish (*Peprilus triacanthus*), bluefish (*Pomatomus saltatrix*), surf clam (*Spisula solidissima*), ocean quahog (*Arctica islandica*), and tilefish (Malacanthidae) by the MAFMC; and mackerel, cobia (*Rachycentron canadum*), dolphinfish (*Coryphaena hippurus*), and wahoo (*Acanthocybium solandri*) by the SAFMC. The NEFMC and MAFMC jointly manage monkfish (*Lophius americanus*) and spiny dogfish (*Squalus acanthias*). Species managed at the regional level include American lobster (*Homarus americanus*), black drum (*Pogonias cromis*), red drum (*Sciaenops ocellatus*), tautog (*Tautoga onitis*), and weakfish (*Cynoscion regalis*). Black sea bass, spiny dogfish, scup, and summer flounder are managed at both the federal and regional level. Individual states manage fisheries that occur within state waters such as blue crab (*Callinectes sapidus*). NOAA has management authority for certain tunas (*Thunnini*), sharks (*Selachimorpha*), swordfish (*Xiphias gladius*), and billfish (*Istiophoridae*).

Table 3.9-1 Managed Species

Managed Species	Managing Agency				
	Federal	Regional/ State Waters	NEFMC	MAFMC	SAFMC
Acadian redfish (*Sebastes fasciatus*)	X				
American lobster (*Homarus americanus*)		X			
Atlantic halibut (*Hippoglossus hippoglossus*)	X				
Atlantic pollock (*Pollachius virens*)	X				
Atlantic salmon (Salmo salar)	X				
Atlantic wolffish (*Anarhichas lupus*)	X				
Black drum (*Pogonias cromis*)		X			
Black seabass (*Centropristis striata*)			X		
Bluefish (*Pomatomus saltatrix*)			X		
Butterfish (*Peprilus triacanthus*)			X		
Cobia (*Rachycentron canadum*)				X	
Dolphinfish (*Coryphaena hippurus*)				X	
groundfish (flounders, Atlantic cod [*Gadus morhua*])	X				
Haddock (*Melanogrammus aeglefinus*)	X				
Herring (*Clupea harengus*)	X				
Mackerel (Scombridae)			X	X	
Monkfish (*Lophius americanus*)			X	X	
Ocean pout (*Zoarces americanus*)	X				
Ocean quahog (*Arctica islandica*)			X		
Red crab (*Chaceon quinquedens*)	X				
Red drum (*Sciaenops ocellatus*)		X			

Managed Species	Managing Agency				
	Federal	Regional/ State Waters	NEFMC	MAFMC	SAFMC
Scup (*Stenotomus chrysops*)			X		
Sea scallop (*Placopecten magellanicus*)	X				
skates (Rajidae)	X				
Spiny dogfish (*Squalus acanthias*)			X	X	
squid (*Illex* sp.)			X		
Summer flounder (*Paralichthys dentatus*)			X		
Surf clam (*Spisula solidissima*)			X		
Tautog (*Tautoga onitis*)		X			
Tilefish (Malacanthidae)			X		
Wahoo (*Acanthocybium solandri*)				X	X
Weakfish (*Cynoscion regalis*)		X			
White hake (*Urophycis tenuis*)	X				
Whiting (*Merlangius merlangus*)	X				
Blue crab (*Callinectes sapidus*)		X			
tunas (Thunnini)*	X				
sharks (Selachimorpha)*	X				
Swordfish (*Xiphias gladius*)*	X				
billfish (Istiophoridae)*	X				

*NOAA has management authority for certain tunas (Thunnini), sharks (Selachimorpha), swordfish (*Xiphias gladius*), and billfish (Istiophoridae).

These are some of the prominent fisheries in the geographic analysis area, but they do not represent a comprehensive list of all managed fisheries in the Atlantic region.

Management of commercial and for-hire recreational fisheries in the geographic analysis area relies on data from both fisheries-dependent and fisheries-independent surveys to inform stock assessments and set harvest targets, and to support various other management objectives. NOAA collaborates with numerous regional, state, and academic/scientific entities to collect data on fish and shellfish biomass, distribution, and condition; fisheries effort and landings; and other markers relative to the health and trends of fisheries resources and the commercial and recreational fishing industries. The primary long-term- fisheries-independent surveys which occur in the geographic analysis area are shown in Table 3.9-2.

Table 3.9-2 Primary Long-Term Annual or Seasonal Fisheries-Independent Surveys in the Geographic Analysis Area

Coordinating Agency	Survey	States/Region
National Oceanic and Atmospheric Administration Fisheries	NMFS NEFSC Bottom Trawl Survey	Maine to North Carolina
	NMFS NEFSC Sea Scallop Survey	Massachusetts to North Carolina
	NMFS NEFSC Research Set-Aside Sea Scallop Surveys	Maine to North Carolina
	NEFSC Ecosystem Monitoring Surveys	Maine to North Carolina

Coordinating Agency	Survey	States/Region
Atlantic States Marine Fisheries Commission	Northeast Area Monitoring and Assessment Program Southern New England and Mid-Atlantic Nearshore Trawl Survey	Massachusetts to North Carolina
	Massachusetts Division of Marine Fisheries Bottom Trawl Survey	Massachusetts
	Southeast Monitoring and Assessment Program-South Atlantic (SEAMAP-SA) Coastal Trawl Survey	North Carolina to Florida
	North Carolina Pamlico Sound Survey	North Carolina
	SEAMAP-SA Longline Surveys	North Carolina to Georgia
	SEAMAP-SA Reef Fish Survey	North Carolina to Florida
	Horseshoe Crab Trawl Survey	New Jersey to Virginia
	Northern Shrimp Trawl Survey	Maine to Massachusetts
	Ventless Trap Survey	Maine to New York

Sources: Atlantic States Marine Fisheries Commission (n.d.); Reid et al. 1999.

3.9.1.2 Regional Fisheries Economic Value and Landings

A detailed description of the commercial and for-hire recreational fisheries and corresponding revenue generated from those activities in the Project area and along the export cable corridor can be found in COP Section 4.4.6 (Dominion Energy 2022). BOEM (2021a, 2021b) examined commercial and recreational fisheries, including corresponding revenue generated from such activities, in the geographic analysis area from Cape Hatteras, North Carolina, north to the U.S.–Canadian border. Information from these reports is incorporated here by reference.

Commercial fisheries in the geographic analysis area use a variety of vessel and gear types, including scallop dredges, otter trawls, shrimp trawls, longline, gillnets (sink and floating), pots, and traps. Commercial fishing vessels range in size from small Carolina and Chesapeake skiffs to larger offshore vessels. The majority of the New England and Mid-Atlantic trawl fleet consists of vessels ranging from 33 to 98 feet (10 to 30 meters) in length; scallop vessels trend somewhat larger. A 2006 publication estimated 20,716 documented commercial fishing vessels were registered in states/USCG jurisdictions within the geographic analysis area, with 1,392 documented in Virginia (USCG 2006). The primary commercial fishery conducted in and around the Project area is the pot and trap fishery targeting black sea bass and whelk/conch (Buccinidae/Strombidae). These vessels typically work out of smaller ports along the Eastern Shore of Virginia (e.g., Cape Charles, Oyster, Willis Warf, Wachapreague, Chincoteague) and Virginia Beach area ports (COP, Appendix V; Dominion Energy 2022).

NOAA maintains landings data for commercial and recreational fisheries based on year, state, and species. The top species landed by weight in recent commercial fisheries operating near the Project area (e.g., offshore Virginia) include menhaden (*Brevoortia tyrannus*), blue crab, spiny dogfish, scallop (Pectinidae), oyster (Ostreidae), croaker (*Micropogonias undulatus*), flounder (Paralichthyidae), and striped bass (*Morone saxatilis*), and a substantial commercial value was derived from harvest of oyster, scallop, blue crab, menhaden, clam, and other species (NOAA 2021a). The highest value commercial landings deriving from the Project area are black sea bass, *Illex* sp. squid, channeled whelk (*Busycotypus canaliculatus*), summer flounder, and *Loligo* sp. squid (COP, Section 4.4.6; Dominion Energy 2022). Commercial fisheries in the geographic analysis area provide a significant amount of regional revenue, averaging around 2 billion per year (NOAA 2021a). The commercial fishing fleets contribute to the overall economy in the region through direct employment, income, and gross revenues, as well as through products and services to maintain and operate vessels, seafood processors, wholesalers/distributors, and retailers. Five ports in the geographic analysis area ranked in the top 20 U.S. ports for commercial landings quantity (Reedville, Virginia; New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; Gloucester, Massachusetts; and Point Judith, Rhode Island) and commercial landings value (New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; Point Judith, Rhode Island; Gloucester, Massachusetts; Hampton Roads, Virginia) in 2018 or 2019 (NMFS 2021a). Domestic landings in the geographic analysis area were approximately 573,000 and 542,500 metric tons in 2018 and 2019, respectively (NMFS 2021a).

The value of commercial landings in the majority of the geographic analysis area has been generally increasing since 2000, ranging from $986 million in 2001 to just over $2 billion in 2019 (NOAA 2021a). The value of landings in 2020 ($1.72 billion) was the lowest reported since 2013 (NOAA 2021a). Commercial landings in the Mid-Atlantic are dominated by menhaden, a high-volume, low value fishery that typically accounts for 50 to 65 percent of the region's landings by weight, but less than 10 percent by value. An analysis of the landings of economically important species in the Mid-Atlantic other than menhaden showed a marked decline in landed weight, but an increase in ex-vessel landed value between 2002 and 2015 (King 2017).

Commercial fisheries landings in Virginia between 2017 and 2020 ranged from 145,995 to 177,979 metric tons, with the lowest landings by weight occurring in 2020 (NMFS 2021a). The value of landings in Virginia over this period ranged from $179 million to $214 million, with the highest value occurring in 2020 (NMFS 2021a).

Table 3.9-3 shows commercial fishing revenue by FMP fishery for the Mid-Atlantic and New England fisheries from 2008 to 2019. While most of the revenue is derived from areas outside of the immediate Project area, it is important to note that the Project's geographic analysis area includes areas under jurisdiction of the NEFMC, MAFMC, and SAFMC. Sea scallops and Atlantic herring were the largest sources of revenue, with average revenue from 2008 to 2019 of $518.9 million and $93.3 million, respectively. Sea scallops ranked second in landings over that time period (Table 3.9-4), while Atlantic herring had the highest average annual landings (155,541,858 pounds).

Table 3.9-3 Commercial Fishing Revenue of Federally Permitted Vessels in Mid-Atlantic and New England Fisheries by FMP Fishery (2008–2019)

FMP Fishery	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)
American Lobster	$117,251.0	$93,250.1
Atlantic Herring	$32,856.3	$25,929.7
Bluefish	$1,820.4	$1,275.3
Golden and Blueline Tilefish	$6,583.4	$5,553.9
Highly Migratory Species	$4,008.4	$2,219.4
Jonah Crab	$17,082.7	$9,607.8
Mackerel, Squid, and Butterfish	$74,576.6	$51,911.7
Monkfish	$28,943.7	$20,597.3
Northeast Multispecies (large-mesh)	$105,418.2	$73,331.4
Northeast Multispecies (small-mesh)	$13,499.5	$11,261.1
Sea Scallop	$661,233.5	$518,891.6
Skate	$10,217.1	$7,448.4
Spiny Dogfish	$5,237.2	$2,975.4

FMP Fishery	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)
Summer Flounder, Scup, Black Sea Bass	$45,205.7	$39,807.4
Surfclam, Ocean Quahog	$63,152.0	$28,290.4
Other FMPs, non-disclosed species and non-FMP fisheries[1]	$33,646.8	$28,290.4
All FMP and Non-FMP Fisheries	**$1,132,912.7**	**$952,438.3**

Source: Developed using data from NMFS 2021a.
Notes: Revenue adjusted for inflation to 2019 dollars. Peak annual revenue and average annual revenue are calculated independently for all rows, including the All FMP and Non-FMP Fisheries row. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.
[1] Other FMPs, non-disclosed species, and non-FMP fisheries includes revenue from two FMP fisheries: Red Crab and River Herring. In addition, it includes revenue from species in FMP fisheries for which data could not be disclosed due to confidentiality restrictions, and revenue earned by federally permitted vessels operating in fisheries that are not federally managed.

Table 3.9-4 Commercial Fishing Landings (pounds) of Federally Permitted Vessels in Mid-Atlantic and New England Fisheries by Species (2008–2019)

Species	FMP Fishery	Peak Annual Landings (pounds)	Average Annual Landings (pounds)
Atlantic Herring	Atlantic Herring	217,820,607	155,541,858
Sea Scallops	Sea Scallop	59,057,105	49,948,027
Loligo Squid	Mackerel, Squid, and Butterfish	38,654,405	24,653,366
Skates	Skate	26,811,281	21,310,278
American Lobster	American Lobster	22,227,430	19,334,031
Atlantic Mackerel	Mackerel, Squid, and Butterfish	48,873,977	18,789,264
Silver Hake	Northeast Multispecies (small-mesh)	17,316,860	14,078,640
Spiny Dogfish	Spiny Dogfish	22,843,386	13,376,198
Jonah Crab	Jonah Crab	17,874,506	11,855,186
Scup	Summer Flounder, Scup, Black Sea Bass	14,551,815	10,859,288
Monkfish	Monkfish	12,188,795	9,732,966
Summer Flounder	Summer Flounder, Scup, Black Sea Bass	14,999,293	9,289,256
Cod	Northeast Multispecies (large-mesh)	16,920,601	7,477,847
Winter Flounder	Northeast Multispecies (large-mesh)	5,875,684	3,631,996
Butterfish	Mackerel, Squid, and Butterfish	7,852,044	3,242,538
Yellowtail Flounder	Northeast Multispecies (large-mesh)	3,915,379	2,172,206
Bluefish	Bluefish	2,886,624	1,825,725
Black Sea Bass	Summer Flounder, Scup, Black Sea Bass	3,093,459	1,806,872
Red Hake	Northeast Multispecies (small-mesh)	1,908,985	1,357,856
Rock Crab	No federal FMP	3,707,631	943,811

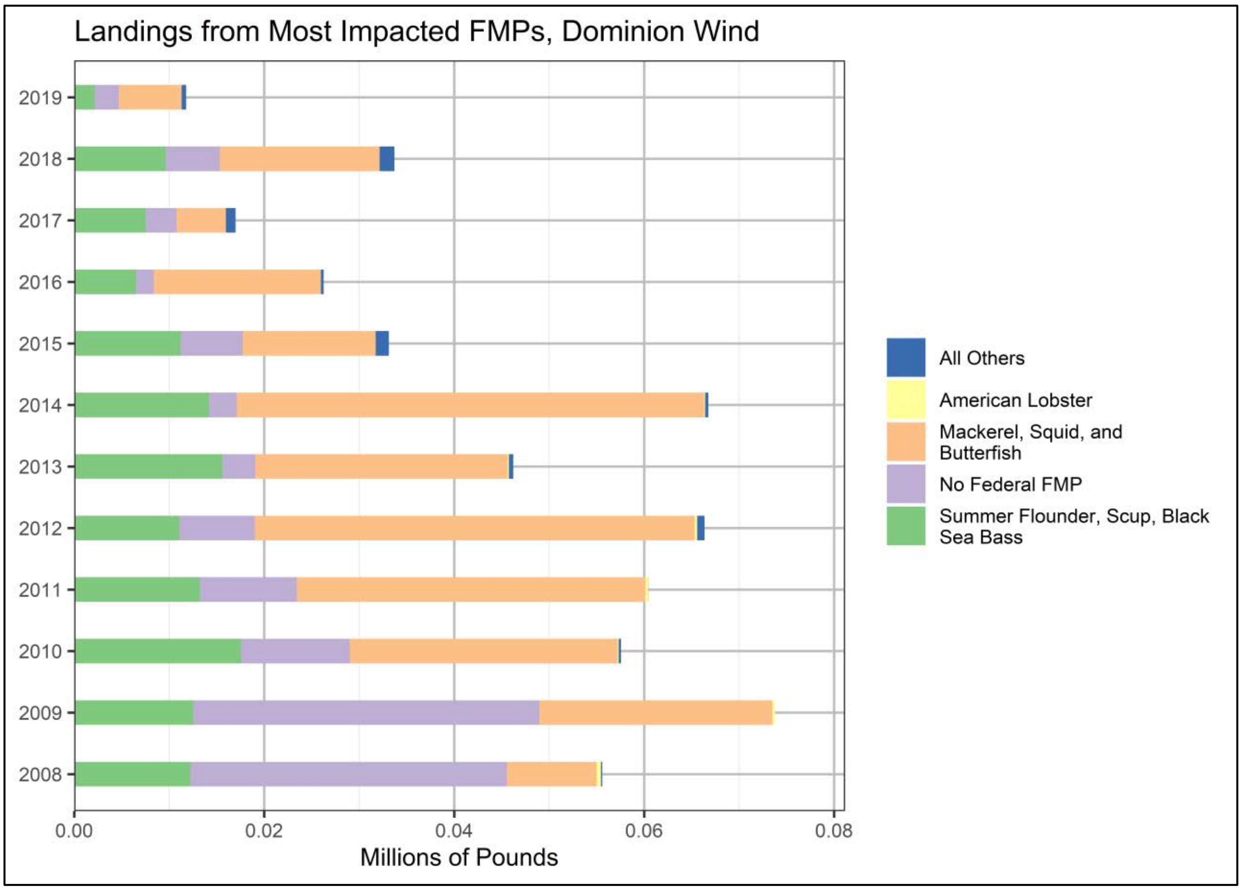
Source: Developed using data from NMFS 2021a.
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

3.9.1.3 Commercial Fisheries in the Lease Area

This section summarizes Project area–specific commercial fish landings and associated revenue by FMP fishery, gear type, and port of landing.

COP Section 4.4.6 (Dominion Energy 2022) reported revenue from catch in the Project Lease Area landed at ports along the U.S. east coast. Revenue ranged from $38,459 to $99,170 between 2008 and 2018. The Lease Area is considered "lightly fished" compared to other WEAs, ranking last in landings value based on 2014 data (Kirkpatrick 2014)

NMFS (2021b) lists the most impacted FMP fisheries in the Project area as being summer flounder, scup, black sea bass, mackerel, squid, butterfish, and American lobster. Landings from the most impacted fisheries from 2008 to 2019 are presented in Figure 3.9-3. Twelve-year (2008 to 2019) total landings were highest for mackerel, squid, and butterfish (281,000 pounds), and summer flounder, scup, and black sea bass (133,000 pounds) (Table 3.9-5). Total revenue (2019 dollars) from those same fisheries is presented in Figure 3.9-4; revenue was highest for the summer flounder, scup, and black sea bass FMP ($433,000) (Table 3.9-5).



Source: NMFS 2021b.

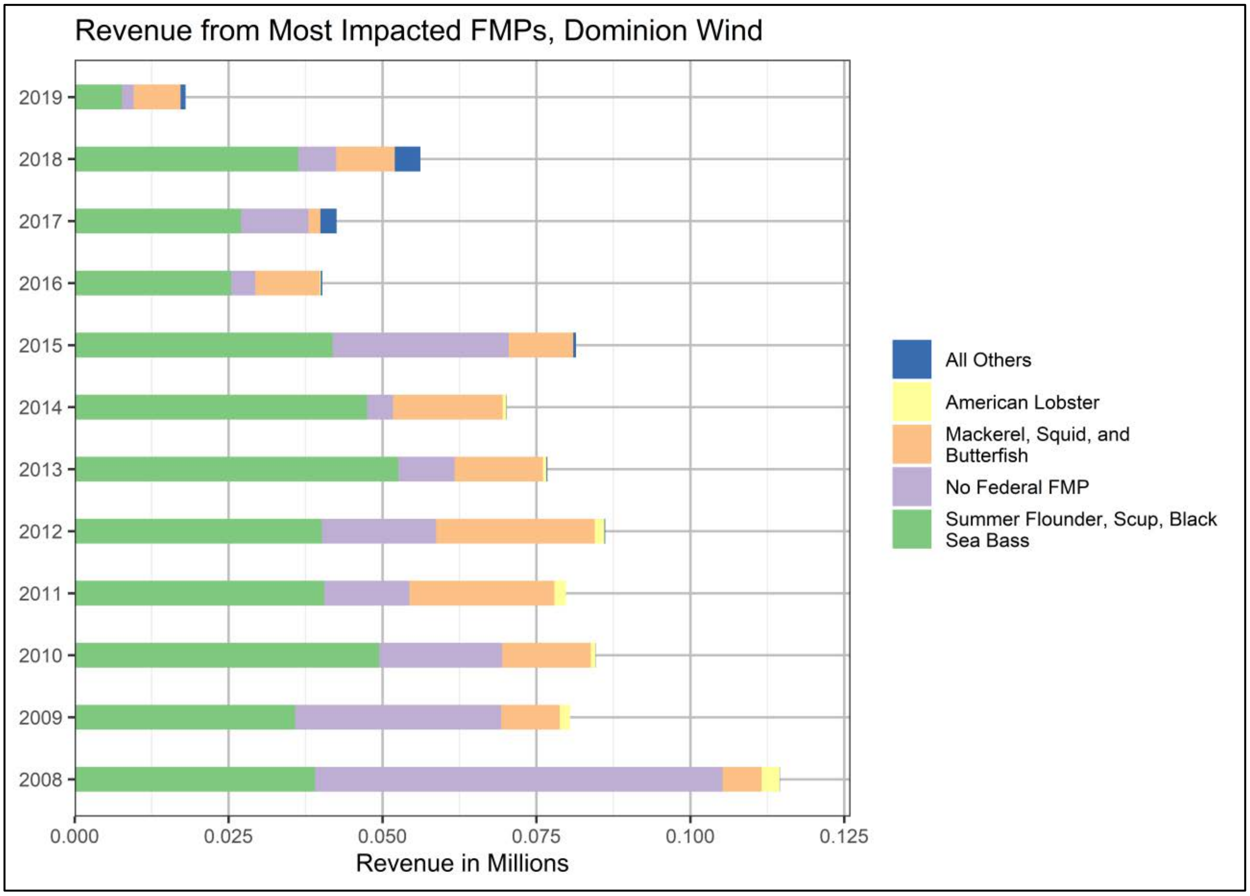
Figure 3.9-3 2008 to 2019 Landings from the Most Impacted FMPs in the Offshore Project Area

Table 3.9-5 2008 to 2019 Landings and Revenue for the Most Impacted FMPs in the Offshore Project Area

FMP Fishery	2008–2019 Landings (Pounds)	2008–2019 Revenue (2019 dollars)
Mackerel, Squid, Butterfish	281,000	$152,000
Summer Flounder, Scup, Black Sea Bass	133,000	$433,000
No Federal FMP	126,000	$217,000

FMP Fishery	2008–2019 Landings (Pounds)	2008–2019 Revenue (2019 dollars)
All Others	7,000	$9,000
American Lobster	2,000	$10,000
Total	**549,000**	**$831,000**

Adapted from: NMFS, 2021b.

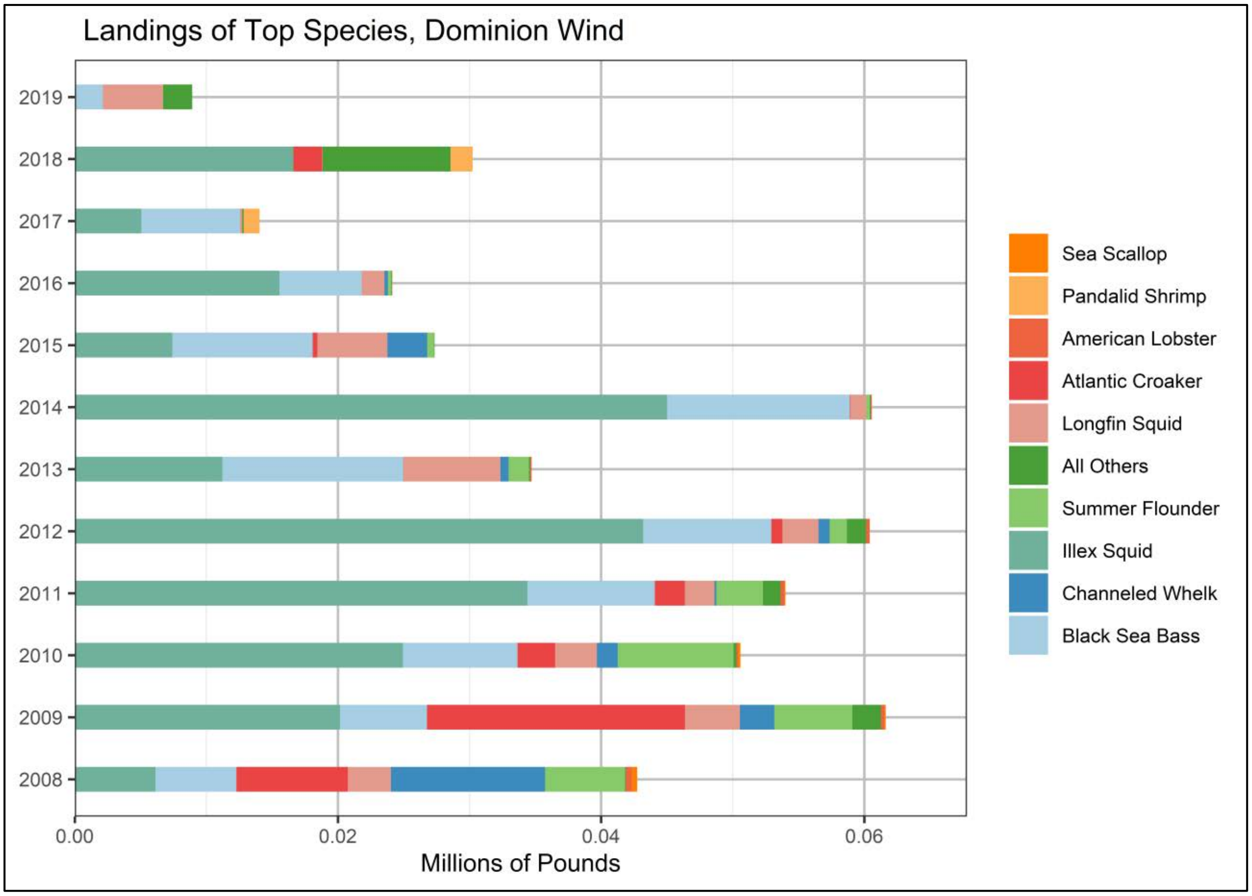


Source: NMFS 2021b.

Figure 3.9-4 2008 to 2019 Revenue (2019 Dollars) from the Most Impacted FMPs in the Offshore Project Area

NMFS (2021b) also presents information on other impacted FMPs in the Project area, including bluefish, golden and blueline tilefish, highly migratory species, Jonah crab, monkfish, Northeast multispecies, sea scallop, skates, small-mesh multispecies and spiny dogfish. Landings for these species were relatively small, with the largest being 3,000 pounds for bluefish. Collectively, the 12-year (2008 to 2019) landings were approximately 10,000 pounds with an associated revenue of just $17,000.

The top 10 most impacted species (by revenue) in the Project area from 2008 to 2019 were black sea bass, channeled whelk, *Illex* sp. squid, summer flounder, longfin squid, Atlantic croaker, red crab, pandalid shrimp, brown shrimp and other shellfish. Landings for these species are presented in Figure 3.9-5 and Table 3.9-6; revenue (in 2019 dollars) is presented in Figure 3.9-6 and Table 3.9-6. Overall, *Illex* sp. squid had the most landings, with 230,000 tons over 12 years. However, the revenue was highest for black sea bass ($353,000), with channeled whelk and *Ilex* sp. squid in second and third place, respectively (NMFS 2021b).



Source: NMFS 2021b.

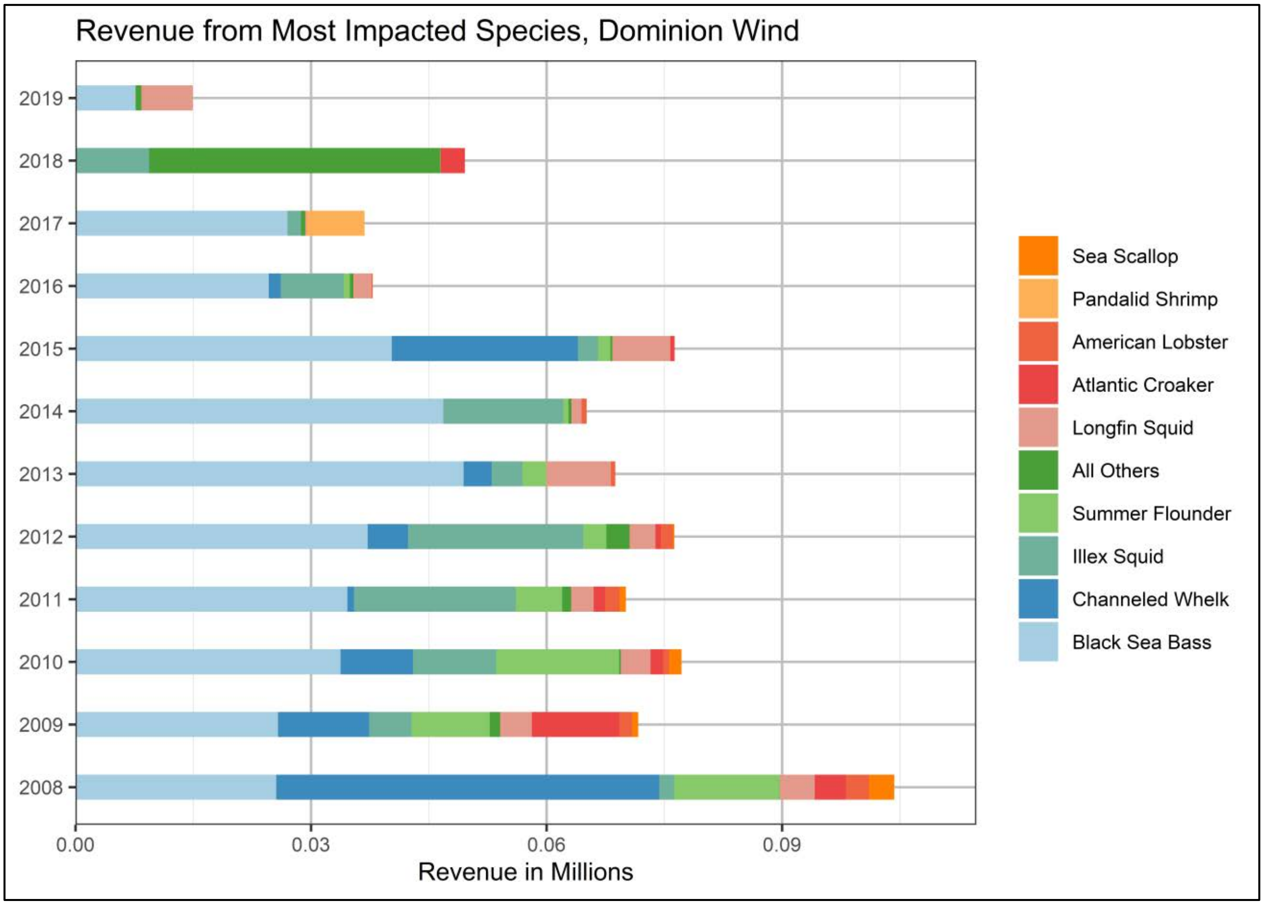
Figure 3.9-5 2008 to 2019 Landings from the Most Impacted Species in the Offshore Project Area

Table 3.9-6 2008 to 2019 Landings and Revenue for the Most Impacted Species in the Offshore Project Area

Species	2008-2019 Landings (Pounds)	2008-2019 Revenue (2019 dollars)
Ilex Squid	230,000	$102,000
Black Sea Bass	95,000	$353,000
Atlantic Croaker	37,000	$23,000
Longfin Squid	36,000	$44,000
Summer Flounder	28,000	$54,000
Channeled Whelk	21,000	$104,000
All Others	18,000	$45,000
Pandalid Shrimp	3,000	$7,000
American Lobster	2,000	$10,000
Sea Scallop	1,000	$7,000

Species	2008-2019 Landings (Pounds)	2008-2019 Revenue (2019 dollars)
Total	**469,000**	**$749,000**

Adapted from: NMFS 2021b.



Source: NMFS 2021b.

Figure 3.9-6 2008 to 2019 Revenue from the Most Impacted Species in the Offshore Project Area

NMFS (2021b) also analyzed fishing gear types used in the Project area. Both landings and revenue were dominated by bottom trawling and pot-other (i.e., non-lobster pots). Total landings (from 2008 to 2019) totaled 381,000 pounds for bottom trawl and 156,000 pounds for pot-other, with the associated 12-year revenue totaling $286,000 for bottom trawl and $527,000 for pot-other. Other gear types, including gillnet, handline, pot-lobster, and dredge-scallop all had 12-year landings totals of 12,000 pounds or less and revenue of $17,000 or less.

The total number of commercial fishing trips and vessels has decreased in recent years, dipping to a low of 77 trips and 28 vessels in 2019, the most recent year for which data is available. Table 3.9-7 presents the number of trips and vessels operating in the Project area from 2008 to 2019. For 2019, longfin squid was the most targeted species by vessel trips (42) and number of vessels (19), with black sea bass, bluefish, blueline tilefish, and silver hake comprising the top five targeted taxa by vessel trip (Table 3.9-8).

Table 3.9-7 2008 to 2019 Number of Vessel Trips and Vessels in the Offshore Project Area

Year	Number of Trips	Number of Vessels
2019	77	28
2018	109	32
2017	125	36
2016	154	47
2015	179	43
2014	206	39
2013	231	52
2012	249	62
2011	344	83
2010	412	102
2009	418	108
2008	445	82

Source: NMFS 2021b.

Table 3.9-8 Number of Vessel Trips and Vessels by Species in the Offshore Project Area, 2019

Species	Number of Trips	Number of Vessels
Atlantic Mackerel	7	5
Black Sea Bass	23	8
Bluefish	21	13
Blueline Tilefish	19	11
Butterfish	14	8
Smooth Dogfish	6	3
Spiny Dogfish	4	4
Golden Tilefish	5	5
John Dory	4	4
King Mackerel	3	3
Longfin Squid	42	19
Monkfish	10	7
Red Hake	7	4
Silver Hake	15	8
Summer Flounder	9	8

Source: NMFS 2021b.

The ports in Table 3.9-9 were estimated by NMFS (2021b) as being the top 10 most impacted from commercial fishing that occurs in the Project area. The port with the highest 12-year (2008 to 2019) revenue was Virginia Beach, Virginia, with a total landings revenue of $443,000. Twelve-year revenue from other ports ranged from $15,000 (New Bedford, Massachusetts) to $79,000 (North Kingstown, Rhode Island).

Table 3.9-9 Most Impacted Ports and Revenue for Commercial Fishing in the Offshore Project Area

Port	2008-2019 Revenue (2019 dollars)
Virginia Beach, Virginia	$443,000
North Kingstown, Rhode Island	$79,000
Newport News, Virginia	$48,000
Chincoteague, Virginia	$47,000
Hampton, Virginia	$41,000
Wanchese, North Carolina	$39,000
Davisville, Rhode Island	$33,000
Cape May, New Jersey	$29,000
Engelhard, North Carolina	$28,000
New Bedford, Massachusetts	$15,000

Source: NMFS 2021b.

3.9.1.4 Recreational and For-Hire Fisheries in the Lease Area

Recreational fishing in and around the Project area occurs year-round, with the majority of charter trips occurring from April through October. The for-hire recreational fishing industry in Virginia and North Carolina is primarily made up of small- to medium- sized (i.e., 25- to 50-foot [8- to 15-meter]) vessels that are chartered for half-day or full-day trips. The majority of chartered fishing vessels originating from coastal Virginia operate out of the Rudee and Lynnhaven inlets in Virginia Beach and out of various small inlets on the Virginia Eastern Shore. In North Carolina, recreation fishing charters operate out of various ports along the Outer Banks and in and along coastal towns in the Pamlico and Albemarle Sounds.

Recreational fishers use the Lease Area both as a targeted fishing location (primarily the Triangle Reef in the northern portion of the Lease Area), but also as a transit corridor to access offshore fishing along the continental shelf break (COP, Section 4.4.6.2; Dominion Energy 2022). Highly migratory species are the primary target within the Lease Area, including tuna, various billfish (e.g., blue marlin [*Makaira nigricans*]), and tilefish. Targeted species for recreational fishing trips originating in North Carolina and Virginia, as well as offshore recreational fishing tournaments typically occurring in late summer (COP, Section 4.4.6.2; Dominion Energy 2022).

3.9.1.4.1 Target Species

Recreational fisheries in Virginia recorded considerable landings of spot (*Leiostomus xanthurus*), Atlantic croaker, cobia, spotted sea trout (*Cynoscion nebulosus*), black seabass, Spanish mackerel (*Scomberomorus cavalla*), southern kingfish (*Menticirrhus americanus*), red drum, bluefish, and other species. Species that yielded large recreational catches in the geographic analysis area in 2019 or 2020 include striped bass, yellowfin tuna (*Thunnus albacares*), scup, bluefish, summer flounder, black seabass, tautog, dolphinfish, bluefin tuna (*T. thynnus*), spotted seatrout, and other species (NOAA 2021b). The most commonly targeted species in 2019 in Virginia from charter boats were tunas and mackerels, whereas in North Carolina, dolphinfish was the most common (as ranked by the number of individuals fishing; Table 3.9-10) (COP, Section 4.4.6.2; Dominion Energy 2022). Fishing tournaments offshore of Virginia and North Carolina typically target billfish and tunas (COP, Section 4.4.6.2; Dominion Energy 2022). At Triangle Reef specifically, commonly targeted species include tautog in the wintertime, sea bass throughout the year, and triggerfish (Balistidae) and flounder in the summer, but numerous species of fish and sharks can be caught throughout the year (Young n.d.). In the broader geographic analysis area, recreational fisheries target a variety of species including highly migratory species (e.g., tunas, dolphinfish, wahoo), sharks, flounders, black seabass, Atlantic cod, haddock, pollock, scup). While the majority of for-hire recreational fishing effort is concentrated in nearshore coastal areas, a substantial portion of charter fishing effort overlaps with offshore wind lease areas (Figure 3.9-1).

Table 3.9-10 Recreational Saltwater Catch (Number of Individuals) in Virginia and North Carolina in 2019

Virginia– 2019 Total Catch					
Species Group	**Charter Boat**	**Party Boat**	**Private/ Rental Boat**	**Shore**	**Total**
Bluefish	3,151	515	54,939	1,100,382	1,158,987
Cartilaginous fishes	33	336	24,872	242,874	268,115
Dolphins	3,805	0	20,706	0	24,511
Drums	1,525	64	361,794	4,196,659	4,560,042
Eels	1	12	0	0	13
Flounders	32	9	76,842	303,582	380,465
Grunts	0	143	37,081	110,363	147,587
Herrings	0	0	3,989	0	3,989
Jacks	0	61	127	11,040	11,228
Other fishes	8,240	53	59,067	20,111	87,471
Porgies	0	196	26,813	0	27,009
Puffers	0	31	1,390	39,678	41,099
Sea basses	0	25,140	383,749	71,685	480,574
Sea robins	0	10	1,964	5,236	7,210
Temperate basses	0	0	0	260,836	260,836
Toadfishes	0	43	1,983	0	2,026
Triggerfishes/ filefishes	14	548	3,806	0	4,368
Tunas and mackerels	28,672	3	318,388	400,759	747,822
Wrasses	0	42	7,557	0	7,599
Total	**45,473**	**27,206**	**1,385,067**	**6,763,205**	**8,220,951**

North Carolina – 2019 Total Catch				
Species Group	**Charter Boat**	**Private/ Rental Boat**	**Shore**	**Total**
Barracudas	1,782	29,406	0	31,188
Bluefish	52,957	987,758	6,937,630	7,978,345
Cartilaginous fishes	8,360	221,719	1,818,660	2,048,739
Catfishes	143	0	7,762	7,905
Cods and hakes	58	0	8,204	8,262
Dolphins	163,998	329,374	0	493,372
Drums	13,957	640,036	14,664,542	15,318,535
Eels	71	0	0	71
Flounders	1,007	101,095	661,235	763,337
Grunts	14,863	182,364	288,881	486,108
Herrings	54	257,257	314,825	572,136
Jacks	12,432	111,499	3,414,080	3,538,011
Mullets	0	43,498	722,386	765,884
Other fishes	66,325	267,342	738,495	1,072,162
Porgies	9,379	298,993	4,196,379	4,504,751
Puffers	52	100,467	3,617,114	3,717,633

Sea basses	69,094	1,275,236	244,011	1,588,341
Sea robins	0	4,439	163,930	168,369
Snappers	18,785	77,632	0	96,417
Temperate basses	129	1,286	5,531	6,946

Source: Dominion Energy 2022.
Note: Virginia separates "Party Boat" from "Charter Boat"; North Carolina combines these.

Target species for recreational saltwater fishing tournaments are summarized in Table 3.9-11. Target species vary by tournament, but generally consist of highly migratory species including marlins, spearfish, swordfish, and tunas.

Table 3.9-11 Target Species for Recreational Saltwater Tournaments in Coastal Virginia.

Target Species	Virginia Beach Tuna Tournament	Virginia Beach Invitational Marlin Tournament	Wine, Women, and Fishing Tournament	Virginia Beach Billfish Tournament	Oceans East Swordfish Tournament
Blue marlin		X	X	X	
White marlin		X	X	X	
Sailfish		X	X	X	
Longbill spearfish		X		X	
Roundscale spearfish				X	
Swordfish		X			X
Bluefin tuna	X	X	X	X	
Bigeye tuna	X	X	X	X	
Albacore tuna	X		X	X	

Source: Dominion Energy 2022.
Note: X indicates target species; blank cells indicate that the species is not targeted.

3.9.1.4.2 Gear Type

Fishing techniques used on for-hire recreational fishing vessels fishing in and around the Project area vary by target species, but include trolling, jigging, spinning, deep-dropping, spearfishing, and shellfishing (VMRC n.d.). However, much of the recreational fishing that occurs in the region is from shore using rod and reel. When not fishing from shore, personal vessels and for-hire vessels are used most commonly to access fishing areas.

In the Project area, spearfishing is common and is usually conducted by divers at offshore structures. Spearfishing activity has been noted at the CVOW-Pilot Project turbines and it is expected that if the full array of WTGs are installed in the Project area, spearfishing activity would likely increase.

3.9.1.4.3 Economic Value

Recreational fisheries also generate revenue for coastal communities through the need for goods and services (e.g., dockage, tackle and other equipment, meals, lodging, vessel repairs). In 2018, the for-hire recreational fishery sector in Virginia supported 116 jobs and generated $10.9 million in sales, $3.6 million in income, and $6.5 million in added value to the community (NMFS 2021c).

Recreational saltwater fishing tournaments also significantly contribute to local and regional economies. Participants in tournaments spend money on food, fuel, lodging, fishing gear and bait, as well as rental/charter vessels. Tournament operators have reported an average net return per tournament of

$16,045, with each participating team spending on average $13,360 per tournament (Hutt and Silva 2019).

3.9.1.5 Current Trends

Commercial fisheries and for-hire recreational fishing in the geographic analysis area are subject to pressure from ongoing activities, including regulated fishing effort, changes in fisheries management strategies (e.g., implementation of catch-share programs), vessel traffic, and climate change. Fisheries management impacts commercial fisheries and for-hire recreational fishing in the region through management of sustainable fish stocks and measures to reduce impacts on important habitat and protected species. These management plans include spatial and temporal-based measures such as regulated fishing seasons, rotational management areas, and closed areas. The management plans also include effort-based management measures such as limitations on days-at-sea and quota allocation on a species level or on individual fishermen/vessels. These management measures constrain how the fisheries operate and adapt to change, may reduce or increase the size of available landings to commercial and for-hire recreational fisheries, and incentivize the consolidation of commercial fleets (Kuriyama et al. 2019). Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60 percent (McCreary and Brooks 2019). This, coupled with management measures aimed at rebuilding severely depleted lobster stocks in southern New England, may influence fishing effort in the lobster and Jonah crab (*Cancer borealis*) fisheries in the geographic analysis area south of Cape Cod, Massachusetts. The Baseline Conditions section in Table 3.9-2 includes additional details on specific future fishery management actions that would affect commercial fisheries and for-hire recreational fishing (also see BOEM 2021a).

Impacts on commercial and for-hire recreational fishing industries also occurred from the recent COVID-19 pandemic, which led to the cancellation of numerous fisheries-independent surveys and a 16-month suspension of data collection mechanisms such as the Northeast observer program. COVID-related restrictions on travel, declines in consumer demand, and labor shortages in many direct and support services also had a marked impact on commercial and for-hire recreational fisheries (NOAA 2021b; Grabowski and Scyphers 2020).

Climate change is also predicted to affect Northeast and Mid-Atlantic fishery species and fishing communities (Hare et al. 2016; Rogers et al. 2019). Impacts may affect local and regional commercial and for-hire fisheries differently. For example, some commercially and recreationally important species may be subject to increases or decreases in available habitat and shifts in distribution. The ability of fisheries regulatory bodies to adapt to these changes quickly may have a direct influence on the health and sustainability of certain fish and shellfish stocks. Changing environmental and ocean conditions (currents, water temperature, etc.), increased storm magnitude or frequency, and shoreline changes can affect fish distribution, populations, and availability to commercial and for-hire recreational fisheries. See Section 3.13 for impacts on finfish, invertebrates, and essential fish habitat. Sea level rise and storm intensity may also have a direct effect on coastal infrastructure available to commercial and recreational fisheries. Impacts from other ongoing activities, including structures such as existing cables and pipelines, have been largely mitigated through burial of the infrastructure, but remain a consideration.

3.9.2 Environmental Consequences

3.9.2.1 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

Definitions of impact levels are provided in Table 3.9-12 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

.

Table 3.9-12 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Impacts on the affected activity or community would be avoided and would not disrupt the normal or routine functions of the affected activity or community. Once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects.
	Beneficial	Small or measurable effects that would result in an economic improvement.
Moderate	Adverse	Impacts on the affected activity or community are unavoidable. The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Project or, once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects if proper remedial action is taken.
	Beneficial	Notable and measurable effects that would result in an economic improvement.
Major	Adverse	The affected activity or community would experience substantial disruptions and, once the affecting agent is eliminated, the affected activity or community could retain measurable effects indefinitely, even if remedial action is taken.
	Beneficial	Large local or notable regional effects that would result in an economic improvement.

3.9.3 Impacts of the No Action Alternative on Commercial and Recreational Fisheries

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing non-offshore wind activities and other offshore wind activities. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.9.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing described in Section 3.9.1, *Description of the Affected Environment for Commercial Fisheries and For-Hire Recreational Fishing*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Ongoing non-offshore wind activities within the geographic analysis area that are contributing or may contribute to impacts on commercial fisheries and for-hire recreational fishing resources are generally associated with activities that limit the aerial extent of where fishing can occur such as tidal energy projects, military use, dredge material disposal, and sand borrowing operations; increased vessel congestion that can pose a risk for collisions or allisions; dredging and port improvements, marine transportation, and oil and gas activities; or activities that pose a risk for gear entanglement such as undersea transmission lines, gas pipelines, and other submarine cables. Existing undersea transmission lines, gas pipelines, and other submarine cables are generally indicated on nautical charts and may also cause commercial fishermen to avoid the areas to prevent the risk of gear entanglement. Some of these activities may also result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality, resulting in a less-productive fishery or causing some vessel operators to seek alternate fishing grounds, target a different species, or switch gear types.

Activities of NMFS and fishery management councils could affect commercial and for-hire recreational fisheries through stock assessments, setting quotas, and implementing fishery management plans to ensure the continued existence of species at levels that will allow commercial and for-hire recreational fisheries to occur. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by state, regional, or federal agencies may affect commercial fisheries and for-hire recreational fishing by modifying the nature, distribution, and intensity of fishing-related impacts.

Commercial and for-hire recreational fisheries would also be affected by climate change primarily through ocean acidification, ocean warming, sea level rise, and increases in both the frequency and magnitude of storms, which could lead to altered habitats, altered fish migration patterns, increases in disease frequency, and safety issues for conducting fishing operations.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on commercial and recreational fishing include:

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

Ongoing O&M of the Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect commercial and recreational fishing through the primary IPFs of noise, presence of structures, and cable emplacement and maintenance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.9.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

3.9.3.2 Cumulative Impacts of the No Action Alternative

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

Offshore wind development along the U.S. Atlantic coast is expected to result in over 3,287 turbine structures (WTG, OSS, and met towers) over the next 30 years (see Table F-3 in Appendix F). BOEM expects offshore wind activities to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs:

Anchoring: Anchoring could pose a localized (within a few hundred feet of anchored vessels), temporary (hours to days) navigational hazard to fishing vessels. There would be an increase in vessel anchoring during survey activities and during the construction and installation of offshore components as a result of offshore wind activities over the next 10 years. However, the location and level of these impacts would depend on specific locations and duration of activity, and the use of dynamic positioning vessels would lessen this impact. As specified in Appendix F, Table F2-2, BOEM assumes that up to 1,955 acres (7.9 square kilometers) of seafloor could be disturbed within the geographic analysis area as a result of anchoring during construction activities over the next 10 years. In addition, there could be increased anchoring associated with the installation of met towers or buoys. Anchoring impacts on finfish, invertebrates, and essential fish habitat are discussed in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, and impacts on navigation and vessel traffic are discussed in Section 3.16, *Navigation and Vessel Traffic*.

New cable emplacement and maintenance: This IPF could cause localized, short-term impacts including disrupting fishing activities during active installation and maintenance or periods during which the cable is exposed on the seabed prior to burial (if simultaneous lay and burial techniques are not used). As specified in Appendix F, Table F2-2, BOEM assumes over 130,145[1] acres (526.7 square kilometers) of seafloor could be disturbed within the geographic analysis area as a result of inter-array and export cable emplacement. Although the offshore wind projects listed in Appendix F are currently at various stages in the process, BOEM does anticipate some simultaneous emplacement activities. This will result in an actual disturbed footprint that will vary in scale and location over the course of the 10-year period. Fishing vessels may not have access to affected areas, in whole or in part, over various durations during the installation and operation period, which could lead to reduced revenue, displacement, or increased conflict over other fishing grounds. Because most construction activities would likely take place in more favorable conditions (i.e., late spring through early fall), fisheries and fishery resources most active during that time period would likely be affected more than those in the winter (e.g., the longfin squid fishery). The localized commercial and for-hire recreational fishing industries proximal to the offshore export cable corridor (OECC) landing sites would also be disproportionately affected by emplacement activities.

Noise: Noise from construction, site assessment and monitoring geological and geophysical (G&G) survey activities, operations and maintenance, pile driving, trenching, and vessels could cause localized, temporary impacts on commercial fisheries and for-hire recreational fishing through direct effects on species (Popper and Hastings 2009). The most impactful noise on commercial fisheries and for-hire recreational fishing is expected to result from pile driving, which can cause behavioral changes, injury, and mortality (Popper et al. 2014). Noise impacts are also anticipated from operational WTGs; however, these are anticipated to occur at relatively short distances from the WTG foundations and there is no available information to suggest that such noise would negatively affect fishery resources on a broad scale (English et al. 2017); therefore, fishery-level impacts are unlikely in this context.

Port utilization: Ports are largely privately owned or managed businesses that are expected to compete against each other for offshore wind business. Major fishing ports in the geographic analysis area that have been identified as possible ports to support offshore wind energy construction and operations include New Bedford, Massachusetts; Hampton Roads, Virginia; Atlantic City and Ocean City, New Jersey; and Montauk, New York. Of those ports, only New Bedford and Hampton Roads have been identified as possible construction staging area ports. Other non-major fishing ports could also be used for operation and maintenance support. Port expansion and modification could have local, temporary impacts on commercial and for-hire fishing vessels in ports used for both fishing and offshore wind and other projects, and some displacement of available dockage may occur.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through fish aggregation, habitat conversion, allisions, displacement of certain vessels/gear types, entanglement or gear loss/damage, navigation hazards (including transmission cable infrastructure), alterations on fisheries management mechanisms, space use conflicts, and safety-related issues (e.g., hindering search and rescue). These impacts may arise from buoys, met towers, WTG

[1] Kitty Hawk South has 3 export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Caroline) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-mile-wide corridor to Virginia and 1,000-mile-wide corridors to North Carolina to allow for optimal routing of the cables.

foundations, OSSs, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Appendix F, Tables F2-1 and F2-2, the expanded planned activities scenario would include over 3,135 WTGs, 4,592 acres (18.6 square kilometers) of WTG scour protection, and 2,684 acres (10.9 square kilometers) of new hard protection atop export and inter-array cables. Projects may also install additional buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until conceptual decommissioning of each facility is complete.

Structures may alter the availability of targeted fish species in the immediate vicinity of the structures for commercial and for-hire recreational fishers. Structure-oriented fish such as black sea bass, striped bass, lobster, and cod may increase in areas where there was no previous structure (natural or artificial) (Claisse et al. 2014; Linley et al. 2007; Smith et al. 2016; Stevens et al. 2019). Highly migratory species may also be attracted to the wind turbine foundations (Fayram et al. 2007). Flatfish, clams, and squid species are likely to remain in open soft-bottom sandy areas, although offshore wind structures may act as substrate for larval settlement. Furthermore, altered community composition could change natural mortality of certain species due to predation (decrease) or refuge (increase), and increase competition between species, which could have beneficial and adverse effects, depending on the species (Langhammer 2012). These effects are not anticipated to result in stock-level impacts that would affect fisheries.

The presence of structures (including transmission cable infrastructure) would have long-term impacts on commercial fisheries and for-hire fishing by increasing the risk of allisions, entanglement or gear loss/damage, and navigational hazards. Although portions of cable infrastructure achieving target burial depths (3 to 3.3 feet [1 to 1.2 meters] below stable seabed elevation) would not likely pose a risk to vessels using mobile bottom-tending gear (Eigaard et al. 2015), the conversion of soft sediment to hard bottom via protective cover could negatively affect vessels fishing with bottom-tending mobile gear (e.g., dredges and trawls) by increasing the risk of snagging structure and the resultant vessel instability. The need to change vessel transit routes may also affect commercial and for-hire recreational fisheries by affecting travel time, fuel consumption, and overall trip costs. Certain sectors of the commercial fishing industry will likely be at higher risk operating within a WEA (e.g., mobile gear such as trawls and dredges) due to maneuverability and entanglement hazards. Similar considerations also apply to fisheries-dependent and fisheries-independent surveys. Several long-standing fisheries surveys utilize mobile gear and have stations that will fall within offshore wind lease areas. These stations may need to be repositioned or non-standardized gear used, which will induce inconsistency in the data compared to the historical time series.

Space use conflicts could cause a temporary or permanent reduction in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Potential increases in structure-affiliated species (e.g., black sea bass) may result in an increase in for-hire recreational vessel trips in and around turbine structures. This may result in increased gear or space use conflicts as commercial fisheries and for-hire recreational fishing compete for space between turbines. Commercial fishing vessels, particularly those using mobile gear, which typically fish in areas designated as a Wind Farm Area may be displaced, and this relocation of fishing activity outside of offshore wind lease areas could increase conflict among commercial fishing interests as other areas are encroached. The competition is expected to be higher for less-mobile species such as lobster, crab, surfclam/ocean quahog, and sea scallop.

Table 3.9-13 shows the annual commercial fishing revenue exposed[2] to offshore wind energy development in the Mid-Atlantic and New England regions by FMP fishery from 2021 through 2030. However, it is only a lower-bound estimate of the maximum exposed revenue, as it is calculated using

[2] Revenue exposure is the amount of revenue that could be potentially affected by WEA development.

average historical revenue overlapping the WEAs and is based on vessel trip reporting data, which do not fully capture all fishery operations in the WEAs.

The amount of revenue at risk increases as proposed offshore wind energy projects are constructed and come online, and would continue beyond 2030 during the continued operational phases of the offshore wind energy projects. The largest impacts in terms of exposed revenue are expected to be in the sea scallop, other FMP, non-disclosed species, and non-FMP fisheries, and surfclam/ocean quahog FMP fisheries. The maximum exposed revenue is projected to occur in 2030, but exposure will continue to increase in years thereafter until facilities are decommissioned.

Table 3.9-13 Annual Commercial Fishing Revenue Exposed to Offshore Wind Energy Development in the New England and Mid-Atlantic Regions Under the No Action Alternative by Fishery Management Plan

FMP Group	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 [1]
Mackerel, Squid, and Butterfish	$0.11	$0.11	$388.43	$625.18	$821.63	$1,187.76	$1,341.04	$1,474.91	$1,608.77	$1,608.77
Summer Flounder, Scup, Black Sea Bass	$0.15	$0.15	$306.08	$458.93	$641.68	$913.00	$1,098.87	$1,263.83	$1,428.79	$1,428.79
Northeast Multispecies (small-mesh)	$0.00	$0.00	$143.55	$185.44	$275.53	$366.48	$394.86	$411.72	$428.57	$428.57
Skates	–	–	$260.53	$299.64	$360.34	$455.44	$506.68	$538.91	$571.14	$571.14
American Lobster	$0.00	$0.00	$331.97	$377.13	$449.60	$606.01	$705.63	$760.30	$814.98	$814.98
Monkfish	$0.00	$0.00	$439.94	$513.04	$620.05	$784.47	$888.22	$970.77	$1,053.31	$1,053.31
Sea Scallop	$0.00	$0.00	$465.66	$2,709.55	$2,983.86	$7,927.08	$12,794.32	$17,634.56	$22,474.79	$22,474.79
Jonah Crab	$0.00	$0.00	$56.46	$93.99	$239.69	$326.31	$350.67	$371.17	$391.68	$391.68
Other FMPs, non-disclosed species and non-FMP fisheries	$0.42	$0.42	$783.50	$936.47	$1,123.64	$1,723.86	$2,137.48	$2,519.32	$2,901.16	$2,901.16
Golden and Blueline Tilefish	–	–	$4.14	$9.60	$55.69	$76.27	$81.37	$86.35	$91.33	$91.33
Northeast Multispecies (large-mesh)	–	–	$182.64	$197.21	$214.93	$264.12	$286.49	$300.78	$315.07	$315.07
Bluefish	$0.00	$0.00	$5.92	$8.51	$12.56	$16.08	$18.06	$19.60	$21.13	$21.13
Spiny Dogfish	–	–	$21.46	$28.71	$33.55	$39.48	$43.59	$45.70	$47.80	$47.80
Surfclam, Ocean Quahog	–	–	$132.53	$169.30	$792.71	$1,191.92	$1,591.13	$1,990.34	$2,389.56	$2,389.56
Atlantic Herring	–	–	$65.78	$97.88	$117.20	$169.57	$211.01	$243.39	$275.78	$275.78
Highly Migratory Species	$0.00	$0.00	$0.15	$0.21	$0.63	$0.86	$1.09	$1.31	$1.52	$1.52
All FMP and non-FMP Fisheries	$0.69	$0.69	$3,588.73	$6,710.80	$8,743.28	$16,048.69	$22,450.51	$28,632.95	$34,815.38	$34,815.38

Source: NMFS 2021d; excludes the Proposed Action.

Note: Dollar amounts are in $1,000s.
[1] This column represents the total average revenue exposed in 2030 in order to give a value reference for the percentage of revenue exposed in 2030.
Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery-dependent landings' data. To produce the data set, Vessel Trip Report information was merged with data collected by at-sea fisheries observers, and a cumulative distribution function was estimated to present the distance between Vessel Trip Report points and observed haul locations. Resolution of the data does not allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates only pertain to individual offshore wind lease areas. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. Slight differences in totals are due to rounding.
"–" indicates the value is zero; "$0" indicates the value is positive but less than $100.

Of all the sub-IPFs identified herein, the presence of structures is likely to be the main mechanism of impacts on commercial and for-hire recreational fisheries. The presence of structures associated with offshore wind is anticipated to yield a variety of both positive and negative impacts on commercial and for-hire recreational fisheries, the extent of which are dependent on numerous factors. Additional details on the anticipated impacts on commercial and for-hire recreational fisheries in the geographic analysis area can be found in BOEM 2021a and 2021b.

Increased vessel traffic: Increased vessel traffic associated with offshore wind development could increase congestion, delays at ports, and the risk for collisions with fishing vessels. As stated in Section 3.16, offshore wind projects would result in a small incremental increase in vessel traffic, with a peak during surveys and construction over a 6- to 10-year period, particularly when offshore wind project construction activities overlap (Appendix F, Table F-4). The presence of construction vessels could restrict harvesting or other fishing activities in offshore wind lease areas and along cable routes during installation and maintenance activities.

Climate change: Climate change is affecting commercial fisheries and for-hire recreational fishing and is predicted to continue to do so over the course of this analysis. The primary driver of climate change-induced impacts on fisheries resources stems from an increase in sea surface and bottom temperature resulting in shifts in distribution, habitat utilization, and movement (Fabrizio et al. 2014; Hopkins and Cech 2003; Secor et al. 2018; Sims et al. 2001). Fish and invertebrate distribution in the Northeast and Mid-Atlantic have shifted markedly northward and into deeper waters over the past 35 years (NOAA 2022). These shifts in species distribution have changed, and will continue to change, the distribution of commercial fishing effort, impacting commercial and for-hire recreational fishermen and coastal communities (Hare et al. 2016; Rogers et al. 2019). Ocean acidification, resulting from enriched levels of CO_2 in the marine environment, may impact growth and survival of many important crustacean and bivalve species including lobster, oyster, and scallops (Talmage and Gobler 2010; Keppel et al. 2012).

Additional impacts on commercial fisheries and for-hire recreational fishing can result from climate change events such as an increase in the magnitude and frequency of storms and shoreline changes due to sea level rise. Increased freshwater input into nearshore estuarine habitats from stronger and more frequent precipitation events can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016). These effects may directly or indirectly impact commercially and recreationally important species and result in a decrease in catch or an increase in fishing costs (e.g., transit costs to other fishing grounds, need to switch to different fishing gear to target a different species). Thus, the viability of businesses engaged in or supporting commercial fisheries and for-hire recreational fishing could be affected. The economies of communities reliant on commercial and/or for-hire recreational fisheries may also be vulnerable to climate change-induced effects, as fishing-related infrastructure near the shore could be adversely affected by sea level rise (Colburn et al. 2016; Rogers et al. 2019).

Regulated fishing effort: Regulated fishing effort refers to fishery management measures necessary to maintain maximum sustainable yield under the Magnuson-Stevens Fishery Conservation and Management Act. This includes quota and effort allocation management measures. Offshore wind development could influence regulated fishing effort through two primary pathways: by changing fishing behavior to such an extent that overall harvest levels are not as predicted, and by impacting fisheries scientific surveys on which management measures are based. If scientific survey methodologies are not adapted to sample within wind energy facilities, then there could be increased uncertainty in scientific survey results, which would increase uncertainty in stock assessments and quota setting processes. Future spatial management measures may change in response to changes in fishing behavior due to the presence of structures. Impacts on management processes would in turn have short-term or long-term impacts on commercial and for-hire recreational fisheries operations.

3.9.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on commercial and recreational fishing. These effects are primarily driven by offshore construction impacts, the presence of structures.

Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to follow current regional trends and respond to current and future environmental trends and societal activities.

BOEM expects planned and ongoing offshore wind activities and future non-offshore wind activities to have continuing temporary to long-term impacts (displacement, space use conflicts, navigational and fishing hazards, changes in target species abundance and distribution) on commercial fisheries and for-hire recreational fishing, primarily through new cable emplacement, noise, port expansion, presence of structures, vessel traffic, ongoing climate change, and regulated fishing effort. The extent of impacts on commercial fisheries and for-hire recreational fishing would vary by fishery due to different target species, gear type, and location of activity.

BOEM anticipates **moderate** adverse to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fisheries as a result of ongoing activities other than offshore wind. This is largely driven by the effects of climate change and the ability for fisheries management agencies to readily adapt to changing distributions, and other climate-related effects. Regulated fishery effort will also have a substantial influence on commercial fisheries and for-hire recreational fishing in the geographic analysis area.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and commercial and recreational fishing would continue to be affected by natural and human caused IPFs. In addition to ongoing activities, reasonably foreseeable (i.e., planned) activities other than offshore wind may also contribute to impacts on commercial fisheries and for-hire fishing, particularly from increased vessel traffic and climate change. BOEM anticipates **moderate** adverse to **major** adverse impacts on commercial fisheries from planned actions other than offshore wind (dependent largely on the ability for management to adapt to climate change). For-hire recreational fisheries would experience **moderate** adverse impacts due to the potential need to shift fishing grounds as well as ongoing effects of climate change. In the context of reasonably foreseeable trends (e.g., environmental, infrastructure) BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **moderate** adverse to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fisheries.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with offshore wind activities in the geographic analysis would result in **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing due primarily to the presence of structures (e.g., through gear loss, navigational hazards, space use conflicts, and potential impacts on fisheries surveys), new cable emplacement and to pile-driving noise. The presence of structures may also induce a **moderate beneficial** impact, particularly on the for-hire recreational fishing.

The No Action Alternative would forgo any current or planned fisheries monitoring that Dominion Energy has committed to voluntarily perform, the results of which could provide an understanding of the effects of offshore wind development in and around the Project area, benefit future management of commercial and for-hire fisheries and inform planning of other offshore developments. However, other ongoing and future surveys could still provide similar data to support similar goals.

3.9.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Number, type, size, and location of WTGs and OSSs.
- The export cable landfall's potential to interfere with nearshore fishing grounds during construction.
- The route of the inter-array cables and the offshore export cable, including the ability to reach target burial depth.
- The type of cable protection measures when burial depth is insufficient. Cables that may not achieve the proper burial depth and would require cable protection in the form of rock placement, concrete mattresses, or half-shells. Such covers can change the fish habitat (soft-bottom habitat to hard-bottom habitat) and can also damage fishing gear and equipment, which in turn could cause a potential safety hazard should gear snag or hook on to seabed structures. Cable protection measures could also result in a fish-aggregating effect for structure-oriented species. With an increase in structure-oriented species, predation in the vicinity of cable protection structures has the potential to increase. Alternatively, new hard surfaces could provide new habitat for hard-bottom species, resulting in increases in biomass for commercially or recreationally fished benthic fish and invertebrates. New hard-bottom habitat could also be colonized by invasive species (e.g., certain tunicate species), but in the event this occurs, it is not expected to substantially affect commercial or for-hire recreational fisheries.
- The time of the year during which construction occurs. For-hire recreational fisheries are generally most active when the weather is more favorable, while commercial fishing is active year-round with many species harvested throughout the year. However, certain fisheries have peak times. Construction activities can affect access to fishing areas and availability of fish in the area, thereby reducing catch and fishing revenue.

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

- WTG and OSS number, size, and location: the level of impacts related to presence and location of structures. The number and size of WTGs and OSSs will influence the magnitude of impacts stemming from navigation, accessibility/displacement, and habitat conversion effects. Because known fishing grounds exist within the Project area (e.g., Triangle Reef), presence or lack of structures on or in the vicinity of these grounds will greatly influence the magnitude of impact.
- Season of construction: although commercial and for-hire recreational fishing occurs year-round, the majority of for-hire recreational fishing occurs April through October. Construction outside of this window would have a lesser effect on commercial fisheries and for-hire recreational fishing than construction during the active season.

3.9.5 Impacts of the Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

Anchoring: Vessel stabilization during construction and possibly during conceptual decommissioning are assumed to be primarily done using either spud barges, jack-up vessels, or dynamic positioning vessels;

therefore, only minimal anchoring would occur. Vessel anchoring would cause temporary impacts on fishing vessels and fishing activities. Anchoring vessels used in the course of the Proposed Action would pose a navigational hazard to fishing vessels and disturb seafloor habitats. All impacts would be localized, and potential navigation hazards would be temporary (hours to days). The anticipated impacts from anchoring on commercial fisheries and for-hire recreational fishing in the geographic analysis area under the Proposed Action alone would be negligible. Anchoring impacts on finfish, invertebrates, and essential fish habitat are discussed in Section 3.13. Under Alternative A-1, impacts from anchoring would generally be the same as or slightly lower than the Proposed Action due to the construction of three fewer WTGs and aligning the OSSs within the gridded layout of WTGs.

New cable emplacement and maintenance activities: The Proposed Action would result in up to 988 acres (4.0 square kilometers) (Table F2-2; Dominion Energy 2022) of temporary seafloor disturbance by cable installation, some of which will be co-located during the cable entrenchment process. Alternative A-1 would require slightly fewer inter-array cables than the Proposed Action due to the construction and operation of three fewer WTGs. Construction and installation of the Proposed Action or Alternative A-1 could prevent deployment of fixed and mobile fishing gear in limited parts of the Project area from 1 day up to several months (if simultaneous lay and burial techniques are not used), which may result in the loss of revenue if alternative fishing locations are not available. Activities from cable emplacement would require communications with fixed-gear fisheries to ensure no gear is deployed in the installation path. According to information provided in the COP (Sections 4.4.6.1 and 4.4.6.2; Dominion Energy 2022), fixed commercial gears are much more prevalent than mobile gear. The Proposed Action or Alternative A-1 would result in localized and temporary minor adverse impacts.

Though many of the impacts from cable installation are temporary, it is expected that 253 acres (1.0 square kilometers) of the offshore export cable would require cable protection and would therefore be permanently impacted. Although cable routes and lengths for most other offshore wind projects are not known at this time, using assumptions in Appendix F, Table F2-2, the total seafloor disturbance from new cable emplacement within the geographic analysis area is estimated to be over 132,813[3] acres (537.5 square kilometers). Overall, cable-laying activities would not restrict large areas, and navigational impacts would be on the scale of hours to days.

Noise: Noise from G&G surveys, construction, trenching, pile driving, operations, and maintenance may occur during construction of the Proposed Action. Noise can temporarily disturb fish and invertebrates in the immediate vicinity of the source, causing a temporary behavior change, including leaving the area affected by the sound source. Impacts on commercial fisheries and for-hire recreational fishing would depend on the duration of the noise-producing activity and corresponding impacts on fish species, coinciding with fishing, and are anticipated to be negligible to minor adverse impacts from the Proposed Action alone.

Acoustic modeling of construction noise indicates noise that exceeds behavioral thresholds for fish may extend to approximately 6 miles (10 kilometers) with 10 dB noise attenuation, so during impact pile driving fish may swim as far as 6 miles (10 kilometers) to avoid the greatest area of ensonification. However, this distance is based on the Project using the highest hammer energy, which will not occur for the full duration of construction, and impact pile-driving activities are only expected to occur for 4–6 hours per day, so this avoidance would be temporary. Additionally, the Project would only conduct impact pile-driving activities between May and October, and they would only occur during 109 days in

[3] Kitty Hawk South has 3 export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Caroline) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-mile-wide corridor to Virginia and 1,000-mile-wide corridors to North Carolina to allow for optimal routing of the cables.

2024, 114 days in 2025, and 15 days in 2026 per the schedule in Table 8 of the Letter of Authorization application, so any avoidance of the ensonified area would be temporary and would not be expected to result in any biologically significant effects.

While Alternative A-1 would result in a slightly reduced duration of underwater noise and vibration due to the construction of fewer WTGs compared to the Proposed Action (up to 202 WTGs under Alternative A-1), potential impacts to commercial fishers and for-hire recreational fishing are anticipated to be the same. Potential mitigation measures are outlined in the COP (Section 3.4.1.1; Dominion Energy 2022). Noise impacts on fish and invertebrates are discussed in Section 3.13.

The negligible to minor adverse impacts of noise under the Proposed Action or Alternative A-1 alone would not considerably increase the impacts of noise beyond the impacts under the No Action Alternative.

Port utilization: During construction and operations, vessels would use existing ports, particularly Portsmouth, Virginia (COP, Table 3.4-5; Dominion Energy 2022). This may result in a slight decrease in available dockage. Therefore, the Proposed Action or Alternative A-1 would generate minor adverse impacts on commercial fisheries and for-hire recreational fishing associated with port utilization.

The minor impacts of port utilization under the Proposed Action or Alternative A-1 alone would not considerably increase the level of impact under the No Action Alternative.

Presence of structures: The various types of impacts on commercial fisheries and for-hire recreational fishing that could result from the presence of structures are described in detail in Section 3.9.3.1, *Impacts of the No Action Alternative*. The Proposed Action or Alternative A-1 may result in 205 or 202 foundations and 3 OSSs, respectively. The total disturbance from the foundation footprints and the scour protection for the Proposed Action would be 177 acres (0.7 square kilometer), with slightly less for Alternative A-1.

The impacts from the presence of structures associated with the Proposed Action or Alternative A-1 alone on commercial fisheries and for-hire recreational fishing are anticipated to range from negligible to major adverse impacts based on the sub-IPFs identified in Table G-6 and would not increase the impacts across entire fisheries beyond those of the No Action Alternative. However, impacts on local commercial fisheries and for-hire recreational fishing would be greater than under the No Action Alternative. Magnitude of impact will also vary depending on distance from the Project area, vessel size, and type of gear used (e.g., large mobile-gear vessels would be affected more than smaller fixed-gear vessels). There would also be a minor beneficial impact on local for-hire recreational fishing (e.g., from fish aggregation effects).

The installation of components, as well as the presence of construction vessels and permanent structures, could restrict harvesting and fishing activities in the Project area. The mechanisms of impacts from structures associated with the Proposed Action or Alternative A-1 on commercial fisheries and for-hire recreational fishing are similar to those presented for other projects and are described in detail in the COP (Section 4.4.6.3; Dominion Energy 2022; BOEM 2021a).

The location of the proposed infrastructure within the Project area could affect transit corridors and access to preferred or traditional fishing locations. The presence of structures in the Fish Haven area would create space use conflicts between recreational and commercial fishers and may increase risk of gear entanglement or loss. Transiting through the Project area could also create challenges associated with using navigational radar when there are many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions like heavy fog. Larger vessels may find it necessary to travel around the Project area to avoid maneuvering among the WTGs. Vessels transiting to/from Virginia Beach may be most affected navigationally by the presence of structures.

Using the assumptions in Appendix F, there could be over 3,207 foundations, 4,790 acres (19.4 square kilometers) of foundation scour protection, and 2,843 acres (11.5 square kilometers) of new hard protection atop cables from planned actions (inclusive of the Proposed Action). Of this, up to 205 WTG foundations, three substations, and 430 acres (1.7 square kilometer) of permanent seafloor disturbance would result from the Proposed Action (Table F2-2; Dominion Energy 2022). Alternative A-1 would result in slightly less seafloor disturbance due to the construction of three fewer WTGs.

Increased vessel traffic: The Proposed Action would generate a small increase in vessel traffic compared to the planned activities scenario (Appendix F), with a peak during the proposed Project construction. Alternative A-1 would result in a slightly smaller increase of vessel traffic than the Proposed Action due to the construction of three fewer WTGs. Offshore construction and installation of the Proposed Action or Alternative A-1 would temporarily restrict access to the Project area (OECC route and Wind Farm Area) during construction. Construction support vessels, including vessels carrying assembled WTGs or WTG components, would be present in the waterways between the Wind Farm Area and the ports used during the Proposed Action or Alternative A-1 construction and installation.

The Proposed Action or Alternative A-1 would result in the use of up to 77 vessels operating at some phase during construction and installation, with most transiting to and from the Project area from Portsmouth, Virginia (COP, Table 3.4-5; Dominion Energy 2022). Vessel trips would average 46 trips per day through the duration of construction activities. Frequency of transit for these vessels fluctuate from daily to only a few cycles in total. Daily estimated vessel trips would be dependent on the construction period and activity and range from a minimum of 8 to a maximum of 44 trips per day.

Fishing vessels transiting in proximity to the Project area or ports being utilized by construction and installation vessels would be required to avoid Project vessels and restricted safety zones though routine adjustments to navigation. Although fishing vessels may experience increased transit times in some situations, these situations are spatially and temporally limited, and, overall, BOEM expects vessel activities in the open waters between the Wind Farm Area and ports and along the OECC to have minor adverse impacts on fishing vessels during the construction and installation phase.

The operations and maintenance of the Proposed Action or Alternative A-1 would require a much more limited number of vessels than construction activities, with most vessels used for routine operations and maintenance. Estimated vessel trips during the operations and maintenance phase is 26 annual round trips for each of two vessel service types (service operations vessel and crew transfer vessel) (COP, Section 3.5.1; Dominion Energy 2022). Given this relatively low number of Project vessel trips during the operations and maintenance phase, it is expected the Proposed Action or Alternative A-1 would have a negligible impact on commercial and for-hire recreational fisheries during this phase. For more discussion, see Section 3.16.

Climate change: This IPF would contribute to shifting distributions of commercial and for-hire recreational fisheries. Because this IPF is a global phenomenon, the impacts in context of reasonably foreseeable environmental trends and planned actions through this IPF would be similar to those under the No Action Alternative. Implementation of offshore wind projects would likely result in a net decrease in greenhouse gases, and more details on this IPF can be found in Sections 3.9.3.1 and 3.9.3.2.

Regulated fishing effort: This IPF would contribute to short-term and long-term moderate adverse impacts on commercial fisheries and for-hire recreational fisheries operations, as described in more detail in Sections 3.9.3.1 and 3.9.3.2. The extent of impacts from offshore wind development on regulated fishing effort is difficult to predict. However, because the Project area is considered lightly fished compared to other offshore wind lease areas, the effects of the Proposed Action or Alternative A-1 alone with respect to fisheries regulations would only marginally increase impacts on commercial and for-hire recreational fisheries beyond those of the No Action Alternative and would be minor.

The impacts on regulated fishing effort would vary depending on the fishery and the changes in fishing behavior due to offshore wind development in the geographic analysis area. Offshore wind development may change the distribution of fishing effort in ways not contemplated in current fishery management plans. Additionally, impacts on fisheries scientific surveys may result in more conservative quota and effort management measures.

3.9.5.1 Cumulative Impacts of the Proposed Action.

This section outlines the cumulative impacts of the Proposed Action considered in combination with other ongoing and planned wind activities.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the combined anchoring impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities, including offshore wind. Anchoring activities would result in minor increased vessel anchoring during survey activities and during the construction, installation, maintenance, and conceptual decommissioning of offshore components. In addition, there could be increased anchoring/mooring of met/ocean buoys. In context of reasonably foreseeable environmental trends and planned actions, anchoring could affect up to approximately 42 acres (0.17 square kilometers), including the Proposed Action (Appendix F, Table F2-2). Overall, impacts would be localized and temporary (hours to days) leading to negligible impacts.

The combined impacts from new cable emplacement and maintenance activities on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action or Alternative A-1, would likely be localized, temporary minor adverse.

Combined noise impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be similar to the impacts under the No Action Alternative, and would range from negligible to moderate adverse.

Combined impacts due to port utilization from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be minor adverse.

In context of reasonably foreseeable environmental trends, the combined impacts from the presence of structures on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action or Alternative A-1, would likely range from negligible to major adverse. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater. Remedial action during conceptual decommissioning may reduce long-term impacts.

Ongoing activities, future activities, and other offshore wind development could incrementally affect commercial fishing vessels as more projects are developed. In context of reasonably foreseeable environmental trends, the combined impacts from increased vessel traffic on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action or Alternative A-1, would range from minor to moderate adverse.

The intensity and type of impacts in context of reasonably foreseeable environmental trends and planned actions, including the Proposed Action or Alternative A-1, resulting from climate change are uncertain, but are likely to be moderate adverse.

In context of reasonably foreseeable environmental trends, the combined impacts of regulated fishing effort on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be moderate adverse.

3.9.5.2 Conclusions

Impact of the Proposed Action. Impacts from the Proposed Action or Alternative A-1 alone would include the temporary or permanent reduction in catch or loss of access to fishing areas due to the presence of construction activities or changes in fish and shellfish populations that are the basis of fishing activities. Other impacts also include a temporary or permanent reduction in fishing activities and fishing revenue due to characteristics of the Proposed Action or Alternative A-1. This could include abandonment of fishing locations due to difficulty in maneuvering fishing vessels, fear of allisions with the Proposed Action or Alternative A-1 components (e.g., WTGs), increased risk of collisions with construction or lay vessels, and fear of damage or loss of deployed gear. Other impacts associated with the Proposed Action or Alternative A-1 include alterations in the management of fisheries resources due to changes in fishing effort (duration, location, methodology), which may impact quota allocation in certain sectors.

In summary, activities associated with the construction and installation, operations and maintenance, and conceptual decommissioning in the Project area as part of the Proposed Action or Alternative A-1 would affect commercial fisheries and for-hire recreational fishing to varying degrees. The main impact would be from the presence of structures, which, when combined with other IPFs could lead to **moderate** adverse impacts on commercial fisheries and for-hire recreational fishing and **minor beneficial** impacts on for-hire recreational fishing. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater.

Cumulative Impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including the Proposed Action or Alternative A-1, would range from **negligible** to **major** adverse. Presence of structures is also expected to yield a **minor beneficial** impact, particularly on for-hire recreational fishing. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1 would result in **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing in the analysis area, driven largely by the presence of structures.

3.9.6 Impacts of Alternatives B and C on Commercial Fisheries and For-Hire Recreational Fishing

Impacts of Alternatives B and C. The impacts resulting from individual IPFs associated with Alternatives B and C would be similar to those described under the Proposed Action, with the exception of the presence of structures. Alternatives B, and C would exclude the Fish Haven area along the northern boundary of the Lease Area (around the Triangle Reef) from development. The Fish Haven areas (including the Triangle Wrecks artificial reef) are important fishing grounds for commercial and recreational fishermen (COP, Section 4.4.6.2; Dominion Energy 2022). Additionally, Alternative C would avoid and minimize impacts to sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, the removal of four WTGs from priority sand ridge habitat, and the relocation of one WTG to a spare position. Commercial fisheries and for-hire recreational fishing local to the Project area would still be affected to a greater degree than fisheries located outside of the Project area under Alternatives B and C. Displacement of the local fisheries effort from other areas within the Project area (both commercial and for-hire recreational) may affect fisheries located outside of the Project area through increased competition for fishing grounds. Alternatives B and C would decrease the number of WTGs (from up to 205 under the Proposed Action, up to 176 under Alternative B, and up to 172 under Alternative C). The length and locations of the OECC between Alternatives B and C and the Proposed Action may differ based on the different number and locations of WTGs. However, BOEM does not expect a change to impact from IPFs or sub-IPFs as compared to the Proposed Action with the exception of the presence of structures (particularly related to structures in the Fish Haven area and sand ridge habitat area; see Section 3.9.5, *Impacts of the Proposed*

Action on Commercial Fisheries and For-Hire Recreational Fishing). The presence of structures sub-IPF would range from negligible to moderate adverse for commercial fisheries and for-hire recreational fishing, which would decrease potential impacts compared to the Proposed Action due to the exclusion of development in the Fish Haven area under Alternatives B and C, and the exclusion of portions of the sand ridge habitat under Alternatives C.

Cumulative Impact of Alternatives B and C. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including Alternatives B, and C would not be notably different from those described under the Proposed Action, and would range from negligible to major adverse.

3.9.6.1 Conclusions

Impacts of Alternatives B and C. Activities associated with the construction and installation, operations and maintenance, and conceptual decommissioning in the Project area under Alternatives B and C would impact commercial fisheries and for-hire recreational fishing similar to the Proposed Action with the exception of the presence of structures IPF. The main impacts would be from the presence of structures, which when considered with other IPFs could lead to **moderate** adverse impacts on commercial fisheries and for-hire recreational fishing and **minor beneficial** impacts on for-hire recreational fishing due to the increase in structures provided by WTGs, OSSs, and associated scour pads. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater. Mitigation measures may reduce impacts post-conceptual decommissioning.

Cumulative Impacts of Alternatives B and C. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including Alternatives B, and C would not be notably different from those described under the Proposed Action, and would range from **negligible** to **major** adverse. Considering all of the IPFs collectively, BOEM anticipates that the overall impact from ongoing and planned actions, including Alternatives B and C would result in the same level of impacts as the Proposed Action: **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing in the geographic analysis area.

3.9.7 Impacts of Alternative D on Commercial Fisheries and For-Hire Recreational Fishing

Impacts of Alternative D. Alternative D differs from the Proposed Action only with respect to onshore routing of the interconnection cable. Because the onshore portion of the Project lies outside of the geographic analysis area for commercial fisheries and for-hire recreational fishing, impacts from Alternatives D-1 and D-2 would be the same as those under the Proposed Action and would range from negligible to major adverse in the geographic analysis area, depending on the IPF. The overall impacts would likely remain as moderate adverse on commercial fisheries and for-hire recreational fishing and minor beneficial on for-hire recreational fishing.

Cumulative Impacts of Alternative D. Considering all of the IPFs collectively, BOEM anticipates that the overall impact from ongoing and planned actions, including Alternative D, would result in the same level of impacts as under the Proposed Action: major adverse on commercial fisheries and moderate adverse on for-hire recreational fishing in the geographic analysis area.

3.9.7.1 Conclusions

Impacts of Alternative D. Although Alternatives D-1 and D-2 would minimize impacts on onshore habitats, BOEM does not anticipate a measurable benefit for finfish, invertebrates, and EFH in the geographic analysis area. Therefore, overall potential impacts would be the same as the Proposed Action and would range from **negligible** to **moderate** adverse.

Cumulative Impacts of Alternative D. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including Alternative D, would not be different from those described under the Proposed Action, and would range from **negligible** to **major** adverse. Considering all of the IPFs collectively, BOEM anticipates that the overall impact from ongoing and planned actions, including Alternative D, would result in the same level of impacts as under the Proposed Action: **major** adverse on commercial fisheries and **moderate** adverse on for-hire recreational fishing in the geographic analysis area.

3.9.8 Proposed Mitigation Measures

BOEM has proposed guidance to lessees for mitigating impacts on commercial and recreational fisheries (see https://www.boem.gov/sites/default/files/documents/renewable-energy/DRAFT%20Fisheries%20Mitigation%20Guidance%2006232022_0.pdf). BOEM will consider requiring mitigation measures that may help mitigate impacts on commercial and for-hire recreational fishing. These measures include the following.

Compensation for Gear Loss and Damage: The lessee shall implement a gear loss and damage compensation program consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment. BOEM recognizes that Dominion Energy has an applicable gear loss and damage claims process resulting from survey activities. This measure, if adopted, would be applicable to the IPF presence of structures during both construction and operations. If adopted, this measure would reduce negative impacts resulting from loss of gear associated with uncharted obstructions resulting from the Proposed Action.

Compensation for Lost Fishing Income: Dominion Energy would implement a compensation program for lost income for commercial and recreational fishermen and other eligible fishing interests for construction and operations consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment. This measure, if adopted, would reduce impacts from the IPF presence of structures by compensating commercial and recreational fishing interests for lost income during construction and a minimum of 5 years post-construction. Levels of funding required by Dominion Energy to be set aside for fulfilling verified claims would be commensurate with commercial fishing revenue amounts in the Project area as described in Section 3.9.1.3. If adopted, this measure would reduce the negligible to major impact level from the presence of structures to negligible to moderate. This is because a compensation scheme will mitigate "indefinite" impacts to a level where the fishing community would have to adjust somewhat to account for disruptions due to impacts, but income losses would be mitigated.

Mobile Gear–Friendly Cable Protection Measures: Cable protection measures should reflect the pre-existing conditions at the site. This mitigation measure, if adopted, ensures that seafloor cable protection does not introduce potential for snags for mobile fishing gear (reducing impacts from the presence of structures IPF). Therefore, the cable protection measures should be trawl-friendly with tapered/sloped edges. If cable protection is necessary in "non-trawlable" habitat, such as rocky habitat, then Dominion Energy would use materials that mirror that benthic environment.

These measures, if adopted, will have the effect of reducing the overall negligible to major impact from the Proposed Action to negligible to moderate. This is driven largely by compensatory mitigation that will mitigate “indefinite” impacts to a level where the fishing community would have to adjust somewhat to account for disruptions due to impacts, but income losses would be mitigated. Other measures will also alleviate some impacts associated with the Proposed Action. BOEM anticipates that the overall impacts on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be unchanged (major) because some commercial and for-hire recreational fisheries and fishing operations could experience substantial disruptions indefinitely, even with these Project-specific mitigation measures.

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3.10 Cultural Resources

This section discusses potential impacts on cultural resources from the proposed Project, alternatives, and ongoing and planned activities in the cultural resources geographic analysis area. The cultural resources geographic analysis area, as shown on Figure 3.10-1, is equivalent to the Project's area of potential effect (APE), as defined in the implementing regulations for NHPA Section 106 at 36 CFR Part 800 (Protection of Historic Properties). In 36 CFR 800.16(d), the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist." BOEM (2020) defines the Project APE as the following:

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities, constituting the marine portion of the APE.
- The depth and breadth of terrestrial areas potentially impacted by any ground-disturbing or other physical activities, constituting the terrestrial portion of the APE.
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible, constituting the visual portion of the APE.
- Any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the APE.

The phrase *cultural resource* refers to a physical resource valued by a group of people. The resource can be historic (post-Contact) in character or date to the pre-Contact past (i.e., the time prior to written records). The range of common resource types includes archaeological sites, buildings, structures, objects, districts, and traditional cultural properties (TCPs) and may be listed on national, state, or local historic registers or be identified as being important to a particular group during consultation. Federal, state, and local regulations recognize the public's interest in cultural resources. Many of these regulations, including NEPA and NHPA, require a project to consider how it might have impacts on significant cultural resources. For a more detailed discussion of cultural resource types, see Section 3.10.1, *Description of the Affected Environment for Cultural Resources*.

The phrase *historic property*, as defined in the NHPA (54 U.S.C. 300308), refers to any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places [National Register; NRHP], including artifacts, records, and material remains related to such a property or resource." The term historic property also includes National Historic Landmarks (NHLs) as well as properties of traditional religious and cultural importance to tribal nations that meet National Register criteria.

3.10.1 Description of the Affected Environment for Cultural Resources

This section discusses baseline conditions in the geographic analysis area for cultural resources as described in COP Section 4.3 (Dominion Energy 2022), supplemental COP cultural resources studies (COP, Appendices F, G, H-1, H-3, and H-4; Dominion Energy 2022), and Appendix O of this Draft EIS (*Finding of Adverse Effect for the Coastal Virginia Offshore Wind Construction and Operations Plan*). Specifically, this includes marine and terrestrial areas potentially affected by the proposed Project's seabed- and ground-disturbing activities, areas where structures from the Proposed Action would be visible, and area of intervisibility where structures from both the Proposed Action and other offshore wind projects would be visible simultaneously.

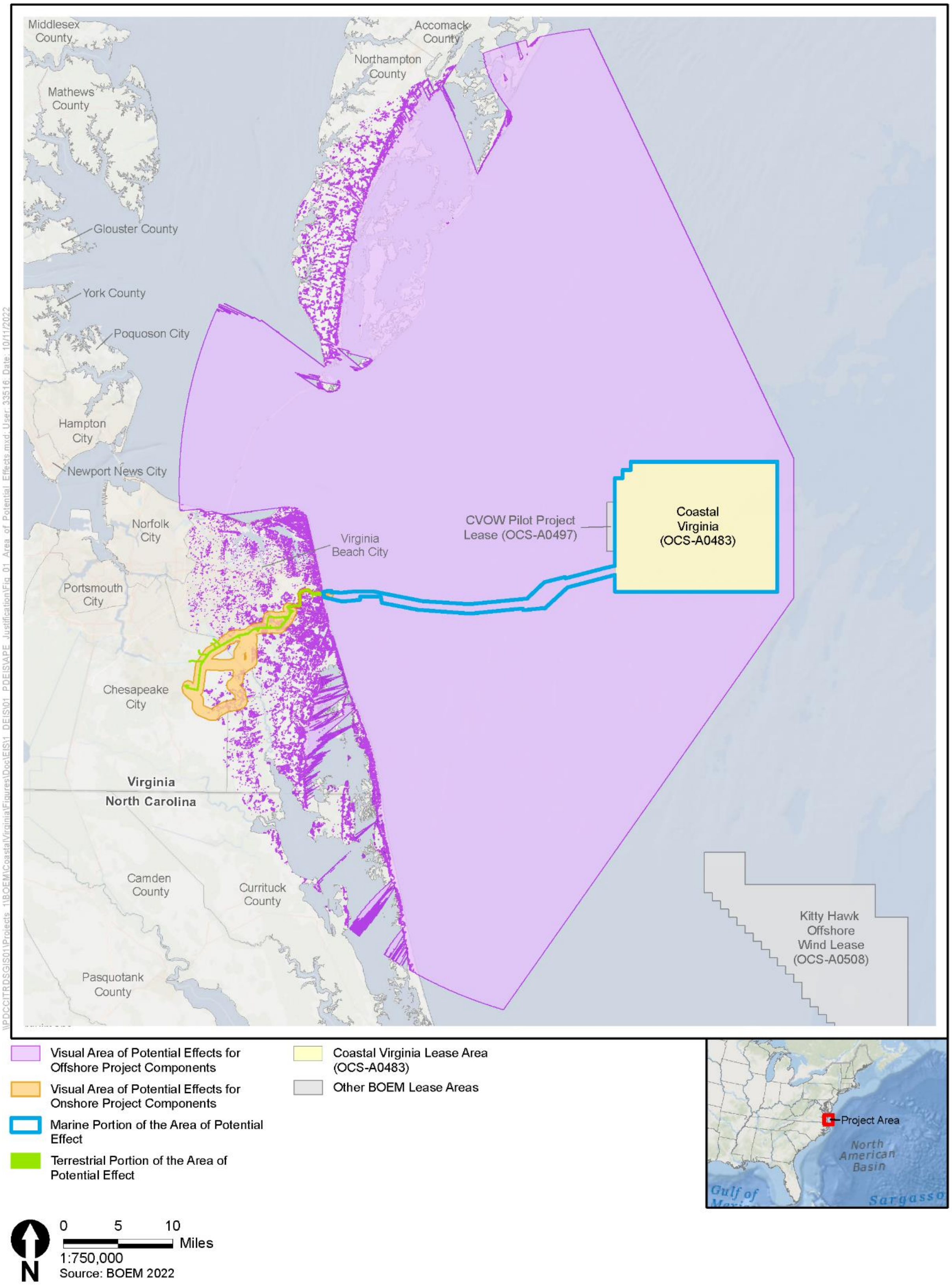

Figure 3.10-1 Cultural Resources Geographic Analysis Area

Dominion Energy has conducted onshore and offshore cultural resource investigations to identify known and previously undiscovered cultural resources in the marine, terrestrial, and visual portions of the APE. Table 3.10-1 presents a summary of the pre-Contact and post-Contact cultural context of the Project area based on the Project's Terrestrial Archaeological Resources Assessment (TARA) (COP, Appendix G; Dominion Energy 2022).

Table 3.10-1 Summary of Cultural Context of Project Area

Period	Date	Description
Paleoindian	14950–9950 B.P.	The Paleoindian period in the Project area is characterized by small, likely kin-based, highly mobile bands engaged in generalized foraging. The fluted points that characterize the early Paleoindian period were manufactured from both high-quality lithic material derived far from their points of origin as well as more readily available, but coarser grained, materials such as quartz and quartzite.
Archaic	9950–3150 B.P.	The Archaic Period is subdivided into Early (9950–8450 B.P.), Middle (8450–4950 B.P.), and Late (4950–3150 B.P.) phases. During the Early Archaic Period, regional stylistic differences in the lithic assemblage become more pronounced with an increase in the amount of locally available material used for their manufacture. At the onset of the Middle Archaic, locally sourced lithic raw materials become more pronounced and biface technology markedly changed from notched to stemmed forms. The Late Archaic Period sees a profusion of sites throughout the region, which is likely indicative of a population increase and concurrent reduction in mobility.
Woodland	3150–350 B.P.	The Woodland Period, which is subdivided into Early (3150–2450 B.P), Middle (2450–1050 B.P), and Late (1050–350 B.P.) phases, is broadly characterized by a more sedentary population with a subsistence strategy increasingly reliant on plant cultivation and the widespread manufacture of ceramics. Late pre-Contact economy in the Virginia Coastal Plain shifted from a focus on hunting and foraging to maize-bean-squash horticulture situated on floodplains and was accompanied by a parallel shift toward semi-sedentism and increased population density.
Settlement to Society	1607–1750 A.D.	While the English presence at Jamestown, to the north, began in 1607, settlement in the Project area did not begin until the 1630s. Conflict between English settlers and Indians occurred often even as the two groups pursued mutually beneficial trade. The economy during this period was based primarily on tobacco and products produced from surrounding pine forests including tar and turpentine. Agricultural output came from both plantations and small holdings. Initially, tenant farmers and indentured servants provided much of the labor with enslaved Africans making up only a small proportion of the workforce throughout the 17th and early 18th centuries. However, shifting economic pattern led to a decrease in the number of indentured servants during this period, and by the mid-18th-century enslaved Africans became the bulk of agricultural laborers in the region.
Colony to Nation	1750–1789 A.D.	Over the course of the 18th century as the population increased, inland settlements, particularly along waterways, continued to grow. Most of these settlements comprised small holders and the economy remained primarily agricultural.
Early Nation	1789–1830 A.D.	Throughout the late 18th and early 19th centuries, the Project area remained largely rural in character with the larger towns to the north and farms to the south. In the early 19th century, free people of African descent established a community in what is now the Beach District of Virginia Beach, named Seatack. Economic growth after the end of the War of 1812 spurred new interest in exploiting the resources of the Great Dismal Swamp.
Antebellum Period and Civil War	1830–1865 A.D.	Prior to the Civil War, the Project area continued to be largely rural with an economy predicated on agriculture and exploiting marine resources. The advent of war led to a U.S. Navy blockade of the southern coastline, including what is now Virginia Beach. The U.S. Government regained control of the area including Princess Anne County after the Confederates abandoned Hampton Roads in 1862. However, guerilla attacks against the U.S. military continued throughout the war. Like most of the South, Princess Anne County and environs were devastated both socially and economically by the end of the war.

Period	Date	Description
Reconstruction	1870–1916 A.D.	After the Civil War, several communities were established in the area by people who had been formerly enslaved including Beechwood, Burton Station, Doyletown, Gracetown, Great Neck, and Lake Smith. The economy continued to be primarily agriculture-based and the Port of Norfolk provided ready access to regional markets. The expansion of railroads in the area during the 1880s created further opportunities for development, and in the late 19th and early 20th centuries both tourism and the military began to become important components of the regional economy.
World War I to World War II	1917–1945 A.D.	The entry of the United States into the First World War predicated the establishment of Naval Station Norfolk in 1917. The military presence in Norfolk and the surrounding area would become a major engine of economic growth over the course of the 20th century. World War II prompted further expansion of the military facilities in the area, including the establishment of what would become NAS Oceana, and saw an influx of both military and civilian workers to Norfolk, Virginia Beach, and environs. The tourist industry grew throughout the early 20th century spurred by improved transportation in the region.
---	20th Century A.D.	By the early 20th century, the Powhatan peoples of the Virginia Tidewater numbered around 2,000 individuals, largely comprised of the Pamunkey, Mattaponi, Chickahominy, and Nansemond tribes. During the Jim Crow era (circa 1890–1965), the Powhatan strove to distinguish themselves from African American Virginians, seeking separate status for themselves that would protect them from the repressive laws of racial apartheid. The Pamunkey and Mattaponi had been accorded tribal status by Virginian authorities since the 17th century, while the Chickahominy and Nansemond had to wait for Commonwealth recognition until the 1980s.

Source: COP, Appendix G; Dominion Energy 2022.
B.P. = before present; A.D. = Anno Domini.

For the purposes of this analysis, cultural resources are divided into several types and subtypes: marine cultural resources (i.e., marine archaeological resources and ancient submerged landform features), terrestrial archaeological resources, and historic aboveground resources. These broad categories may include sub-aerial or aboveground resources with cultural or religious significance to Native American tribes.

Archaeological resources are the physical remnants of past human activity that occurred at least 50 years ago. These remnants can include items left behind by past peoples (i.e., artifacts) and physical modifications to the landscape (i.e., features). This analysis divides archaeological resources into those that are submerged underwater (i.e., marine) and those that are not (i.e., terrestrial). *Ancient submerged landform features* (ASLFs) are landforms that have the potential to contain Native American archaeological resources inundated and buried as sea levels rose at the end of the last Ice Age; additionally, Native American tribes in the region may consider ASLFs to be TCPs or tribal resources representing places where their ancestors lived. *Historic aboveground resources* include standing buildings, bridges, dams, and other structures of historic or aesthetic significance. *TCPs* are places, landscape features, or locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community; they may have either or both archaeological and aboveground elements. *Historic districts* may be composed of a collection of any of the resources described above. The discussion of cultural resources in this section is divided by the marine, terrestrial, and visual portions of the APE and may be further discussed in relation to Onshore and Offshore Project components.

As a subcategory of marine cultural resources, marine archaeological resources in the region include pre-Contact and post-Contact archaeological resources that are submerged underwater. Based on known historic and recent maritime activity in the region, the marine portion of the APE (hereafter referred to as the *marine APE*) has a high probability for containing shipwrecks, downed aircraft, and related debris fields (BOEM 2012; COP, Appendix F; Dominion Energy 2022). Marine geophysical archaeological surveys performed for the Proposed Action identified 42 potential marine archaeological resources:

29 within or near the proposed offshore Lease Area and 13 within or near the Offshore Export Cable Route Corridor (ECRC) (COP, Appendix F; Dominion Energy 2022). These resources include both known and potential shipwrecks, downed aircraft, and related debris fields from the post-Contact and recent eras (i.e., less than 50 years ago). The ages of 31 marine archaeological resources cannot be confirmed through the marine cultural investigations; therefore, these resources are all assumed to be archaeological and therefore cultural resources potentially eligible for listing in the NRHP. Eleven other marine archaeological resources near the northern border of the Lease Area consist of large, scuttled World War II-era ships, tires, cable spools, and other materials intentionally deposited since the 1970s to facilitate development of the Triangle Reef Fish Haven (Fish Haven) and are therefore not considered eligible for listing in the NRHP (COP, Sections 2.1.1 and 4.2.4.2, Appendix F; Dominion Energy 2022); these include United States Naval Ships *Garrison* (Wreck Number [WN] 002a), *Webster* (WN 002b), *Haviland* (WN 003a), *Clark* (WN 003b), *John Morgan* (WN 007), *Lillian Luckenback* (WN 010), *Kurn* (WN 011), and *Tripca* (WN 013), as well as three other unidentified objects (i.e., WNs 009, 014, and 015).

Marine cultural resources also include ASLFs on the OCS (BOEM 2012). Marine geophysical remote archaeological surveys performed for the Proposed Action identified six ASLFs (COP, Appendix F; Dominion Energy 2022). Five of these landforms are located within the Lease Area portion of the marine APE. No ASLFs were identified within the Offshore ECRC. A sixth ASLF was identified outside of but near the Lease Area and is considered for potential impacts from the Proposed Action due to its proximity. The extent of marine cultural investigations performed for the Proposed Action does not enable conclusive determinations of eligibility for listing identified resources in the NRHP; as such, all identified marine archaeological resources and ASLFs are assumed eligible for listing in the NRHP and are therefore historic properties.

Cultural resource investigations performed for the Proposed Action (hereafter referred to as the *terrestrial APE*) identified 25 terrestrial archaeological resources, one cemetery, and one historic aboveground resource in or near the terrestrial APE or within areas that had been previously proposed for ground-disturbing activities and have since been eliminated from the PDE (COP, Appendices G and H-3; Dominion Energy 2022). The extent of investigations performed for the Proposed Action as of May 2022 does not enable conclusive determinations of eligibility for listing 19 of the 25 identified terrestrial archaeological resources in the NRHP; as such, BOEM assumes these are eligible for listing in the NRHP and are, therefore, historic properties. Otherwise, sufficient data from Dominion Energy's investigations have enabled BOEM to determine that the six other resources are not eligible for listing in the NRHP. Dominion Energy's investigations identified one cemetery, presently known to comprise one mid-20th century grave, outside of but near the terrestrial APE; this cemetery is considered for potential impacts from the Proposed Action due to its proximity to the proposed Harpers Switching Station. The historic aboveground resource in the terrestrial APE is the Camp Pendleton/State Military Reservation Historic District, which is presently listed in the NRHP. Two structures that are contributing elements to the historic district (i.e., Buildings 59 and 410) are in the terrestrial APE.

As of August 2022, terrestrial archaeological investigations terrestrial Phase IB archaeological surveys have not been fully completed in the terrestrial APE. As such, presently undiscovered but potential terrestrial archaeological resources may exist in the terrestrial APE. In consultation with BOEM and the Virginia Department of Historic Resources (VDHR; the Virginia state historic preservation office [SHPO]), Dominion Energy will be using a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for the unsurveyed areas of the terrestrial APE (COP, Appendices DD; Dominion Energy 2022). Completion of Phase IB archaeological surveys during the phased process may lead to the identification of additional archaeological resources in the terrestrial APE. Findings from the phased process are anticipated to be presented in the Final EIS for this Project. However, some information pertaining to terrestrial archaeological resources will not be available until after completion of the Final EIS. BOEM will use a Memorandum of Agreement (MOA) to establish commitments for reviewing the sufficiency of any supplemental terrestrial archaeological investigations as phased identification; assessing effects to historic properties; and implementing measures to avoid, minimize, or mitigate effects in these areas prior to construction. See Appendix O, Section O.6, for additional details on the phased process.

The visual portion of the APE (hereafter referred to as the *visual APE*) includes a visual APE for Offshore Project components and visual APE for Onshore Project components. Cultural resources review of the visual APE for Offshore Project components identified 712 historic aboveground resources, including two NHLs (i.e., First Cape Henry Lighthouse and Eyre Hall) (COP, Appendix H-1; Dominion Energy 2022). Cultural resources review of the visual APE for Onshore Project components identified 322 historic aboveground resources. While consultation with the VDHR is ongoing, 13 of these resources have been determined to be historic properties listed or eligible for listing in the NRHP (COP, Appendices H-3; Dominion Energy 2022).

3.10.2 Environmental Consequences

3.10.2.1 Impact Level Definitions for Cultural Resources

This Draft EIS uses a four-level classification scheme to characterize potential impacts on cultural resources (including historic properties under Section 106) resulting from Project alternatives, including the Proposed Action, as shown in Table 3.10-2.

Table 3.10-2 Adverse Impact Level Definitions for Cultural Resources

Impact Level	Historic Properties Under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(1).	A. No cultural resources subject to potential impacts from ground- or seabed-disturbing activities; or B. All disturbances to cultural resources are fully avoided, resulting in no damage to or loss of scientific or cultural value from the resources.	A. No measurable impacts; or B. No physical impacts and no change to the integrity of resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or C. All physical impacts and disruptions are fully avoided.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b). This can include avoidance measures.	A. Some damage to cultural resources from ground- or seabed-disturbing activities, but there is no loss of scientific or cultural value from the resources; or B. Disturbances to cultural resources are avoided or limited to areas lacking scientific or cultural value.	A. No physical impacts (i.e., alteration or demolition of resources) and some limited visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to historic or aesthetic settings are short-term and expected to return to an original or comparable condition (e.g., temporary vegetation clearing and construction vessel lighting).

Impact Level	Historic Properties Under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be altered in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, but the adversely affected property would remain eligible for the NRHP.	As compared Minor Impacts: A. Greater extent of damage to cultural resources from ground- or seabed-disturbing activities, including some loss of scientific or cultural data; or B. Disturbances to cultural resources are minimized or mitigated to a lesser extent, resulting in some damage to and loss of scientific or cultural value from the resources.	As compared to Minor Impacts: A. No or limited physical impacts and greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to settings are minimized or mitigated; or C. Historic or aesthetic settings may experience some long-term or permanent impacts.
Major	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be affected in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association to the extent that the property is no longer eligible for listing in the NRHP.	As compared to Moderate Impacts: A. Destruction of or greater extent of damage to cultural resources from ground- or seabed-disturbing activities; or B. Disturbances are minimized or mitigated but do not reduce or avoid the destruction or loss of scientific or cultural value from the cultural resources; or C. Disturbances are not minimized or mitigated resulting in the destruction or loss of scientific or cultural value from the resources.	As compared to Moderate Impacts: A. Physical impacts on cultural resources (for example, demolition of a cultural resource onshore); or B. Greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance, including long-term and/or permanent impacts; or C. Disruptions to settings are not minimized or mitigated.

3.10.3 Impacts of the No Action Alternative on Cultural Resources

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

3.10.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.10.1, *Descriptions of the Affected Environment on Cultural Resources,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing and non-offshore wind and offshore wind activities. Ongoing activities in the geographic analysis area that contribute to impacts on cultural resources in onshore areas include ground-disturbing activities and the introduction of intrusive visual elements, while the primary sources of impacts on cultural resources in offshore areas include seabed-disturbing activities. Onshore and offshore construction activities and associated impacts are expected to continue at current trends, range in severity from minor to major, and have the potential to affect cultural resources.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on cultural resources include:

- Continued O&M of the CVOW-Pilot Project (2 WTGs) in Lease Area OCS-A 0497.

3.10.3.2 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Other planned non-offshore wind activities that may have impacts on cultural resources include new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Appendix F, Section F.2 for a description of planned activities). These activities may result in short-term, long-term, and permanent onshore and offshore impacts on cultural resources.

The following discussion assesses the potential impacts on these types of cultural resources from ongoing and planned wind facility developments during construction, O&M, and decommissioning and excludes the Proposed Action. BOEM assumes that the planned Kitty Hawk North and Kitty Hawk South Projects will be subject to NEPA and NHPA reviews and, as a result, will require the identification of cultural resources in their NEPA geographic analysis areas and NHPA APEs. The results of these project-specific studies to identify cultural resources are not yet available. Therefore, the No Action Alternative assumes that the same types of cultural resources identified within the geographic analysis area of the Proposed Action (i.e., marine cultural resources, terrestrial archaeological resources, and historic aboveground resources) are present within the geographic scopes of the planned Kitty Hawk North and Kitty Hawk South Projects and will be subject to the same IPFs as the Proposed Action. BOEM assumes that if project-specific cultural resource investigations identify historic properties within a project's APE and determines that the project would adversely affect said historic properties, BOEM will require the project to develop treatment plans to avoid, minimize, or mitigate effects to comply with the NHPA. Impacts are possible on marine cultural resources (i.e., marine archaeological resources and ASLFs), terrestrial archaeological resources, and historic aboveground resources.

Impacts on cultural resources are expected through the following primary IPFs.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, may pose risks to cultural resources. The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils. In the planned activities scenario, there would be a low risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs or substations offshore Virginia or North Carolina. The potential for accidental releases, volume of released material, and associated need for cleanup activities from future offshore wind projects aside from the Proposed Action in the geographic analysis area would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events. As such, the majority of individual accidental releases from future offshore wind development would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts.

Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete removal of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic buildings, structures, objects, and districts, which could include significant landscapes and TCPs; and damage to or removal of nearshore submerged marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources.

Anchoring: Anchoring associated with ongoing commercial and recreational activities and the development of future offshore wind projects has the potential to cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction, O&M, and eventual decommissioning of future offshore wind energy facilities. Construction of offshore wind projects could result in impacts on cultural resources on the seafloor caused by anchoring in the geographic analysis area. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb marine cultural resources on or just below the seafloor surface. The damage or destruction of marine cultural resources from these activities would result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts.

The scale of impacts on cultural resources would depend on the number of marine archaeological resources and ASLFs within offshore wind lease areas and offshore export cable corridors. Impacts on marine archaeological resources can typically be avoided through project design. The number, extent, and dispersed character of the ASLFs make avoidance difficult, while the depth of these resources makes mitigative measures difficult and expensive. It is unlikely that offshore wind projects would be able to avoid all of these resources. The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources. Specifically, as part of its compliance with the NHPA, BOEM requires offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, or mitigate impacts on these resources. As a result, impacts on marine cultural resources from anchoring from ongoing and planned activities, would be localized and permanent, and range from negligible to major on a case-by-case basis, depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Land disturbance: The construction of onshore components associated with future offshore wind projects, such as electrical export cables and onshore substations, could result in adverse physical impacts on known and undiscovered cultural resources. Such ground-disturbing construction activities could disturb or destroy undiscovered archaeological resources and TCPs, if present. The number of cultural resources subject to impacts and scale, extent, and severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources and the proportion of the resource subject to impacts. State and federal requirements to identify cultural resources, assess project impacts, and develop treatment plans to avoid, minimize, or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources; as a result, if adverse impacts from this IPF occur, they would likely be permanent but localized, and range from negligible to major.

Lighting: Development of future offshore wind projects would increase the amount of offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night) and use of aircraft and vessel hazard/warning lighting on

WTGs and offshore substations during operation. Up to 190 WTGs with a maximum blade tip height of approximately 1,042 feet (317.6 meters) above mean sea level (AMSL) would be added in the geographic analysis area for cultural resources (Kitty Hawk Wind North 2022; Kitty Hawk Wind South 2022).

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Up to three lease areas in the geographic analysis area could be constructed from 2024 through 2030 and beyond (with up to three projects simultaneously under construction between 2026 and 2028; see Appendix F, Table F-3). Some of the future offshore wind projects could require nighttime construction lighting, and all would require nighttime hazard lighting during operations. Construction lighting from any project would be temporary, lasting only during nighttime construction, and could be visible from shorelines and elevated locations, although such light sources would be limited to individual WTG or offshore substations and nearby vessels rather than the entirety of the lease areas in the geographic analysis area. Aircraft and vessel hazard lighting systems would be in use for the entire operational phase of each future offshore wind project, resulting in long-duration impacts. The intensity of these impacts would be relatively low, as the lighting would consist of small, intermittently flashing lights at a significant distance from the resources.

The impacts of construction and operational lighting would be limited to cultural resources on the coasts of Virginia and North Carolina for which a dark nighttime sky is a contributing element to historical integrity. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources, as the majority of the proposed WTGs would be at least 27.9 statute miles (44.9 kilometers) from the shoreline in Corolla, North Carolina (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022). The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As a result, nighttime construction and decommissioning lighting would have temporary, intermittent, and localized adverse impacts on a limited number of cultural resources. Operational lighting would have longer-term, continuous, and localized adverse impacts on a limited number of cultural resources.

Lighting impacts would be reduced if Aircraft Detection Lighting System (ADLS) is used to meet FAA aircraft hazard lighting requirements. ADLS would activate the aviation lighting on WTGs and offshore substations only when an aircraft is within a predefined distance of the structures (for a detailed explanation, see Section 3.20, *Scenic and Visual Resources*). For the Proposed Action, the reduced time of FAA hazard lighting resulting from an ADLS, if implemented, would likely reduce the duration of the potential impacts of nighttime aviation lighting compared with the normal operating time that would occur without using ADLS. The use of ADLS or related systems on future offshore wind projects other than the Proposed Action would likely result in similar limits on the frequency of WTG and offshore substation aviation warning lighting use. This technology, if used, would reduce the already low-level impacts of lighting on cultural resources. As such, lighting impacts on cultural resources would range from negligible to moderate.

Onshore structure lighting would be required for future offshore wind projects and could impact cultural resources. The magnitude of impact would depend on the height of the buildings or towers and the intensity of the lighting fixtures. The impacts on cultural resources from these lights would be minimized by the distance between the facilities and cultural resources, and the presence of vegetation, buildings, or other visual buffers that may diffuse or obscure the light. Therefore, lighting associated with onshore components from future offshore wind activities could have long-term, continuous, negligible to moderate impacts on cultural resources.

Cable emplacement and maintenance: Construction of future offshore wind infrastructure would have permanent, geographically extensive, adverse impacts on cultural resources. Future offshore wind projects would result in seabed disturbance from foundation construction and installation of inter-array and offshore export cables and associated installation activities that may occur within cable corridors. Construction, O&M, and decommissioning of these cables may necessitate additional geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. The only future offshore wind development projects (other than the Proposed Action) that are expected to lay cable in the geographic analysis area is Kitty Hawk Wind North and Kitty Hawk Wind South (Lease Area OCS-A 0508) (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022). The 2012 BOEM study and the Proposed Action studies (BOEM 2012; COP, Appendix F; Dominion Energy 2022) suggest that the offshore wind lease areas and export cable route corridors of the offshore wind projects would likely contain a number of marine archaeological resources and ASLFs subject to impacts from offshore construction activities.

As part of compliance with NHPA, BOEM and SHPOs will require offshore wind project lessees to conduct extensive geophysical surveys of offshore wind lease areas and offshore export cable corridors to identify marine cultural resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction on marine cultural resources would be infrequent and isolated. However, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided.

If present within a project area, the number, extent, and dispersed character of ASLFs make avoidance impossible in many situations and make extensive archaeological investigations of formerly terrestrial archaeological resources within these features logistically challenging and prohibitively expensive. As a result, offshore construction would result in geographically widespread and permanent adverse impacts on portions of these resources. For those ASLFs that are contributing elements to an NRHP-eligible TCP but cannot be avoided, mitigation would be considered under the NHPA Section 106 review process, including studies to document the nature of the paleontological environment during the time these now-submerged landscapes were occupied and provide Native American tribes with the opportunity to include their history in these studies. However, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts.

Presence of structures: The development of future offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coasts of Virginia and North Carolina. Up to 193 foundations (190 WTGs and a maximum of three suction caisson jacket foundations for electrical service platforms) would be added in the geographic analysis area for cultural resources, assuming WTGs with a maximum blade tip height of approximately 1,042 feet (317.6 meters) AMSL.

Impacts on cultural resources from the presence of structures would be limited to those cultural resources from which future offshore wind projects would be visible, which would typically be limited to historic buildings, structures, objects, and districts, and could include significant landscapes and TCPs relatively close to shorelines and on elevated landforms near the coast. The magnitude of impacts from the presence of structures would be greatest for cultural resources for which a maritime view, free of modern visual elements, is an integral part of their historic integrity and contributes to their eligibility for listing in the NRHP. Due to the distance between the reasonably foreseeable wind development projects and the nearest cultural resources, in most instances exceeding 27.9 miles (44.9 kilometers) (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022), WTGs of individual projects would appear relatively small on the horizon, and the visibility of individual structures would be further affected by environmental and atmospheric conditions such as vegetation, clouds, fog, sea spray, haze, and wave action (for a detailed explanation, see Section 3.20). While these factors would limit the intensity of impacts, the presence of visible WTGs from future offshore wind activities would have long-term, continuous, major impacts on cultural resources.

Additionally, the presence of onshore components associated with offshore wind projects, including substations, converter or switching stations, transmission lines, operations and maintenance facilities, and other components, would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources located within sight of these components in Virginia and North Carolina. The magnitude of impacts from the presence of structures would be greatest for aboveground cultural resources for which a setting free of modern visual elements is an integral part of their historic integrity and contributes to their eligibility for listing in the NRHP. Factors such as distance and visual buffers, including vegetation and buildings, would also affect the intensity of these impacts. While these factors would limit the intensity of impacts, the presence of onshore components associated with offshore wind activities would have long-term, continuous, negligible to major impacts on cultural resources.

3.10.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, cultural resources would continue to be subject to impacts from existing environmental trends and ongoing activities. Ongoing activities are expected to have continued short-term, long-term, and permanent impacts (e.g., via disturbance, damage, disruption, destruction) on cultural resources. These effects are primarily driven by offshore construction impacts and the presence of structures and to a lesser extent onshore construction impacts. The primary sources of onshore impacts from ongoing activities include ground-disturbing activities and the introduction of intrusive visual elements, while the primary sources of offshore impacts include dredging, cable emplacement, and activities that disturb the seafloor. Given the extent of known cultural resources in the region and extent of planned development on the OCS, ongoing offshore wind activities would noticeably contribute to impacts on cultural resources. While long-term and permanent impacts may occur as a result of offshore wind development, impacts would be reduced through the NHPA Section 106 consultation process to resolve adverse effects on historic properties. The No Action Alternative would result in **moderate** impacts on cultural resources.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and cultural resources would continue to be subject to impacts by natural and human-caused IPFs. Planned activities would contribute to impacts on cultural resources due to disturbance, damage, disruption, and destruction of individual cultural resources located onshore and offshore. BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **moderate** due to the extent of known cultural resources in the region subject to impacts.

3.10.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Physical impacts on marine cultural resources (i.e., archaeological resources and ASLFs), depending on the location of offshore bottom-disturbing activities, including the locations where Dominion Energy would embed the WTGs and offshore substations into the seafloor in the Lease Area and the location of the cable in the Offshore ECRC;
- Physical impacts on terrestrial cultural resources (i.e., archaeological resources and historic aboveground resources), depending on the location of onshore ground-disturbing activities; and
- Visual impacts on cultural resources (e.g., historic aboveground resources, such as historic buildings, structures, objects, and districts, which could include landscapes and TCPs), depending on the design, height, number, and distance of WTGs, offshore substations, and Onshore Project components (e.g., transmission lines, substations, and switching stations) visible from these resources.

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

- WTG and offshore substation number, size, and location: If marine cultural resources cannot be avoided, impacts can be minimized with fewer WTGs and substation footprints, smaller footprints, and the selection of footprint locations in areas of lower archaeological or ASLF sensitivity. Fewer WTGs could also decrease visual impacts on cultural resources for which unobstructed ocean views and a setting free of modern visual elements is a contributing element to historical integrity.
- WTG and substation lighting: Arrangement and type of lighting systems, such as the implementation of an ADLS, could affect the degree of nighttime visibility of WTGs onshore and decrease visual impacts on cultural resources for which a dark nighttime sky is a contributing element to historical integrity.
- Size of scour protection around foundations: If marine cultural resources cannot be avoided, a smaller size of scour protection around foundations can minimize disturbance or destruction of marine cultural resources.
- Offshore cable (inter-array, substation interconnector) burial location, length, depth of burial, and burial method: If marine cultural resources cannot be avoided entirely, specific location, length, and depth of burial could minimize disturbance or destruction of marine cultural resources. Cable burial method such as jetting tool, vertical injection, pre-trenching, scare plow, trenching (including leveling, mechanical cutting), plowing, and controlled-flow excavation could have varying degrees of potential to disturb or destroy marine cultural resources.
- Landfall for offshore export cable installation method: Selection of trenchless installation over open-cut installation could have decreased potential for disturbance of terrestrial archaeology.
- Onshore export cable width and burial depth: Reduced width and burial depth to reduce overall volume of excavation in the export cable construction corridor could decrease potential for unanticipated disturbance of terrestrial archaeology. Additionally, the installation of aboveground onshore export cables and associated towers would have lesser adverse impacts on terrestrial archaeology than the installation of underground onshore export cables.

Dominion Energy has committed to several measures to avoid, minimize, or mitigate impacts on cultural resources. These applicant-proposed measures (APMs) are described in Appendix H, *Mitigation and Monitoring,* Table H-1.

3.10.5 Impacts of the Proposed Action on Cultural Resources

Under the Proposed Action, Dominion Energy would install up to 205 WTGs, three OSSs, and related facilities, which would have negligible to minor impacts on most cultural resources but would potentially have moderate to major impacts on known and presently undiscovered but potential marine archaeological resources, ASLFs, known and presently undiscovered but potential terrestrial archaeological resources, historic aboveground resources, and potential but presently undocumented TCPs. While similar to the Proposed Action, Alternative A-1 would relocate the three offshore substations into the grid layout with the WTGs, resulting in a total of 202 WTGs. This would still constitute the same impact levels as the Proposed Action on these cultural resources.

Specifically, the Proposed Action and Alternative A-1 may have negligible to major impacts on 42 known marine archaeological resources (COP, Appendix F; Dominion Energy 2022); six ASLFs with archaeological or TCP potential (COP, Appendix F; Dominion Energy 2022); 25 known terrestrial archaeological resources (COP, Appendix G; Dominion Energy 2022); and 1 mid-20th century cemetery (COP, Appendix G; Dominion Energy 2022). The proposed Project would have moderate impacts on 25 historic aboveground resources that are historic properties located in the visual APE for Offshore

Project components, including one NHL: the First Cape Henry Lighthouse (COP, Appendix H-1; Dominion Energy 2022). The proposed Project would have moderate to major impacts on one resource located in both the terrestrial and visual APE for Onshore Project components, the Camp Pendleton/State Military Reservation Historic District (COP, Appendix H-3; Dominion Energy 2022). This historic district would experience physical impacts due to the demolition of two contributing structures (Buildings 59 and 410) and removal of vegetation and visual impacts from visibility of from Offshore Project components. See Appendix O for a complete list of historic properties in the marine, terrestrial, and visual APEs for the Project.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, could have impacts on cultural resources. The WTGs, offshore substations, and onshore substation for the Proposed Action would include storage for a variety of potential chemicals such as coolants, oils, lubricants, and diesel fuel (COP, Tables 3.3-2 and 3.3-6 and Section 3.3.2.5; Dominion Energy 2022). The Proposed Action would also require use of several types of machinery, vehicles, ocean-going vessels, and aircraft from which there may be unanticipated release or spills of substances onto land or into receiving waters. Overall, the potential for accidental releases, volume of released material, and associated need for cleanup activities from the Proposed Action would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events. Dominion Energy has produced an Oil Spill Response Plan to encompass activities for this Project (COP, Appendix Q; Dominion Energy 2022).

The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils, trash, or debris. As such, the majority of potential individual accidental releases from the Proposed Action would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete destruction of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic aboveground resources such as historic buildings, structures, objects, and districts, which could include significant landscapes and TCPs; and damage to or destruction of nearshore marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources. Overall, the impacts on cultural resources from accidental releases from the Proposed Action would be localized, short term, and negligible to major depending on the number and scales of accidental releases.

Anchoring: Anchoring associated with offshore activities of the Proposed Action could have impacts on cultural resources. Dominion Energy's marine geophysical archaeological surveys identified 42 potential marine archaeological resources: 29 within or near the proposed offshore Lease Area and 13 within or near the Offshore ECRC (COP, Appendix F; Dominion Energy 2022). Additionally, five ASLFs were identified within the Lease Area. No ASLFs were identified within the Offshore ECRC. One additional landform was identified outside of but near the Lease Area and is considered for potential impacts from the Proposed Action due to its proximity. The severity of effects of this IPF would depend on the horizontal and vertical extent of disturbance relative to the size of the marine archaeological resource or

ASLF subject to impacts. If the Proposed Action or Alternative A-1 are unable to avoid marine cultural resources due to design (e.g., the cultural resource crosses the entire Offshore ECRC), engineering, or environmental constraints, Dominion Energy would work with the consulting parties, Native American tribes, BOEM, and VDHR to develop and implement minimization and mitigation plans for disturbance of known resources.

To reduce the risk of potential impacts on marine cultural resources, Dominion Energy has conducted or proposed to conduct the following APMs (COP, Table ES-1; Dominion Energy 2022; and Appendix H):

- Dominion Energy will develop an operations plan prior to construction, to ensure that construction activities adhere to the recommended avoidance buffers.
- Design and construction methods, including micrositing opportunities, will continue to be evaluated in order to avoid or minimize the extent of seabed disturbance and adverse effects to historic properties.
- Disturbance to known resources that cannot practicably be avoided would only occur with appropriate consultations (i.e., BOEM, SHPOs, Tribal Historic Preservation Offices) and approvals.
- Additional archaeological investigation of resources that cannot be avoided may be needed to determine whether they are historic properties and to fully assess Project effects on them.
- Dominion Energy would develop and implement an Unanticipated Discoveries Plan to avoid and mitigate impacts to unknown resources. Repairs and other future activities will only occur within previously disturbed portions of the APE which have been previously assessed by the QMA.
- Adherence to the QMA recommended avoidance buffers would remain in effect during O&M.

Based on this information, impacts of the Proposed Action or Alternative A-1 on marine cultural resources would be localized, permanent, and range from negligible to major depending on the ability of Dominion Energy to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Land disturbance: Land disturbance associated with the construction of Onshore Project components could have impacts on cultural resources. Ground-disturbing activities associated with construction (e.g., site clearing, grading, excavation, and filling) could have impacts on terrestrial archaeological resources. The number of resources subject to impacts would depend on the location of specific Project components relative to known and undiscovered cultural resources, and the severity of impacts would depend on the horizontal and vertical extent of disturbance relative to the size of the resources subject to impacts. Dominion Energy's investigations have identified 25 terrestrial archaeological resources, 1 cemetery, and 1 historic aboveground resource in or near the terrestrial APE or within areas that had been previously proposed for ground-disturbing activities and have since been eliminated from the PDE (COP, Appendix G; Dominion Energy 2022). Of these resources, BOEM anticipates the undertaking as currently proposed would have adverse effects on 13 known terrestrial archaeological resources that are historic properties assumed eligible for listing in the NRHP and the 1 historic aboveground resource (i.e., Camp Pendleton/State Military Reservation Historic District) presently listed in the NRHP and of which two structures that are contributing elements to the historic district (i.e., Buildings 59 and 410) have been proposed for demolition (COP, Appendix H-2 and H-3; Dominion Energy 2022).

As of August 2022, terrestrial archaeological investigations terrestrial Phase IB archaeological surveys have not been fully completed in the terrestrial APE. As such, presently undiscovered but potential terrestrial archaeological resources may exist in the terrestrial APE. In consultation with BOEM and the VDHR, Dominion Energy will be using a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for the remaining unsurveyed areas of the terrestrial APE

(COP, Appendices DD; Dominion Energy 2022). Completion of Phase IB archaeological surveys during the phased process may lead to the identification of additional archaeological resources in the terrestrial APE. Findings from the phased process are anticipated to be presented in the Final EIS for this Project. However, some information pertaining to terrestrial archaeological resources will not be available until after completion of the Final EIS. BOEM will use the MOA to establish commitments for reviewing the sufficiency of any supplemental terrestrial archaeological investigations as phased identification; assessing impacts; and implementing measures to avoid, minimize, or mitigate impacts in these areas prior to construction. See Appendix O, Section O.5, *Phased Identification and Evaluation*, for additional details on the phased process. Furthermore, Dominion Energy has conducted or proposed to several APMs to reduce the risk of impacts on terrestrial archaeological resources in the siting, routing, and design process of the Onshore Project components and development and implementation of an Unanticipated Discoveries Plan to minimize or mitigate impacts on other undiscovered resources that could potentially be affected (Appendix H; COP Section 4.3.2.4; Dominion Energy 2022). As a result, terrestrial archaeological resources and the identified cemetery would be subject to negligible to major impacts depending on the ability of Dominion Energy to avoid, minimize, or mitigate impacts.

Cultural resource investigations have also determined that the Proposed Action or Alternative A-1 would have moderate impacts on one historic aboveground resource: the Camp Pendleton/State Military Reservation Historic District (134-0413). The demolition of two contributing structures, Buildings 59 and 410, for the installation of the underground transmission lines associated with the landing location to the Harpers Route would alter the setting and viewshed, resulting in a moderate impact on the resource (COP, Appendix H-3; Dominion Energy 2022). BOEM anticipates that Dominion Energy would implement plans to avoid, minimize, or mitigate impacts on aboveground historic properties as aligned with VDHR and NHPA requirements. Dominion Energy proposes to determine treatment options through consultation with BOEM, the Virginia SCC, VDHR, property owners, and consulting parties. Dominion Energy notes that treatment options could include any of the following: detailed site documentation, historic research, and historic preservation studies; preparation of digital media or museum-type exhibits for public interpretation; installation of historic markers or signs; installation of vegetative screening; or contributions to historical preservation organizations or specific preservation projects. Additionally, the Young Men's Christian Association (YMCA) foundations that are part of the Historic District will be protected during construction with the installation of temporary fencing.

Based on this information, the impacts of the Proposed Action or Alternative A-1 on cultural resources are expected to be localized, permanent, and range from negligible to major. The degrees of impact on terrestrial archaeological resources depend on the findings from the completed archaeological surveys and the ability of Dominion Energy to avoid, minimize, or mitigate impacts. BOEM anticipates that Atlantic Shores would implement plans to avoid, minimize, or mitigate impacts on cultural resources as aligned with VDHR and NHPA requirements. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

In the event of changes to the Project design or inadvertent archaeological discoveries during construction, BOEM could further reduce potential impacts of onshore construction by requiring one or both of the following mitigation measures as a condition of COP approval.

- Dominion Energy must avoid any identified archaeological resource or TCP or, if Dominion Energy cannot avoid the resource, it must perform additional investigations for the purpose of determining eligibility for listing in the NRHP. Of those resources determined eligible, BOEM would require Phase III data recovery investigations for the purposes of resolving adverse effects per 36 CFR 800.6.
- Archaeological monitoring during onshore construction in areas identified as having high or moderate archaeological sensitivity and implementation of a terrestrial post-review discoveries plan would

reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction.

Lighting: Development of the offshore wind industry would increase the amount of offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night) and use of hazard/warning lighting on WTGs and offshore substations during operations. The susceptibility and sensitivity of cultural resources to lighting impacts from the Proposed Action would vary based on the unique characteristics of individual cultural resources. Nighttime lighting impacts could occur on cultural resources for which a dark nighttime sky or unobstructed ocean views are a contributing element to their historic integrity. Of the 712 historic aboveground resources reviewed in the offshore visual APE that could potentially be impacted, up to 25 aboveground historic properties would be impacted by operational lighting on offshore components.

Construction and decommissioning of the Proposed Action or Alternative A-1 may require nighttime vessel and construction area lighting. The lighting impacts would be short-term, as they would be limited to the construction phase of either action alternative. The intensity of nighttime construction lighting would be limited to the active construction area at any given time. Impacts would be reduced by the distance between the nearest construction area (i.e., the closest line of WTGs) and the nearest cultural resources on the Virginia and North Carolina coasts. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. Based on this information, the impact of vessel nighttime lighting from the Proposed Action or Alternative A-1 on cultural resources is expected to be localized, short term, and negligible.

The Proposed Action and Alternative A-1 would include nighttime and daytime use of operational phase aviation and vessel hazard avoidance lighting on WTGs and offshore substations. Permanent aviation and vessel warning lighting would be required on all WTGs and offshore substations built by offshore wind projects. Operational lighting from the Proposed Action or Alternative A-1 would have long-term, permanent, moderate impacts on up to 25 aboveground historic properties.

The operation and maintenance of onshore facilities could potentially impact cultural resources in the visual APE for Onshore Project components. To mitigate onshore impacts, Dominion Energy would evaluate vegetative buffers to help screen views of the onshore substation and switching station; design the lighting of the onshore substation and switching station to reduce light pollution where feasible, such as using downward lighting or motion-detecting sensors; and consult with the U.S. Navy, City of Virginia Beach, and the City of Chesapeake to evaluate color treatment and other visual impact mitigations for the switching station and the onshore substation (COP, Section 4.3.4.4; Dominion Energy 2022). Therefore, onshore facility operational lighting from the Proposed Action or Alternative A-1 would have negligible overall impacts on cultural resources.

Cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sand wave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which could have impacts on cultural resources. The specific cultural resources subject to potential impacts, APMs, and potential range of severity and extent of impacts on cultural resources under this IPF are the same as those described under the *Anchoring* IPF for the Proposed Action and Alternative A-1. Overall, the impacts of the Proposed Action on marine cultural resources from this IPF are expected to be localized, permanent, and range from negligible to major depending on the ability of Dominion Energy to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Presence of structures: The presence of structures, including foundations and scour protection for WTGs and offshore substations, in the Lease Area could have impacts on cultural resources. Dominion Energy's historic aboveground resource investigations of the visual APE for Offshore Project components determined that the presence of offshore structures could result in adverse visual effects on 25 aboveground historic properties (COP, Appendix H-1; Dominion Energy 2022). The study determined that an uninterrupted sea view, free of modern visual elements, is a contributing element to the NRHP eligibility of these properties. As a result, the presence of visible WTGs from the Proposed Action or Alternative A-1 would have long-term, continuous, widespread, moderate impacts on these resources. Although the operation life of the Project is 33 years, and the WTGs and offshore substations would be removed after that period, the presence of visible WTGs from the Proposed Action alone would have long-term, continuous, widespread, moderate impacts on these resources. The study determined that the scale, extent, and intensity of these impacts would be partially mitigated by environmental and atmospheric factors such as clouds, haze, fog, sea spray, vegetation, and wave height that would partially or fully screen the WTGs from view during various times throughout the year.

The presence of onshore structures, including substations, converter stations, transmission lines, and O&M facilities, could have impacts on cultural resources. Dominion Energy's Onshore Historic Resources Visual Effects Analysis (HRVEA) of the visual APE for Onshore Project components identified 322 historic aboveground resources (COP, Appendix H-3; Dominion Energy 2022). While consultation with the VDHR is ongoing, 13 of these resources have been determined to be historic properties listed or eligible for listing on the NRHP. BOEM has determined the undertaking would have an adverse effect on 1 of these 13 aboveground historic properties: the Camp Pendleton/State Military Reservation Historic District in Virginia Beach, Virginia, which is also located within the visual APE for Offshore Project components. With the elimination of certain Onshore Project components from Dominion Energy's PDE (i.e., Interconnection Cable Route Options 2–6, including the proposed use of the Chicory Switching Station location under Route Option 6), BOEM finds that the undertaking will have no effect on 5 of the 13 aboveground historic properties that would have otherwise been subject to visual adverse effects from the undertaking: the Albemarle & Chesapeake Canal Historic District in Chesapeake, Virginia; Albemarle & Chesapeake Canal in Chesapeake, Virginia; a workers House associated with Murray Farms in Chesapeake, Virginia; a residence at 2773 Salem Road in Virginia Beach, Virginia; and the Centreville-Fentress Historic District in Chesapeake, Virginia.

To further minimize and mitigate the effects of the Proposed Action or Alternative A-1, Dominion Energy identified the following potential measures (see Appendix H):

- Explore the use of an ADLS to minimize nighttime effects by only activating the FAA required warning lights when an aircraft is in the vicinity of the Wind Farm Area.
- Use of non-reflective pure white (RAL Number 9010) or light grey (RAL Number 7035) paint on offshore infrastructure to minimize daytime visual effects.
- Support for preparation of NRHP nominations for Chesapeake Beach, Doyletown, or Queen City, Virginia Beach.
- Support for planning and design studies for the rehabilitation of the St. Teresa's Chapel and/or the 1902 Railroad Station.
- Support for the preservation of historic properties associated with African American history, including Seatack Elementary School and the Mount Olive Baptist Church.
- Support for updating the publication, 50 Most Significant Houses and Structure in Virginia Beach.
- Support for interpretive signs in the Historic Kempsville mini park in Virginia Beach.
- Support for preservation planning for 302 22nd Street, the C & P Telephone Building.

- Support for the survey and designation of resources associated with underrepresented communities in the region.
- Support for a public lecture series on preservation topics to support regional historic preservation planning objectives.
- Support documentation and public outreach on the history of the State Military Reservation (formerly Camp Pendleton).
- Install temporary fencing to protect the YMCA foundations associated with the Camp Pendleton/State Military Reservation Historic District during construction.
- Apply other treatment options as determined through consultation, which could include detailed site documentation, historic research, and historic preservation studies; preparation of digital media or, museum-type exhibits for public interpretation; installation of historic markers or signs; installation of vegetative screening; or contributions to historical preservation organizations or specific preservation projects.
- If determined appropriated through the Section 106 process, Dominion Energy suggests a donation of $50,000 to be made prior to the completion of the Project to a private, non-profit preservation group, such as the United States Lighthouse Society or Preservation Virginia, to support qualified projects in the Chesapeake Bay region for the preservation and rehabilitation of historic lighthouses. It is anticipated that up to four competitive grants may be supported and that the issuing organization will widely publicize the availability of the targeted grant program. Applications might include the current owner of the Chesapeake Light Tower dependent on the provisions of the grant application requirements.

Dominion Energy proposes to determine specific treatment options through consultation with BOEM, the Virginia SCC, VDHR, property owners, and consulting parties. The final minimization and mitigation of adverse effects will be determined through BOEM's NHPA Section 106 consultation process and included as conditions of COP approval.

3.10.5.1 Cumulative Impacts of the Proposed Action

Construction and installation, O&M, and decommissioning of the Proposed Action and other offshore wind projects could potentially have impacts on cultural resources. The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. In context of reasonably foreseeable trends, impacts from accidental releases from offshore wind projects would be similar to those of the Proposed Action and be negligible in most cases, except for rare cases of large-scale accidental release that represent major impacts. The overall impacts on marine cultural resources from accidental releases from the Proposed Action combined with those from ongoing and planned activities would range from localized, short-term, and negligible to geographically extensive, permanent, and major depending on the number and scales of accidental releases, if any.

The Proposed Action or Alternative A-1, combined with impacts from ongoing and planned activities, could have impacts on marine cultural resources through anchoring and cable emplacement and maintenance. BOEM anticipates that lead federal agencies and relevant SHPOs would require the lessees for future offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. Additionally, the cumulative impacts from land disturbance would result in localized, permanent, negligible to major impacts on terrestrial cultural resources. BOEM would also continue to require developers to avoid, minimize, or mitigate impacts on any identified marine cultural resources during construction, operation, and decommissioning. BOEM has committed to working with applicants, consulting parties, Native American tribes, VDHR, and North Carolina SHPO to develop specific treatment plans to address effects on marine cultural resources that cannot be avoided by proposed offshore wind development projects. Development and implementation of Project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on marine cultural resources; however, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided.

As a result, in context of reasonably foreseeable trends, the impacts on cultural resources from anchoring, cable emplacement and maintenance, and land disturbance from the Proposed Action or Alternative A-1, combined with those from ongoing and planned activities, would be localized and permanent, and range from negligible to major depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final Project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting from the offshore wind developments could result in impacts on cultural resources. Permanent aviation and vessel warning lighting would be required on all WTGs and OSPs built by offshore wind projects. The Proposed Action would account for the majority of the WTGs and offshore substations in the geographic analysis area that could potentially have cumulative visual impacts on aboveground historic properties. Construction of other offshore wind projects in the geographic analysis area would contribute similar lighting impacts from nighttime vessel and construction area lighting as under the Proposed Action or Alternative A-1. If ADLS were used by offshore wind developments, nighttime hazard lighting impacts on cultural resources from ongoing and planned activities including offshore wind and the Proposed Action, would be reduced in intensity. If offshore wind projects do not commit to using ADLS or a related system, operational lighting from the Proposed Action combined with ongoing and planned activities including offshore wind would have moderate impacts on cultural resources. Therefore, in context of reasonably foreseeable environmental trends, the Proposed Action, combined with ongoing and planned activities, would result in localized and negligible to moderate impacts on cultural resources.

BOEM conducted a Cumulative Historic Resources Visual Effects Assessment (CHRVEA) to evaluate visual impacts on the 25 adversely affected aboveground historic properties in the visual APE for Offshore Project components (BOEM 2022). The planned activities scenario effects assessment determined the number of WTGs from the Proposed Action and offshore wind projects that could be constructed in the geographic analysis area and from each historic property. The CHRVEA assessed these values using numbers and heights of WTGs from the Proposed Action and offshore wind projects in the geographic analysis area (see Appendix F, Table F2-1) in order to determine the maximum number of WTGs that could be theoretically visible from the Proposed Action and other offshore wind projects. Other offshore wind projects included in the cumulative WTG count from historic properties included the CVOW-Pilot Project and Kitty Hawk North Project; the exact WTG locations for the Kitty Hawk South Project are not yet known, so that project was not included in the analysis.

The CHVREA demonstrated that portions of the WTGs could theoretically be visible from ground-level and high elevations. Substantially fewer WTGs would be visible from lower elevations or locations without clear east-facing seaward views. The 25 historic properties would be subject to the largest scale impacts, with portions of at least 207 WTGs of the up to 276 WTGs represented in the full build-out of offshore wind development activities theoretically visible from all but one of the properties. The Project WTG locations represent 72.7 to 99 percent of the total WTGs that are theoretically visible from the 25 historic properties in the planned activities scenario. Thus, the Project WTGs would constitute the majority of the WTGs potentially visible from the properties.

The intensity of cumulative visual impacts on these historic properties would be limited by distance and environmental and atmospheric factors. As discussed in the Visual Impacts Assessment (COP, Appendix I-1; Dominion Energy 2022), the visibility of WTGs would be further reduced by environmental and atmospheric factors such as meteorological conditions, such as cloud cover, fog, or haze. While these factors would limit the intensity of impacts, the presence of visible WTGs from ongoing and planned activities, including the Proposed Action, would have long-term, continuous, and moderate impacts on the 25 historic properties.

3.10.5.2 Conclusions

Impacts of the Proposed Action or Alternative A-1: The Proposed Action or Alternative A-1 would have negligible to major impacts on individual cultural resources. Impacts would be reduced through the NHPA Section 106 consultation process as a result of the commitments made by Dominion Energy and implementation of mitigation measures to resolve adverse effects on historic properties. Similarly, the analysis of impacts is based on a maximum-case scenario; impacts would be reduced by implementation of a less-impactful construction or infrastructure development scenario within the PDE. Greater impacts, ranging from moderate to major, would occur without the preconstruction NHPA requirements to identify historic properties, assess potential effects, and develop treatment plans to resolve effects through avoidance, minimization, or mitigation. These NHPA-required, “good-faith” efforts to identify historic properties and address impacts resulted in or contributed to Dominion Energy identifying potential measures to reduce the magnitude of impacts on cultural resources (Appendix H).

BOEM anticipates that NHPA requirements to identify historic properties and resolve adverse effects would similarly reduce the significance of potential impacts on historic properties from future offshore wind projects as they complete the NHPA Section 106 review process. However, mitigation of adverse visual effects on historic properties will still be needed under the Proposed Action and Alternative A-1. Therefore, the overall impacts on historic properties from either action alternative would likely qualify as **moderate to major** because a notable and measurable impact requiring mitigation is anticipated.

Cumulative Impacts of the Proposed Action: In the context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from the Proposed Action or Alternative A-1 in combination with other ongoing and planned activities would be appreciable. Considering all the IPFs together, BOEM anticipates that the impacts on cultural resources associated with the Proposed Action or Alternative A-1 and other ongoing and planned activities would be **moderate to major** due to the long-term or permanent and irreversible impacts on archaeological (marine and terrestrial) resources, ASLFs, and historic aboveground resources if they cannot be avoided, and long-term impacts on other historic aboveground resources, including the First Cape Henry Lighthouse NHL.

3.10.6 Impacts of Alternative B on Cultural Resources

Impacts of Alternative B: Alternative B (Revised Layout to Accommodate the Fish Haven and Navigation) involves the exclusion of Offshore Project components near the northern border of the Lease Area to avoid impacts on cultural resources and marine habitats in the Triangle Reef Fish Haven and in the northwest corner of the Lease Area to avoid conflicts with a proposed vessel traffic fairway. Proposed activities under Alternative B would not involve changes to any Onshore Project components; therefore, impacts on historic aboveground resources in the visual APE for Onshore Project components and terrestrial archaeological resources under this alternative would be the same as those under the Proposed Action or Alternative A-1. Additionally, given the size, location, and number of retained WTGs for this alternative, Alternative B would not substantially change the overall visual impact of Offshore Project components. As a result, impacts on historic aboveground resources in the visual APE for Offshore Project components under these alternatives would be the same or similar to those under the Proposed Action or Alternative A-1.

Impacts on marine cultural resources would differ under Alternative B as compared to those anticipated under the Proposed Action or Alternative A-1. No ASLFs are located within the area from which Offshore Project components would be removed for this alternative; as such, impacts from Alternative B on ASLFs are expected to be the same as the Proposed Action. However, implementation of Alternative B would result in avoidance of impacts on 11 marine archaeological resources in the Fish Haven. These resources consist of large, scuttled World War II-era ships, tires, cable spools, and other materials intentionally deposited since the 1970s to facilitate development of the Fish Haven (COP, Sections 2.1.1 and 4.2.4.2; Dominion Energy 2022) and include the intentionally sunk United States Naval Ships *Garrison* (WN 002a), *Webster* (WN 002b), *Haviland* (WN 003a), *Clark* (WN 003b), *John Morgan* (WN 007), *Lillian Luckenback* (WN 010), *Kurn* (WN 011), and *Tripca* (WN 013), as well as three other unidentified objects (i.e., WNs 009, 014, and 015). Removal of Offshore Project components under this alternative would also reduce impacts on presently undiscovered but potential marine archaeological resources.

Overall, the majority of marine archaeological resources, including those that BOEM have determined are historic properties potentially eligible for listing in the NRHP, are located in other areas of the marine APE that would be unchanged under Alternative B. As a result, this alternative would not substantially change impacts on marine archaeological resources overall, and impacts on marine cultural resources under Alternative B would be similar to those of the Proposed Action or Alternative A-1.

Cumulative Impacts of Alternative B: In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B to the cumulative impacts on cultural resources would be appreciable—the same as under the Proposed Action or Alternative A-1.

3.10.6.1 Conclusions

Impacts of Alternative B: The impacts resulting from individual IPFs associated with Alternative B alone on cultural resources may be reduced compared to those under the Proposed Action or Alternative A-1. However, impacts on cultural resources that are historic properties eligible for listing in the NRHP would be the same as the Proposed Action. As a result, Alternative B would have similar **moderate to major** impacts on individual cultural resources as the Proposed Action or Alternative A-1 that may be avoided, minimized, or mitigated depending on Dominion Energy's implementation of AMMs developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative B: In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B to the cumulative impacts on cultural resources would be appreciable—the same as for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative B when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.7 Impacts of Alternative C on Cultural Resources

Impacts of Alternative C: Alternative C (Sand Ridge Impact Minimization Alternative) would include the range of Project design parameters as described under Alternative B. However, in addition to avoiding the Fish Haven and the proposed vessel traffic fairway, Alternative C would avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure, removing of four WTGs from priority ridge habitat, and relocating one WTG to a spare position.

As is the case with Alternative B, only impacts on marine cultural resources would differ under Alternative C as compared to those anticipated under the Proposed Action or Alternative A-1. No ASLFs are located within the area from which Offshore Project components would be removed for this alternative; as such, impacts from Alternative C on ASLFs are expected to be the same as the Proposed

Action. However, implementation of Alternative C would result in avoidance of impacts on 11 marine archaeological resources in the Fish Haven; these are the same resources as described in Section 3.10.6, *Impacts of Alternative B on Cultural Resources*. Additionally, this alternative may allow for full avoidance or reduction of impact severity on one other marine archaeological resource that is a historic property potentially eligible for listing in the NRHP (i.e., Target 9). Removal of Offshore Project components under this alternative would also reduce impacts on presently undiscovered but potential marine archaeological resources.

Overall, the majority of marine archaeological resources, including the majority of those that BOEM have determined are historic properties potentially eligible for listing in the NRHP, are located in other areas of the marine APE that would be unchanged under Alternative C. As a result, this alternative would not substantially change impacts on marine archaeological resources overall, and impacts on marine cultural resources under Alternative C would be similar to those of the Proposed Action or Alternative A-1.

Cumulative Impacts of Alternative C: In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the cumulative impacts on cultural resources would be appreciable—the same as under the Proposed Action or Alternative A-1.

3.10.7.1 Conclusions

Impacts of Alternative C: The impacts resulting from individual IPFs associated with Alternative C alone on cultural resources may be reduced to those under the Proposed Action or Alternative A-1. However, impacts on a majority of cultural resources that are historic properties eligible for listing in the NRHP would be the same as the Proposed Action. As a result, Alternative B would have similar **moderate to major** impacts on individual cultural resources as the Proposed Action or Alternative A-1 that may be avoided, minimized, or mitigated depending on Dominion Energy's implementation of AMMs developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative C: In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the cumulative impacts on cultural resources would be appreciable—the same as for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative C when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.8 Impacts of Alternative D on Cultural Resources

Impacts of Alternative D: Alternative D includes two sub-alternatives (D-1 and D-2) with modifications to Project components to reduce potential impacts on sensitive onshore habitats, including wetlands. Proposed activities under this alternative would not involve any changes to Offshore Project components; therefore, impacts under Alternative D on historic aboveground resources in the visual APE for Offshore Project components and marine cultural resources would be the same as those under the Proposed Action or Alternative A-1. Impacts on terrestrial archaeological resources as well as historic aboveground resources located in the visual APE for Onshore Project components could differ under Alternative D as compared to those anticipated under the Proposed Action or Alternative A-1. These differences in impacts anticipated under each of the Alternative D sub-alternatives are described below.

Alternative D-1 would involve the use of Interconnection Cable Route Option 1. This interconnection cable route option would be approximately 14.2 miles (22.9 kilometers) long and installed entirely overhead. The proposed Harpers Switching Station would be built and used under this sub-alternative. Alternative D-2 would involve the use of Interconnection Cable Route Option 6 (Hybrid Route). This interconnection cable route option would be approximately 14.2 miles (22.9 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. A proposed Chicory Switching Station would be built and used under this sub-alternative.

Implementation of either Alternatives D-1 or D-2 would result in the same or similar impacts on historic aboveground resources.[1] While adoption of Alternative D-2 may reduce the potential visibility of Onshore Project components, impacts on other historic aboveground resources that BOEM has determined to be historic properties potentially eligible, eligible, or presently listed in the NRHP are not anticipated to differ between Alternative D-1 or D-2. As such, implementation of either Alternative D sub-alternative is anticipated to have the same impacts on historic aboveground resources as the Proposed Action or Alternative A-1.

Implementation of either Alternative D-1 or D-2 would result in similar impacts on known terrestrial archaeological resources due to ground-disturbing activities anticipated for the construction of either sub-alternative. Alternatives D-1 and D-2 would have impacts on 10 of the same terrestrial archaeological resources identified in Dominion Energy’s cultural resource investigations, 7 of which are historic properties potentially eligible for listing in the NRHP. However, Alternative D-1 would subject 1 identified cemetery near the proposed Harpers Switching Station to potential impacts. While BOEM anticipates avoidance, minimization, or mitigation procedures under development for this resource would result in the Project having no impact on this resource, adoption of Alternative D-2 would eliminate the risk entirely. Inversely, while adoption of Alternative D-2 would result in full avoidance of the cemetery, it would present potential impacts for one other terrestrial archaeological resource potentially eligible for listing in the NRHP that Alternative D-1 would otherwise not introduce.

However, as of August 2022, terrestrial archaeological investigations have not been fully completed in the terrestrial APE for the Proposed Action or Alternative A-1 and therefore Alternatives D-1 and D-2.[2] As such, presently undiscovered but potential terrestrial archaeological resources may exist within areas where either Alternative D sub-alternative would introduce impacts. In general, the adoption of Alternative D-1 (Route Option 1 installed entirely overhead) may result in fewer potential impacts on terrestrial archaeological resources as compared to Alternative D-2 (Route Option 6 installed as hybrid of underground and overhead) as the extent of ground disturbance from Project construction activities may be lesser for an entirely overhead route than a route with an underground segment. Overall, impacts on terrestrial archaeological resources may be similar or increased under Alternative D-2 compared to those of Alternative D-1 and therefore also similar or increased compared to those of the Proposed Action and Alternative A-1.

Cumulative Impacts of Alternative D: In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the cumulative impacts on cultural resources would be appreciable—the same as under the Proposed Action or Alternative A-1.

[1] Physical impacts on the Camp Pendleton/State Military Reservation Historic District, a historic aboveground resource that is a historic property presently listed in the NRHP, are not subject to change under Alternative D as the Onshore Project components that would have impacts on this resource (i.e., the cable landing location and onshore export cable route to the Harpers Road Switching Station) are not subject to modification under Alternative D.

[2] In consultation with BOEM and the VDHR, Dominion Energy will be using a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for the remaining unsurveyed areas of the terrestrial APE (COP, Appendices DD; Dominion Energy 2022). BOEM will use the MOA to establish commitments for reviewing the sufficiency of any supplemental terrestrial archaeological investigations as phased identification; assessing impacts; and implementing measures to avoid, minimize, or mitigate impacts in these areas prior to construction. See Appendix O, Section O.5, *Phased Identification and Evaluation*, for additional details on the phased process.

3.10.8.1 Conclusions

Impacts of Alternative D: The impacts resulting from individual IPFs associated with Alternative D alone on cultural resources may be reduced, similar to, or increased compared to impacts under the Proposed Action or Alternative A-1. In general, implementation of Alternative D-2 may reduce the potential visibility of Onshore Project components, thereby reducing potential impacts on historic aboveground resources; however, Alternative D-2 would also increase the extent of ground disturbance in the installation of underground Onshore Project components, thereby increasing the potential for impacts on terrestrial archaeological resources. As a result, Alternative D would have similar **moderate to major** impacts on individual cultural resources as the Proposed Action or Alternative A-1 that may be avoided, minimized, or mitigated depending on Dominion Energy's implementation of AMMs developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative D: In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the cumulative impacts on cultural resources would be appreciable—the same as for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

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3.11. Demographics, Employment, and Economics

This section discusses potential impacts on demographics, employment, and economics from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.11-1, includes the cities where proposed onshore infrastructure and potential port cities are located, as well as the cities closest to the Wind Farm Area: Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach Cities, Virginia. All incorporated cities in Virginia are classified as independent cities and considered as county equivalents by the U.S. Census Bureau for the purposes of data collection.

3.11.1 Description of the Affected Environment for Demographics, Employment, and Economics

The cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach are notable for coastal activities such as swimming, fishing, surfing, and sailing along Virginia's ocean beaches from Grandview Beach in Hampton to False Cape State Park in Virginia Beach. Coastal communities provide hospitality, entertainment, and recreation for many visitors each year and benefit from high tourism employment. In 2019, travel to Virginia Beach yielded $1.6 billion in spending to employ 13,000 people (COP, Section 4.4.5; Dominion Energy 2022). The geographic analysis area is part of the Virginia Beach–Norfolk–Newport News VA-NC Metropolitan Statistical Area (MSA) (also known as the Hampton Roads MSA), which had a total estimated population of 1,768,901 in 2019. The Hampton Roads region is known for its maritime industry, large military installations, and tourism industry, which is dominated by cultural history and coastal recreation (COP, Section 4.4.1.1; Dominion Energy 2022).

Data on population and demographics for the state of Virginia and for the cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach are provided in Table 3.11-1 and Table 3.11-2. The population of Hampton, Newport News, and Portsmouth declined between 2010 and 2019, while the population of Virginia and Chesapeake, Norfolk, and Virginial Beach increased. The U.S. Census Bureau estimated the 2019 population of Norfolk at about 240,000 residents. Norfolk has the lowest percentage of residents over age 65 and the lowest median age. The population of Chesapeake City grew at the highest rate, 9.4 percent from 2010 to 2019, followed by Virginia Beach with 3.3 percent and Norfolk with 1 percent; while, the population of Newport News, Portsmouth, and Hampton declined by 1.2 percent, 1.7 percent, and 2.9 percent, respectively. The population of the six cities are all younger than or the same as, on average, Virginia, with a higher percentage of residents aged 65 or older and a higher median age.

Table 3.11-1 Demographic Trends (2010–2019)

Jurisdiction	2010 Population	2019 Population	2010–2019 Percent Population Change	2019 Percent Population 18—64	2019 Percent Population 65 or Older	2019 Median Age
Virginia	7,841,754	8,454,463	7.8	62.9	15	38.2
Chesapeake city	219,268	239,982	9.4	62.8	13	36.9
Hampton city	139,046	135,041	-2.9	63.9	15	36.2
Newport News city	181,822	179,673	-1.2	64.1	12.7	33.5
Norfolk city	242,143	244,601	1.0	69.4	10.9	30.7
Portsmouth city	96,785	95,097	-1.7	62.1	14.5	35.3
Virginia Beach city	435,996	450,201	3.3	64.0	13.7	36.2

Source: U.S. Census Bureau 2021a, 2021b.

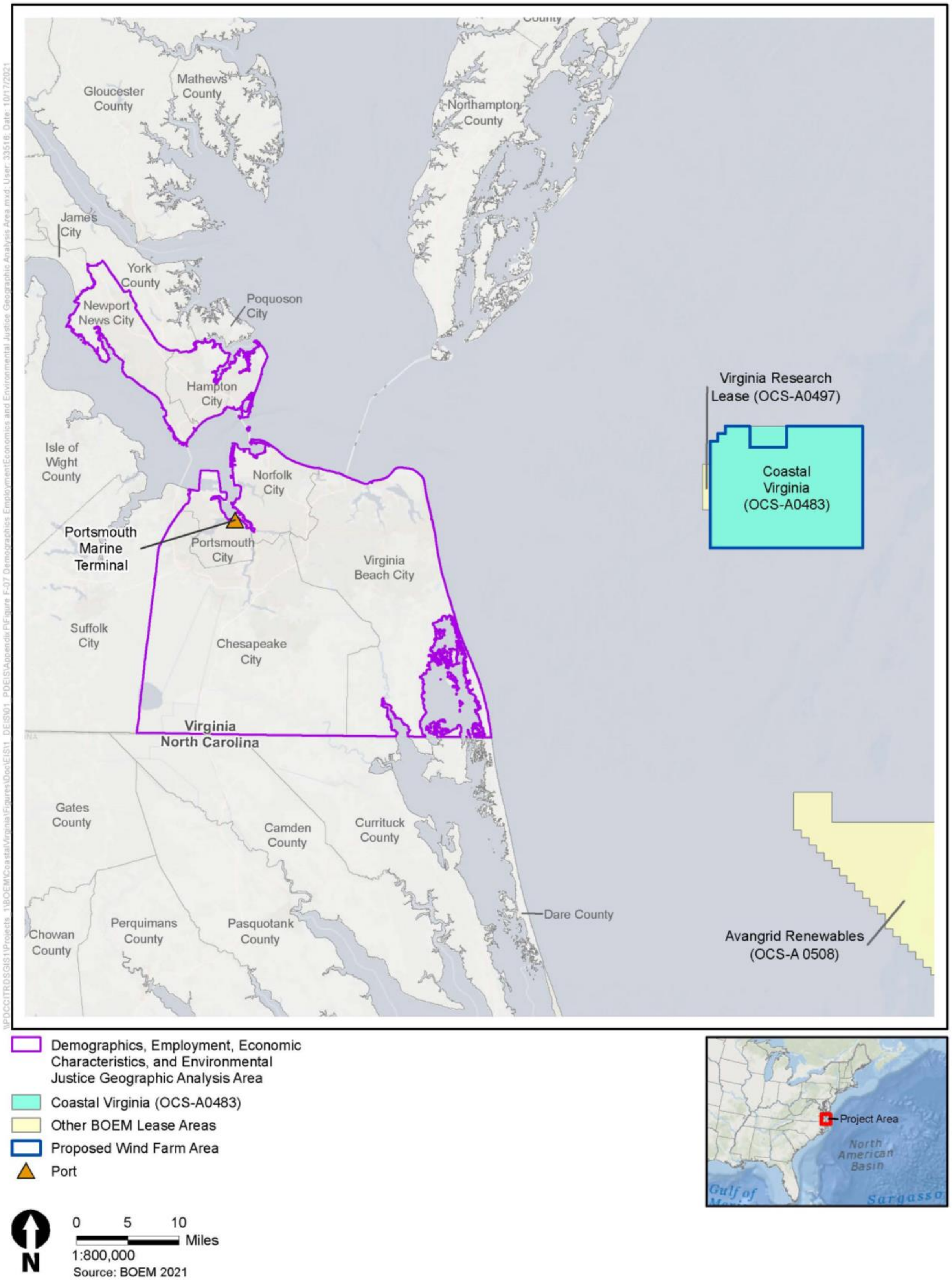

Figure 3.11-1 Demographics, Employment, Economic Characteristics, and Environmental Justice Geographic Analysis Area

Table 3.11-2 Demographic Data (2019)

Jurisdiction	Population	Population Density (persons per mi²)[1]	Per Capita Income (in USD)	Total Employment	Unemployment Rate (percent)
Virginia	8,454,463	214.1	39,278	4,156,018	4
Chesapeake city	239,982	703.8	35,536	111,227	5.2
Hampton city	135,041	990.8	30,135	61,782	5.6
Newport News city	179,673	1502.3	28,294	81,407	6.4
Norfolk city	244,601	2537.4	29,830	104,945	6
Portsmouth city	95,097	2037.2	26,312	41,396	5.1
Virginia Beach city	450,201	905.8	37,776	221,998	4.1

Source: U.S. Census Bureau 2021c; 2021d.
mi² = square mile; USD = U.S. dollars.

Chesapeake occupies about 341 square miles of land. Hampton occupies about 136 square miles of land in the coastal region of Virginia. Newport News occupies about 120 square miles of land bordering the Chesapeake Bay and the James River. Norfolk occupies about 96 miles of land in the coastal region of Virginia. Portsmouth occupies about 47 miles of land, and the Portsmouth Marine Terminal (PMT) resides in Portsmouth County. Virginia Beach occupies around 497 square miles of land and is where the onshore cable route would be located. Virginia Beach is composed of 38 miles of shoreline and 3 miles of boardwalk, which are important to Virginia Beach's economy (Section 3.18, *Recreation and Tourism*).

The percentage of housing units for seasonal, recreational, or occasional use in Virginia Beach is highest at 1.7 percent compared to 0.1 percent in Chesapeake, 0.4 percent in Norfolk, 0.2 percent in Portsmouth, 0.4 percent in Hampton, and 0.2 percent in Newport News in comparison to 2.3 percent in Virginia as a whole (U.S. Census Bureau 2021f) (COP, Section 4.4.1.1; Table 4.4-3; Dominion Energy 2022). Virginia Beach relies on tourism and visitors to its economy and has the closest proportion of seasonal housing to Virginia as a whole. Table 3.11-3 includes housing data for the geographic analysis area. Throughout Virginia, 2.5 percent of housing units are seasonally occupied; (COP, Section 4.4.1.1; Table 4.4-3) 450,201 residents lived in Virginia Beach County in 2019. More than 19 million people visited Virginia Beach in 2017 (City of Virginia Beach 2017).

Table 3.11-3 Housing Data (2019)

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Total)	Vacancy Rate (percent)	Median Value (Owner-Occupied, USD)	Median Monthly Rent (Renter-Occupied, USD)
Virginia	3,537,788	82,998	353,667	10.0	282,800	1,257
Chesapeake city	91,707	52	5,183	5.7	286,000	1,300
Hampton city	60,145	234	5,298	8.8	188,600	1,115
Newport News city	77,851	133	7,475	9.6	194,700	1,075
Norfolk city	98,142	397	8,744	8.9	215,800	1,077
Portsmouth city	40,879	78	4,229	10.3	174,200	1,083
Virginia Beach city	185,735	3,156	13,283	7.2	287,400	1,380

Source: U.S. Census Bureau 2022e, 2022f.

Table 3.11-4 includes data on the industries where residents in these cities work. The industries that employ workers reflect recreation and tourism's importance to Hampton, Newport News, Norfolk, and Virginia Beach. A greater or equal proportion of residents in these cities work jobs in arts, entertainment, recreation, and accommodation and food services (9.3 percent in Hampton, 10.6 percent in Newport News, 12.8 in Norfolk, and 11.1 percent in Virginia Beach) than in Virginia as a whole (8.9 percent) (U.S. Census Bureau 2021c). Table 3.11-5 contains data on at-place employment by industry in the geographic areas of interest. A greater proportion of jobs in these cities is generally in health care and social assistance (18.8 percent in Hampton, 17 percent in Newport News, 19.4 percent in Norfolk, and 28.3 percent in Portsmouth); whereas, accommodation and food services comprise the largest employment by industry for Virginia Beach (16 percent), and retail services comprises the largest employment by industry for Chesapeake (16 percent) (Table 3.11-5). In 2019, unemployment was 5.2 percent in Chesapeake, 5.6 percent in Hampton, 6.4 percent in Newport News, 6 percent in Norfolk, 5.1 percent in Portsmouth, and 4.1 percent in Virginia Beach, compared to 4 percent overall in Virginia.

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally include, among other categories, commercial fishing and seafood processing, marine construction, commercial shipping and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation. In Newport News and Virginia Beach Counties, tourism and recreation account for 67.5 percent and 95.0 percent, respectively, of the overall Ocean Economy gross domestic product (GDP) (NOAA 2021). The "living resource" sector of the Ocean Economy is smaller but contributes to the identity of local communities and tourism. This includes commercial fishing, aquaculture, seafood processing, and seafood markets. Among Newport News and Portsmouth Counties, there are 17 living resources fisheries (NOAA 2021).

Table 3.11-4 Employment of Residents by Industry (2019)

Industry	Virginia	Chesapeake	Hampton	Newport News	Norfolk	Portsmouth	Virginia Beach
Agriculture, forestry, fishing and hunting, and mining	0.9%	0.20%	0.5%	0.3%	0.1%	0.4%	0.3%
Construction	6.6%	6.7%	6.3%	5.5%	7.0%	6.9%	6.5%
Manufacturing	7.1%	8.1%	12.6%	13.7%	7.1%	10.3%	5.5%
Wholesale trade	1.8%	1.5%	1.6%	2.1%	1.6%	2.3%	2.0%
Retail trade	10.4%	10.5%	10.4%	11.8%	11.2%	13.4%	11.5%
Transportation and warehousing, and utilities	4.4%	5.3%	4.4%	4.3%	4.9%	5.8%	4.2%
Information	1.9%	2.2%	1.1%	1.4%	1.7%	1.3%	1.7%
Finance and insurance, and real estate and rental and leasing	6.3%	7.0%	5.1%	3.5%	5.7%	4.3%	7.7%
Professional, scientific, and management, and administrative and waste management services	15.5%	11.8%	12.6%	10.7%	11.7%	9.4%	12.8%
Educational services, and health care and social assistance	22.2%	24.1%	22.0%	23.4%	23.1%	24.5%	22.9%
Arts, entertainment, and recreation, and accommodation and food services	8.9%	7.7%	9.3%	10.6%	12.8%	8.4%	11.1%
Other services, except public administration	5.3%	5.4%	4.5%	4.5%	4.4%	4.2%	4.6%
Public administration	8.8%	9.5%	9.6%	8.2%	8.7%	8.8%	9.2%
Total	100%	100%	100%	100%	100%	100%	100%

Source: U.S. Census Bureau 2021c.

Table 3.11-5 At-Place Employment by Industry (2019)

Industry	Virginia	Chesapeake	Hampton	Newport News	Norfolk	Portsmouth	Virginia Beach
Agriculture, forestry, fishing	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mining, quarrying, oil and gas	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Utilities	0.4%	0.1%	0.0%	0.1%	0.0%	0.1%	0.2%
Construction	5.6%	9.1%	4.4%	3.0%	3.6%	8.4%	6.7%
Manufacturing	7.0%	5.0%	4.9%	30.2%	6.4%	3.4%	3.8%
Wholesale trade	3.1%	4.2%	1.8%	2.3%	3.9%	2.3%	2.4%
Retail trade	12.5%	16.1%	15.4%	10.8%	10.7%	12.4%	15.3%
Transportation and warehousing	3.3%	4.8%	1.3%	1.6%	6.5%	7.0%	1.2%
Information	2.9%	2.5%	2.0%	1.9%	2.1%	0.5%	2.2%
Finance and insurance	4.8%	4.7%	2.1%	1.8%	4.1%	1.5%	7.4%
Real estate	1.6%	1.7%	1.8%	1.5%	3.3%	1.5%	3.4%
Professional services	14.3%	9.5%	12.2%	4.9%	10.4%	5.2%	9.7%
Management	2.4%	2.8%	0.3%	2.8%	2.4%	1.1%	1.6%
Administrative, business support, waste management	8.1%	9.1%	9.8%	6.7%	8.1%	8.7%	7.2%
Educational services	2.4%	1.7%	4.5%	1.2%	1.9%	0.8%	2.5%
Health care and social assistance	13.6%	10.6%	18.8%	17.0%	19.4%	28.3%	13.3%
Arts, entertainment, and recreation	1.9%	1.4%	1.3%	1.3%	1.4%	0.9%	2.3%
Accommodation and food services	10.8%	11.6%	14.7%	9.6%	11.1%	10.8%	16.0%
Other services (e.g., public administration)	5.0%	4.9%	4.4%	3.1%	4.3%	7.0%	4.8%
Industries not classified	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100%	100%	100%	100%	100%	100%	100%

Source: U.S. Census Bureau 2021g.

3.11.1.1 Chesapeake and Virginia Beach

U.S. Census Bureau data indicate that over 70 percent of Virginia Beach's workforce resides in Virginia Beach and over 9 percent resides in both Chesapeake and Norfolk, suggesting significant economic linkages between the cities (COP, Section 4.4.1.1, Table 4.4-1; Dominion Energy 2022). The population of Chesapeake grew over 9 percent from 2010 to 2019 while the population of Virginia Beach only grew about 3 percent. The share of Virginia's population in Chesapeake and Virginia Beach is roughly 8 percent. Median age in Chesapeake (36.9) and Virginia Beach (36.2) is slightly younger than Virginia as a whole (38.2 years) (Table 3.11-1).

Onshore recreational and tourism uses include beachgoing and other water borne activities, waterfront festivals, biking, freshwater fishing, and general use of open park spaces (COP, Section 4.4.5; Dominion Energy 2022). Chesapeake is less dependent on tourism than Virginia Beach. The percentage of housing units for seasonal, recreational, or occasional use in Virginia Beach is 2.3 percent compared to less than 0.1 percent in Chesapeake (COP, Section 4.4.1.1; Table 4-4.3; Dominion Energy 2022). Accommodation and food services comprises the largest employment by industry for Virginia Beach (16 percent) and retail services comprises the largest employment by industry for Chesapeake (16 percent) (Table 3.11-5).

3.11.1.2 Norfolk and Portsmouth

Norfolk and Portsmouth are key contributors to the Port of Virginia. From 2010 to 2019, Norfolk's population grew by 1.0 percent and Portsmouth decreased by 1.7 percent, while the population of Virginia grew by 7.8 percent (Table 3.11-1). Norfolk and Portsmouth's populations are much younger than Virginia's, 30.7 and 35.3, respectively. Compared to Virginia as a whole, Norfolk and Portsmouth have a higher portion of residents who work in health care and social assistance (19.4 percent and 28.3 percent) than Virginia (13.6 percent) (Table 3.11-5).

3.11.1.3 Hampton and Newport News

Across the inlet from Norfolk and Portsmouth are the cities of Hampton and Newport News. From 2010 to 2019, both Hampton and Newport News' population decreased by 2.9 and 1.2 percent, respectively, while Virginia grew by 7.8 percent (Table 3.11-1). Hampton and Newport News' populations are much younger than Virginia's median age of 38.2, 36.2, and 33.5, respectively. Compared to Virginia as a whole, Hampton and Newport News have a higher portion of residents who work in health care and social assistance (18.8 percent and 17 percent) than Virginia as a whole (13.6 percent) (Table 3.11-5).

3.11.2 Environmental Consequences

3.11.2.1 Impact Level Definitions for Demographics, Employment, and Economics

Definitions of impact levels are provided in Table 3.11-6.

Table 3.11-6 Impact Level Definitions for Demographics, Employment, and Economics

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	Either no effect or no measurable benefit.
Minor	Adverse	Impacts on the affected activity or geographic place would not disrupt the normal or routine functions of the affected activity or geographic place.

Impact Level	Impact Type	Definition
	Beneficial	Small but measurable benefit on demographics, employment, or economic activity.
Moderate	Adverse	The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Project.
	Beneficial	Notable and measurable benefit on demographics, employment, or economic activity.
Major	Adverse	The affected activity or geographic place would experience unavoidable disruptions to a degree beyond what is normally acceptable.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

3.11.3 Impacts of the No Action Alternative on Demographics, Employment, and Economics

When analyzing the impacts of the No Action Alternative on demographics, employment, and economics, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for demographics, employment, and economics. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind and offshore wind activities as described in Appendix F.

Impacts of the No Action Alternative Under the No Action Alternative, the baseline conditions demographics, employment, and economics of the geographic analysis area described in Section 3.11.1, *Description of the Affected Environment for Demographics,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Tourism, recreation, and marine industries (e.g., fishing) would continue to be important components of the regional economy. Ongoing non-offshore wind activities within the geographic analysis area that would contribute to impacts on demographics, employment, and economics include continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy. Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise (see Appendix F, Section F.2 for a description of ongoing and planned activities).

3.11.3.1 Cumulative Impacts of the No Action Alternative

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

Offshore wind could become a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the United States, some studies acknowledge that domestic capacity is poised to increase. This EIS uses available data, analysis, and projections to make informed conclusions on offshore wind's potential economic and employment impacts within the geographic analysis area.

The BVG Associates Limited (2017) study estimated that the percentage of jobs sourced in the United States during the initial implementation of offshore wind projects along the Northeast coast would range from 35 percent to 55 percent of jobs. As the offshore wind energy industry grows in the United States, this proportion of jobs would increase because of growth of a supply chain in the East Coast along with a growing number of maintenance and local operations jobs for established wind facilities. The proportion of jobs associated with offshore wind projected to be within the United States is approximately 65 to 75 percent from 2030 through 2056. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would compose the rest of the jobs outside the United States (BVG Associates Limited 2017).

The American Wind Energy Association (AWEA) estimates that the offshore wind industry will invest between $80 and $106 billion in U.S. offshore wind development by 2030, of which $28 to $57 billion will be invested within the United States. This figure depends on installation levels and supply chain growth, as other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects. While most economic and employment impacts would be concentrated in Atlantic coastal states where offshore wind development will occur—there are over $1.3 billion of announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction—there would be nationwide effects as well (AWEA 2020). The AWEA report analyzes base and high scenarios for offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 gigawatts (GW) of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030. The high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. Offshore wind energy development would support $14.2 billion in economic output and $7 billion in value added by 2030 under the base scenario. Offshore wind energy development would support $25.4 billion in economic output and $12.5 billion in value added under the high scenario. It is unclear where in the U.S. supply chain growth would occur.

The University of Delaware projects that offshore wind power will generate 30 GW along the Atlantic coast through 2030. This initiative would require capital expenditures of $100.1 billion by 2030 (University of Delaware 2021). Although the industry supply chain is global and foreign sources would be responsible for some expenditures, more U.S. suppliers are expected to enter the industry.

Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2020 annual GDP for states with offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $60.6 billion in Rhode Island to $1.72 trillion in New York (U.S. Bureau of Economic Analysis 2021) and totaled nearly $4.3 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.6 percent of the combined GDP of these states.

AWEA estimates that in 2030, offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs nationwide, including direct, supply chain, and induced jobs. Most offshore wind jobs (about 60 percent) would be created during the temporary construction phase while the remaining 40 percent would be long-term O&M jobs. The Responsible Offshore Development Alliance (RODA) in 2020 estimated that offshore wind projects would create 55,989 to 86,138 job through 2030 in construction and 5,003 to 6,994 long-term jobs in O&M (Georgetown Economic Services 2020). These estimates are generally consistent with the AWEA study in total jobs supported, although the RODA study concludes that a greater proportion of jobs would be in the construction phase. The two studies conclude that states hosting offshore wind projects would have more offshore wind energy jobs, while states with manufacturing and other supply chain activities may generate additional jobs.

In 2019, employment in Virginia was 4.1 million (Table 3.11-2). While the extent to which there would be impacts on the geographic analysis area is unclear due to the geographic versatility of offshore wind jobs, a substantial portion of the planned offshore wind projects in Virginia would likely be within commuting distance of ports in Hampton, Newport News, Norfolk, and Portsmouth for offshore wind staging, construction, and operations.

In addition to the regional economic impact of a growing offshore wind industry, BOEM expects planned offshore wind development to affect demographics, employment, and economics through the following primary IPFs.

Energy generation and security: Once built, offshore wind energy projects could produce energy at long-term fixed costs. These projects could provide reliable prices once built compared to the volatility of fossil fuel prices. Kitty Hawk Wind North would consist of up to 69 WTGs and Kitty Hawk Wind South would have up to 121 WTGs; a total nameplate capacity has not yet been determined for the projects (Appendix F, Table F2-1). The economic impacts of future offshore wind activities (including associated energy storage and capacity projects) on energy generation and energy security cannot be quantified, but could be long term and beneficial.

Light: Offshore WTGs require aviation warning lighting that could have economic impacts on certain locations. Aviation hazard lighting from up to 190 WTGs and three OSSs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions (Appendix F, Table F2-1). Visitors may make different decisions on coastal locations to visit, and potential residents may choose to select different residences because of nighttime views of lights on offshore wind energy structures. These lights would be incrementally added over the construction period and would be visible for the operating lives of future offshore wind activities. Distance from shore, topography, and atmospheric conditions would affect light visibility.

If implemented, an Aircraft Detection Lighting System would reduce the amount of time that WTG lighting is visible. Visibility would depend on distance from shore, topography, and atmospheric conditions. Such systems would likely reduce impacts on demographics, employment, and economics associated with lighting. Lighting for transit or construction could occur during nighttime transit or work activities. Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction. However, vessel traffic is common along the Atlantic coast, and frequent ship traffic is especially common in the geographic analysis area (COP, Appendix I-1, Section I-1.5.2.1; Dominion Energy 2022).

New cable emplacement and maintenance: Cable installation could temporarily cause commercial fishing vessels, static gear fishing vessels, and recreational vessels based in the geographic analysis area to relocate away from work areas and disrupt fish stocks, thereby potentially reducing income of commercial fishing vessels. Fishing vessels are not likely to access affected areas during active construction, as about 130,145[1] acres (52,667.8 hectares) of seafloor disturbance would occur associated with offshore cable and inter-array cable installation as a result of the Kitty Hawk Wind North, and Kitty Hawk Wind South Projects (Appendix F, Table F2-2). In the long term, concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers and dredgers (COP, Section 4.2.5.2; Dominion Energy 2022). Assuming similar installation procedures as under the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance. Impacts from onshore cable

[1] Kitty Hawk South has 3 export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Carolina) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-mile-wide corridor to Virginia and 1,000-mile-wide corridors to North Carolina to allow for optimal routing of the cables.

installation would depend on the specific location but could temporarily disrupt beaches and other recreational coastal areas. Disruptions may result in conflict over other fishing grounds, increased operating costs for vessels, and lower revenue. Seafood processing and wholesaling businesses could also experience short-term reductions in productivity.

Noise: Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in temporary impacts on demographics, employment, and economics due to impacts on commercial/for-hire fishing businesses, recreational businesses, and marine sightseeing activities based in the geographic analysis area.

Assuming other offshore wind facilities generate vessel traffic similar to the Proposed Action vessel trips, construction of each offshore wind project would generate about 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods (Section 3.16, *Navigation and Vessel Traffic*). Noise from vessel traffic during the maintenance and construction phases could affect species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP, Section 4.2.5; Dominion Energy 2022). This noise may also make these facilities less attractive to fishing operators and recreational boaters. Similarly, noise from pile driving from offshore wind activities would affect fish populations that are crucial to commercial fishing and marine recreational businesses (COP, Section 4.4.6.3; Dominion Energy 2022). These impacts would be greater if multiple construction activities occur in close spatial and temporal proximity. An estimated 193 foundations (190 WTGs and three substations) would be installed within the North Carolina lease areas between 2024 and 2030 (Appendix F, Table F-3).

Onshore construction noise could possibly result in a short-term reduction of economic activity for businesses near installation sites for onshore cables or substations, temporarily inconveniencing workers, residents, and visitors. Noise would have intermittent and short-term impacts on demographics, employment, and economics.

Port utilization: Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would bolster port investment and employment while also supporting jobs and businesses in supporting industries. Future offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the PMT. While simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity, it would also generate considerable economic activity and benefit the regional economy and infrastructure investment.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. Improvements to existing ports and channels would be beneficial to other port activity. Port utilization in the geographic analysis area would occur primarily during development and construction projects, anticipated to occur primarily between 2026 and 2028. Ongoing O&M activities would sustain port activity and employment at a lower level after construction.

Offshore wind activities and associated port investment and usage would have long-term, beneficial impacts on employment and economic activity by providing employment and industries, such as marine construction, ship construction and servicing, and related manufacturing. The greatest benefits would occur during offshore wind project construction between 2026 and 2028. If offshore wind construction results in competition for scarce berthing space and port service, port usage could have short- to medium-term adverse impacts on commercial shipping.

Presence of structures: The presence of up to 190 WTGs, hard cover for scour and cable protection, and up to 81 acres (32.7 hectares) of hard coverage (Appendix F, Table F2-2) would increase the risk of gear loss connected with cable mattresses and structures along the East Coast (COP, Section 4.4.6.3; Dominion Energy 2022). These offshore facilities would also pose allision and height hazard risks, creating obstructions and navigational complexity for marine vessels, which would impose fuel costs, time, and risk and require adequate technological aids and trained personnel for safe navigation (Appendix F, Table F2-1 and Table F2-2). In the event of an allision, vessel damage and spills could result in both direct and indirect costs for commercial/for-hire recreational fishing.

The potential for 190 WTGs could encourage fish aggregation and generate reef effects that attract recreational fishing vessels from the geographic analysis area (COP, Section 4.4.6.3; Dominion Energy 2022). Fish aggregation could increase human fishing activities, but this attraction would likely be limited to recreational fishing vessels that already travel as far from the shore as the wind energy facilities. Fish aggregation could potentially result in increases to recreational fishing activities if these effects are widespread enough to encourage more participants to travel farther from shore.

The offshore wind structures could attract various wildlife and consequently increase the number of vessels conducting ecotourism trips from the geographic analysis area. As a result, the presence of the offshore wind structures could increase economic activity associated with ecotourism.

As a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses, such as seafood processing. The fishing industry is expected to be able to adapt its fishing practices over time in response to these changes. These effects could simultaneously provide new business opportunities, such as fishing and tourism. Overall, the presence of offshore wind structures would have continuous, long-term impacts on demographics, employment, and economics.

Vessel traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses and investment in ports. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate about 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods (Section 3.16, *Navigation and Vessel Traffic*). Construction of two future offshore wind projects could occur within the Virginia and North Carolina lease areas between 2024 and 2027, with a maximum of three projects under construction concurrently (Appendix F, Table F2-1; Dominion Energy 2022). Increased vessel traffic would have continuous, beneficial impacts during all project phases, with stronger impacts during construction and decommissioning.

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

Vessel traffic would occur among ports (outside the demographics, employment, and economic geographic analysis area) and offshore wind work areas. COP Section 3.4.1.5, Table 3.4-5 (Dominion Energy 2022) summarizes the anticipated Project-related vessel traffic during construction of the Proposed Action. Construction vessel trips will likely originate or terminate at Portsmouth, Virginia.

Land disturbance: Land disturbance could result in localized, temporary disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, temporary, and both beneficial (jobs and revenues to local businesses that participate in onshore construction) and adverse (lost revenue due to construction disturbances).

Climate change: Climate change could affect demographics, employment, and economics in the geographic analysis area. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increase insurance costs, and reduce the economic viability of coastal communities. Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency would affect industries that rely on these marine species. There would likely be a net reduction in GHG emissions, which contribute to climate change, and no collective adverse impact on climate change as a result of offshore wind projects.

3.11.3.2 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on demographics, employment, and economics. Future non-offshore wind activities, and future offshore wind activities would continue to sustain and support economic activity and growth in the geographic analysis area based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas, especially in Newport News and Virginia Beach. Marine industries, such as commercial fishing and shipping, would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies—including maintaining or increasing their year-round population—and protect environmental resources.

BOEM anticipates that ongoing activities in the geographic analysis area (continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy) would have **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise. BOEM anticipates that there would be **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics from these planned activities. BOEM expects the combination of ongoing and planned non-offshore wind activities to result in **minor** adverse impacts and **minor beneficial** impacts on ocean-based employment and economics, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise. Increased investment in land and marine ports, shipping, and logistics capability is expected to result along with component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. Additional manufacturing and servicing businesses would result either in the geographic analysis area or other locations in the United States if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output within the geographic analysis area specifically, there would be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, because of offshore wind development.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and demographics, employment, and economics would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on demographics, employment, and economics, due to increased onshore and offshore construction and operations. Many of the jobs generated by offshore wind projects are temporary construction jobs. The combination of these jobs over multiple activities and projects will create notable benefits during the construction phases of these projects. This will particularly be the case as the domestic supply chain for offshore wind evolves over time. Offshore wind projects also support long-term O&M jobs (25 to 35 years); long-term tax revenues; long-term economic benefits of improved ports and other industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce. Therefore, BOEM anticipates that there would be overall **minor beneficial** impacts from future offshore wind activities in the geographic analysis area, combined with ongoing activities and planned activities other than offshore wind.

BOEM also anticipates **minor** adverse impacts associated with future offshore wind activities combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind. Future offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through cable emplacement, noise and vessel traffic during construction, and the presence of offshore structures during operations. These IPFs would temporarily disturb marine species and displace commercial or for-hire fishing vessels, which could cause conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also lead to increased navigational constraints and risks and potential gear entanglement and loss.

3.11.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The extent to which Dominion Energy hires local residents and obtains supplies and services from local vendors.
- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M.
- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity.

The size of the proposed Project would affect the overall investment and economic impacts; fewer WTGs would mean less materials purchased, fewer vessels, and less labor and equipment required. Beneficial economic impacts in the geographic analysis area would depend on the proportion of workers, materials, vessels, equipment, and services that could be locally sourced and the specific ports used by the Project.

3.11.5 Impacts of the Proposed Action on Demographics, Employment, and Economics

Within the SMR, the Onshore Export Cable Route Corridor crosses under Lake Christine via HDD, which also serves as a fishing and boating area. In addition to the above-mentioned resources, there are two elementary schools near the General Booth Boulevard and South Birdneck Road intersection, which have athletic fields and passive open space on their properties. A public bikeway/trail also travels along the Onshore Export Cable Route Corridor on Oceana Boulevard (COP, Section 4.4.5; Dominion Energy 2022).

The Proposed Action and Alternative A-1's beneficial impacts on demographics, employment, and economics depend on what proportion of workers, materials, vessels, equipment, and services can be locally sourced. In a study conducted by BW Research Partnership on behalf of E2, a national, nonpartisan group of advocates for policies that benefit both the economy and environment, every $1.00 spent building an offshore wind farm is estimated to generate $1.73 for Virginia's economy (E2 2018).

Dominion Energy's economic impact study estimates that the Proposed Action, through $8 billion of direct investment from Dominion Energy and up to a $40 million contribution from the State of Virginia for site improvement and readiness at the PMT, would support about 900 direct, indirect, and induced Virginia jobs[2] annually (about 60 percent in Hampton Roads), from 2020 through the end of 2026. Beginning in 2027, once construction is completed, it is estimated that O&M of the PMT facility would support 200 direct FTE jobs and 910 indirect and induced jobs annually in Hampton Roads over the 33-year operational life for the Proposed Action (COP, Figure 4.4-4, Table 4.4-7, Appendix EE-1, and Section 3.6; Dominion Energy 2022).

The Proposed Action would generate employment during construction and installation, O&M, and decommissioning of the Project. The Proposed Action would support a range of positions for professionals such as engineers, environmental scientists, and financial analysts; administrative personnel; trade workers such as electricians, technicians, steel workers, welders, and ship workers; and other construction jobs during construction and installation. O&M would create jobs for maintenance crews, substation and turbine technicians, and other support roles. The decommissioning phase would also generate professional and trade jobs and support roles. Therefore, all phases of the Proposed Action would lead increases in local employment and economic activity.

Assuming that market conditions would be similar to those of the Massachusetts Vineyard Wind Project, job compensation (including benefits) is estimated to average between $88,000 and $96,000 for the construction phase, with occupations including engineers, construction managers, trade workers, and construction technicians. O&M occupations would consist of turbine technicians, plant managers, water transportation workers, and engineers, with average annual compensation of approximately $99,000 (BOEM 2021a). A study from the New York Workforce Development Institute provided salary estimates for jobs in the wind energy industry that concur with the Vineyard Wind Project's projections. The expected salary range for trade workers and technicians ranges from $43,000 to $96,000, $65,000 to $73,000 for ships' crew and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

Hiring local workers would stimulate economic activity through increased demand on housing, food, transportation, entertainment, and other goods and services. A large number of seasonal housing units are available in the vicinity of the Project. During the summer, competition for temporary accommodations may arise, leading to higher rents. However, this effect would be temporary during the active construction period and could be reduced if construction is scheduled outside the busy summer season. Permanent workers are expected to reside locally; there is adequate housing supply to accommodate the increase in the local workforce (COP, Section 4.4.1.2; Dominion Energy 2022).

[2] Direct employment refers to jobs created by the direct hiring of workers. Indirect employment refers to jobs created through increased demand for materials, equipment, and services. Induced employment refers to jobs created at businesses where offshore wind industry workers would spend their incomes.

Tax revenues for state and local governments would increase as a result of the proposed Project. Equipment, fuel, and some construction materials would likely be purchased from local or regional vendors. These purchases would result in short-term impacts on local businesses by generating additional revenues and contributing to the tax base. Dominion Energy's economic impact study estimated total state and local taxes generated would be $41.7 million during construction and $10.6 million annually during operations (COP, Section 4.4.1.2; Dominion Energy 2022). Once the proposed Project is operational, property taxes would be assessed on the value of the Dominion Wind facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the Project area.

The reasonably foreseeable environmental trends and impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are described by IPF below.

Energy generation and security: The Proposed Action would produce up to 3,000 MW of electricity, or 7.5 percent of the estimated 40,201 MW of reasonably foreseeable offshore wind generation potential for the East Coast (Appendix E, Table E-2) (Appendix F, Table F2-1); 5,496 MW of this capacity is estimated to occur in the Virginia and North Carolina offshore areas (Appendix F, Table F2-1). Offshore wind energy projects could produce energy at long-term fixed costs, which could provide stability against fossil fuel price volatility, once built. Therefore, the Proposed Action would provide long-term beneficial contributions to energy security and resilience through a stable supply of energy. Compared to the Proposed Action, Alternative A-1 would make similar or slightly less contributions to long-term energy security if less power were produced due to the use of three fewer WTGs. Impacts related to energy generation and security would have long-term, regional, and minor beneficial impacts on demographics, employment, and economics.

Light: Both onshore and offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Alternative A-1 impacts may be slightly less than the Proposed Action due to the development of three fewer WTGs. Dominion Energy proposes to implement an ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm. Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on the local economy. Impacts related to structure lighting would have localized, long-term, and negligible impacts on demographics, employment, and economics.

Lighting from vessels would occur during nighttime Project construction or maintenance or during transit to/from the ports. This lighting would be visible from coastal businesses, but is not anticipated to discourage tourist-related activities and would not affect other businesses; therefore, the impact of vessel lighting would be short term and negligible.

Between 2025 and 2028, there may be three offshore wind projects within the Virginia and North Carolina lease areas, including as many as two projects under construction concurrently from 2025 through 2030 (CVOW-C and the Kitty Hawk Wind North and South projects) (Appendix F, Table F2-1; Dominion Energy 2022). WTG lighting in future offshore wind activities would be visible from the same locations as the Proposed Action or Alternative A-1 in addition to Virginia coastal locations.

New cable emplacement and maintenance: The Proposed Action or Alternative A-1 cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism, with potential adverse effects on employment and income. Construction vessel trips would average 46 trips per day through the duration of construction activities (2023–2027). Daily estimated vessel trips would be dependent on the construction period and activity but are anticipated to range from a minimum of 3 trips per day to a maximum of 95 trips per day. Operation and maintenance activities are anticipated to consist of 26 annual round tips to port for service operation vessels and each crew transfer vessel (COP, Section 3.4.1.5 and Section 3.5.1; Dominion Energy 2022). Alternative A-1 may require slightly less cable installation due to the use of three fewer WTGs.

The approximate 6,036.6 acres (2,443.7 hectares) of seafloor disturbance (COP, Table 3.4-4; Dominion Energy 2022) could hinder commercial trawlers/dredgers, potentially reducing income and increasing costs for affected businesses over the long term. Cable installation would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of new cables and other existing submarine cables would have intermittent, long-term, negligible impacts under the Proposed Action or Alternative A-1.

Noise: Vessel noise traffic would indirectly affect commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP, Section 4.4.11.2; Dominion Energy 2022). Noise from O&M activities would have localized, intermittent, long-term, negligible impacts on demographics, employment, and economics. Vessel noise could affect marine species relied upon by commercial fishing businesses, marine recreational businesses, recreational boaters, and marine sightseeing activities. The number of vessels in the Offshore Project area is expected to temporarily increase during construction of the Project. Project-related vessels would use existing transit lanes and fairways, as required, while in transit (COP, Section 4.4.6.3; Dominion Energy 2022). Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

The estimated 208 foundations (WTGs and substations) related to the Proposed Action or 205 foundations (WTG and substations) related to Alternative A-1 would generate noise from pile driving, one of the most impactful noises on marine species, especially if multiple project construction activities occur in spatial and temporal proximity to the proposed Project (COP, Section 4.1.5.3, Dominion Energy 2022). These disturbances would be temporary and localized and would extend only a short distance beyond the work area. Pile driving and associated noise would have localized, short-term, and minor impacts on demographics, employment, and economics. Infrequent trenching, cable-laying activities, and construction activities of onshore components would emit noise. This noise could temporarily disrupt commercial fishing, marine recreational businesses, and onshore recreational businesses and residences. Noise from trenching and trenchless technology would affect marine life populations, which would, in turn, affect commercial and recreational fishing businesses. Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

The Proposed Action or Alternative A-1 is anticipated to overlap in time with construction of the Kitty Hawk Wind North Project (Appendix F, Table F2-1). While operational activity would overlap, indirect noise impacts during operations would be far less than during construction.

Port utilization: The Proposed Action would support port investment and employment and would also support jobs and businesses in supporting industries and commerce in the geographic analysis area. The Proposed Action would use facilities at the PMT as a construction management, O&M, and cable-staging base (COP, Sections 3.2 and 3.5; Dominion Energy 2022). The port would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity.

The economic benefits would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. During operations, activities would be concentrated in the Hampton Roads, Virginia Region where the proposed Project's onshore O&M facility would be located; Dominion Energy's preferred lease location for the O&M facility is Lambert's Point in Norfolk, Virginia (COP, Section 3.5; Dominion Energy 2022). Dominion Energy estimated that

201 permanent jobs would support operations in Virginia (COP, Section 4.4.1.2; Dominion Energy). The O&M facility would help diversify the local economy by providing a source of skilled, year-round jobs. Overall, operation of the Proposed Action would generate 3,756 job-years of skilled permanent labor (direct job-years) and 6,360 total job-years created (direct job-years plus indirect and induced job creation) (COP, Section 4.4.1.2; Dominion Energy 2022). The Proposed Action or Alternative A-1 would have a minor beneficial impact on demographics, employment, and economics due to greater economic activity and increased employment at ports used by the proposed Project.

Other offshore wind energy activities would provide business activities at the same ports as the proposed Project, as well as other ports in the geographic analysis area. Port investments are ongoing and planned in response to offshore wind activity. Maintenance and dredging of shipping channels are expected to increase, which would benefit other port users.

Presence of structures: The Proposed Action would add up to 208 offshore wind structures (205 WTGs and three OSSs) and Alternative A-1 would add up to 205 offshore wind structures (202 WTGs and three OSSs) that could affect marine-based businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through impacts such as entanglement and gear loss/damage, navigational hazard and risk of allisions, fish aggregation, habitat alteration, and conflicting use of space. These structures may cause vessel operators to reroute, which would affect fuel costs, operating time, and revenue. Due to the risk of gear entanglement, fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial and for-hire recreational fishing industries. This would have continuous, long-term, and minor impacts on demographics, employment, and economics.

Offshore wind structures could encourage fish aggregation and generate reef effects that attract recreational fishing vessels capable of reaching the offshore wind energy facilities. This would have long-term, negligible benefits on demographics, employment, and economics. The proposed Project structures could increase economic activity associated with offshore sightseeing because these structures create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons. These forms of marine life could attract private or commercial recreational sightseeing vessels (COP, Section 4.4.2.2; Dominion Energy 2022). This would have long-term, negligible beneficial impacts on demographics, employment, and economics.

Views of WTGs could have impacts on businesses serving the recreation and tourism industry. It is expected that the presence of WTGs in the Offshore Project area may change marine recreational usage; however, some of these impacts may be beneficial because WTGs have served as tourism and recreational fishing destinations in other regions, which can lead to opportunities for tours and chartered trips (COP, Section 4.4.5.2; Dominion Energy 2022). Portions of the WTGs and substations are expected to have limited visibility from onshore viewpoints based on location of WTGs, curvature of the earth, topography, wave height, and atmospheric conditions (COP, Section 4.3.4.2 and 4.3.4.3; Dominion Energy 2022). These structures would be visible to recreational boaters who could avoid waters where structures are visible. This would have continuous, long-term, negligible impacts on demographics, employment, and economics.

Across the Virginia and North Carolina lease areas, up to 403 offshore structures, including those of the Proposed Action, would affect employment and economics by affecting marine-based businesses (Appendix F, Table F2-2). The presence of these structures would have both beneficial impacts, such as providing sightseeing opportunities and fish aggregation that benefit recreational businesses, and adverse effects, such as causing fishing gear loss, navigational hazards, and viewshed impacts that could affect business operations and income.

Traffic: The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting Project construction, O&M, and decommissioning. Dominion Energy estimates that construction activity would generate 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods. During operations, the Proposed Action would generate approximately 52 annual round trip vessel trips to port (refer to Section 3.16, *Navigation and Vessel Traffic*, for additional information regarding anticipated vessel traffic). Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. Vessel traffic generated by the Proposed Action or Alternative A-1 alone would result in increased business for marine transportation and supporting services in the geographic analysis area with continuous, short-term, and minor beneficial impacts during construction and decommissioning, and negligible beneficial impacts during operations. Vessel traffic associated with the Proposed Action or Alternative A-1 could also result in temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels, which would result in economic costs for vessel owners. As a result of potential delays from increased congestion and increased risk of damage from collisions, the Proposed Action or Alternative A-1 would have continuous, short-term, and minor impacts during construction and negligible impacts during operations. The impacts of and potential for increased risks of damage from collisions would be slightly less with Alternative A-1 due to fewer vehicle trips associated with the three fewer WTGs, as compared to the Proposed Action.

Land disturbance: Construction of the Proposed Action or Alternative A-1 would require onshore cable installation and substation construction. The employment and economic impact of the Proposed Action or Alternative A-1 caused by disturbance of businesses near the onshore cable route and substation construction site would result in localized, short-term, minor impacts. The extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for future offshore wind energy projects.

Climate change: Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities due, in part, to the costs of resultant damage to property and infrastructure, fisheries, and other natural resources, among other factors. It is anticipated that there would be a net reduction in GHG emissions, which contribute to climate change, and no collective adverse impact on climate change as a result of offshore wind projects. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts associated with the effects of climate change. The Proposed Action or Alternative A-1 would have long-term, negligible beneficial impacts on demographics, employment, and economics from this IPF due to the anticipated carbon dioxide reductions resulting from the displacement of electricity generated from fossil fuel-powered plants. Future offshore wind activities would have similar contributions as the Proposed Action or Alternative A-1 but at a larger scale.

3.11.5.1 Cumulative Impacts of the Proposed Action

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

In context of reasonably foreseeable environmental trends, the Proposed Action or Alternative A-1 would contribute to lighting impacts from ongoing and planned activities, but the impacts on demographics, employment, and economics are anticipated to be negligible.

In context of reasonably foreseeable trends, the new cable emplacement and cable maintenance when combined with ongoing and planned activities would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of new cables and other existing submarine cables would have intermittent, long-term, negligible impacts

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 would contribute a noticeable increment to the combined noise impacts on demographics, employment, and economics from ongoing and planned activities including offshore wind, which would be short term and negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action or Alternative A-1 and other ongoing and planned activities would have combined long-term, minor beneficial impacts on demographics, employment, and economics resulting from port utilization and the associated trained and skilled offshore wind workforce that would contribute to localized increases in economic activity and the region as a whole.

In context of reasonably foreseeable environmental trends, the Proposed Action or Alternative A-1 and other ongoing and planned activities would have a long-term, minor impact on demographics, employment, and economics, due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

In context of reasonably foreseeable environmental trends, increased vessel traffic from the Proposed Action or Alternative A-1 and other ongoing and planned activities would produce demand for supporting marine services, with beneficial impacts on employment and economics during all Project phases, including minor beneficial impacts during construction and decommissioning and negligible beneficial impacts during operations. In context of reasonably foreseeable environmental trends, increased vessel traffic congestion and collision risk from the Proposed Action or Alternative A-1 and other ongoing and planned activities would have long-term, continuous impacts on marine businesses during all Project phases, with minor impacts during construction and decommissioning and negligible impacts during operations.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined land disturbance impacts on demographics, employment, and economics from ongoing and planned activities would be short term and minor due to the short-term and localized disruption of onshore businesses.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined impacts from ongoing and planned activities would have a long-term, minor benefit.

3.11.5.2 Conclusions

Impacts of the Proposed Action. BOEM anticipates that the Proposed Action would have **negligible** impacts on demographics in the geographic analysis area. While it is likely that some workers would relocate to the area due to the proposed Project, this volume of workers would not be substantial compared to the current population and housing supply.

The Proposed Action would affect employment and economics through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development, which would have **minor beneficial** impacts. Construction would have a **minor beneficial** impact on employment and economics due to jobs and revenue creation during the construction period. The beneficial impact of employment and expenditures during O&M would have a modest magnitude over the 37-year duration of the proposed Project (4 years of construction and commissioning, and a 33-year Project lifespan). Although tax revenues and grant funds would be modest in magnitude, they also would provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. The impacts on demographics, employment, and economics from decommissioning would be short term, **minor,** and beneficial due to the construction activity necessary to remove wind facility structures and equipment. After decommissioning, the Proposed Action would no longer affect employment or produce other offshore wind-related revenues. Compared to the Proposed Action, Alternative A-1 would have similar or slightly less impacts due to the construction, operation, and decommissioning of three fewer WTGs.

While the proposed Project investments in wind energy would largely benefit the local and regional economies through job creation, workforce development, and income and tax revenue, adverse impacts on individual businesses and communities would also occur. Short-term increases in noise during construction, cable emplacement, land disturbance, and the long-term presence of offshore lighting and structures would have **negligible** to **minor** adverse impacts on demographics, employment, and economics. The commercial fishing industry and other businesses that depend on local seafood production would experience impacts during construction. Overall, the impacts on commercial fishing and onshore seafood businesses would have **minor** impacts on demographics, employment, and economics for this component of the geographic analysis area's economy. Although commercial fishing is a small component of the regional economy, it is important to the identity of local communities within the region. The IPFs associated with the Proposed Action or Alternative A-1 alone would also result in impacts on certain recreation and tourism businesses that range from **negligible** to **minor**, with an overall **minor** impact on employment and economic activity for this component of the geographic analysis area's economy.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts. Overall, BOEM anticipates that the Proposed Action or Alternative A-1 and ongoing and planned activities would result in **minor** adverse impacts and **moderate beneficial** impacts on demographics, employment, and economics in the geographic analysis area. The **moderate beneficial** impacts primarily would be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the **minor** adverse effects would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions during construction, and land disturbance. Impacts on commercial and for-hire recreational fishing are anticipated to be **minor**. Because they are not expected to disrupt normal demographic, employment, and economic trends, overall impacts in the geographic analysis area likely would be **minor**. In addition, in context of reasonably foreseeable environmental trends, the Proposed Action or Alternative A-1 and ongoing and planned activities would have a notable and measurable benefit from construction and operations employment and would have **minor beneficial** impacts on demographics, employment, and economics.

3.11.6 Impacts of Alternative B on Demographics, Employment, and Economics

Impacts of Alternative B. Alternative B would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitudes would be the same. Alternative B would construct 29 fewer WTGs and fewer associated inter-array cables than the Proposed Action. Alternative B would also use only 14 MW turbines (up to 14.7 MW each using power boost capability), resulting in a total Project capacity of approximately 2,587 MW; a reduction of 413 MW in total power-generating output compared to the Proposed Action. As a result, Alternative B would slightly reduce the offshore construction impact footprint and installation period. Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which would reduce impacts on commercial and for-hire recreational fishing. Because Alternative B would produce less energy, it would also offset fewer GHG emissions from fossil-fueled power generation compared to the Proposed Action, further reducing beneficial impacts. A reduced number of WTGs would slightly reduce port utilization and reduce expenditures, generating less economic activity at ports in general. However, the change in these impacts would not alter the overall impact rating compared to the Proposed Action.

This reduction in number and size of WTGs would also slightly reduce visual and light impacts from shore when compared to the Proposed Action, thereby reducing potential impacts on the tourism, recreation, and real estate businesses that are sensitive to viewshed impacts from WTGs. However, because most of the WTGs would still be visible, localized, long-term, minor impacts are still anticipated. Fewer WTGs and the avoidance of the Fish Haven area in the northern portion of the lease area could reduce reef effects and fish aggregation compared to the Proposed Action but are anticipated to reduce potential displacement of mobile target species from construction noise and the presence of structures. The reduction in WTGs would also reduce the impact of new cable emplacement and maintenance by requiring fewer worksites, slightly reducing the short-term disturbance to species important to recreation and tourism. However, because most of the WTGs would still be built, intermittent, long-term, negligible impacts are still anticipated. Fewer WTGs would reduce the risk of allisions and the need for vessels to reroute, which would reduce travel time, fuel costs, and other associated costs.

Cumulative Impacts of Alternative B. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.6.1 Conclusions

Impacts of Alternative B. Alternative B would reduce the overall offshore footprint of the Project. The impacts resulting from individual IPFs associated with Alternative B would result in slightly lower adverse impacts and slightly lower beneficial impacts compared to the Proposed Action, but would not change the overall impact magnitudes, which are anticipated to range from **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of Alternative B. In context of reasonably foreseeable environmental trends, the contribution of Alternative B to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts.

3.11.7 Impacts of Alternative C on Demographics, Employment, and Economics

Impacts of Alternative C. Alternative C would install 33 fewer WTGs and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Alternative C could potentially reduce localized impacts on marine species that local commercial/for-hire and recreational fishing use for seafood production compared to the Proposed Action, but the overall impact magnitudes would not change. Alternative C would reduce impacts within priority sand ridge habitats, resulting in fewer impacts on species dependent on those habitat types while also reducing the potential for commercial fishing and recreational vessel allisions in the southern portion of the lease area. In addition, reduced underwater noise from pile driving and vessels during construction activities, and reduced habitat alteration, vessel strikes, artificial lighting, and decommissioning activities, would lessen the potential for displacement of marine species and associated impacts on commercial and recreational vessels.

Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. The reduced number of WTGs would also mean that the Project would generate less energy—with the removal of 33 WTGs, Alternative C would result in an expected total power output of 2,528 MW compared to 3,000 MW under the Proposed Action—and would therefore result in slightly lower beneficial impacts associated with delivering a reliable supply of energy and reduced GHG emissions from offsetting fossil-fueled power generation. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would all be slight and would not alter the overall impact rating compared to the Proposed Action.

Cumulative Impacts of Alternative C. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.7.1 Conclusions

Impacts of Alternative C. Alternative C would result in slightly reduced impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitude would not change. The removal of 33 WTGs under Alternative C would result in fewer impacts on marine species and, by extension, fewer impacts on commercial and for-hire recreational fisheries. Energy generation and associated beneficial impacts would be reduced under Alternative C because there would be fewer WTGs. Impacts under Alternative C are anticipated to be short term and range from **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** on demographics, employment, and economics.

Cumulative Impacts of Alternative C. In context of reasonably foreseeable environmental trends, the impacts resulting from individual IPFs would be the same as those of the Proposed Action: **minor** adverse impacts and **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternative C when combined with the impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.8 Impacts of Alternative D on Demographics, Employment, and Economics

Impacts of Alternative D. The impacts of Alternative D on demographics, employment, and economics would be similar to those of the Proposed Action. Alternative D would have the same offshore layout of Project components and number of WTGs; however, Alternative D would consider two onshore interconnection cable route options. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The overall length of Alternative D-1 or Alternative D-2 would be the same (14.2 miles). However, portions of Alternative D-2 would be installed via underground methods, while portions of Alternative D-1 would be installed entirely overhead. Overall, BOEM anticipates land disturbance and visual impacts on onshore businesses and residents from interconnection cable construction and operation under Alternative D to be the same as the Proposed Action.

The impacts on demographics, employment, and employment of Alternative D and the Proposed Action would be substantively the same, and the overall impact magnitude would not change. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the impacts from ongoing and planned activities including offshore wind would be the same as those described under the Proposed Action.

3.11.8.1 Conclusions

Impacts of Alternative D. Alternative D would result in the same impacts on demographics, employment, and economics as the Proposed Action. All offshore components under Alternative D and the associated beneficial impacts from energy generation would be the same as described for the Proposed Action. While Alternative D could reduce impacts on sensitive onshore habitats, including wetlands, when compared to the Proposed Action, the impacts resulting from individual IPFs associated with Alternative D are anticipated to be similar because the same interconnection cable route option could be selected under the Proposed Action. Impacts on demographics, employment, and economics under Alternative D are anticipated to be **negligible** to **minor** adverse and **negligible** to **moderate beneficial**.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action: short term and ranging from **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities on demographics, employment, and economics would be the same as the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts.

3.12. Environmental Justice

This section discusses environmental justice impacts from the proposed Project, alternatives, and ongoing and planned activities within the geographic analysis area. The geographic analysis area for environmental justice, as shown on Figure 3.12-1, includes the boundaries of the incorporated cities where proposed onshore infrastructure and potential port cities are located, as well as the incorporated cities closest to the Offshore Project area. The incorporated cities within the geographic analysis area include the City of Virginia Beach, City of Norfolk, City of Portsmouth, City of Chesapeake, City of Hampton, and City of Newport News.

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Section 3.12.2.2, *Impact Level Definitions for Environmental Justice*. A determination of whether impacts are "disproportionately high and adverse" in accordance with Executive Order (EO) 12898 is provided in the conclusion sections for the Proposed Action and action alternatives.

3.12.1 Description of the Affected Environment for Environmental Justice

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Subsection 1-101). When determining whether environmental effects are disproportionately high and adverse, agencies are to consider whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Indian tribe, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). While beneficial impacts are not typically considered environmental justice impacts, this section identifies beneficial effects on environmental justice communities, where appropriate, for completeness.

EO 12898 directs federal agencies to consider the following with respect to environmental justice as part of the NEPA process (CEQ 1997).

- The racial and economic composition of affected communities.
- Health-related issues that may amplify project effects on minority or low-income individuals.
- Public participation strategies, including community or tribal participation in the NEPA process.

According to USEPA guidance, environmental justice analyses must address disproportionately high and adverse impacts on minority populations (i.e., residents who are non-white, or who are white but have Hispanic ethnicity) when minority populations comprise over 50 percent of an affected area. Environmental justice analyses must also address affected areas where minority or low-income populations are "meaningfully greater" than the minority percentage in the "reference population"—the population of a larger area, often a county, region, or an entire state. Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census Population Reports, Series P-60 on Income and Poverty (USEPA 2016).

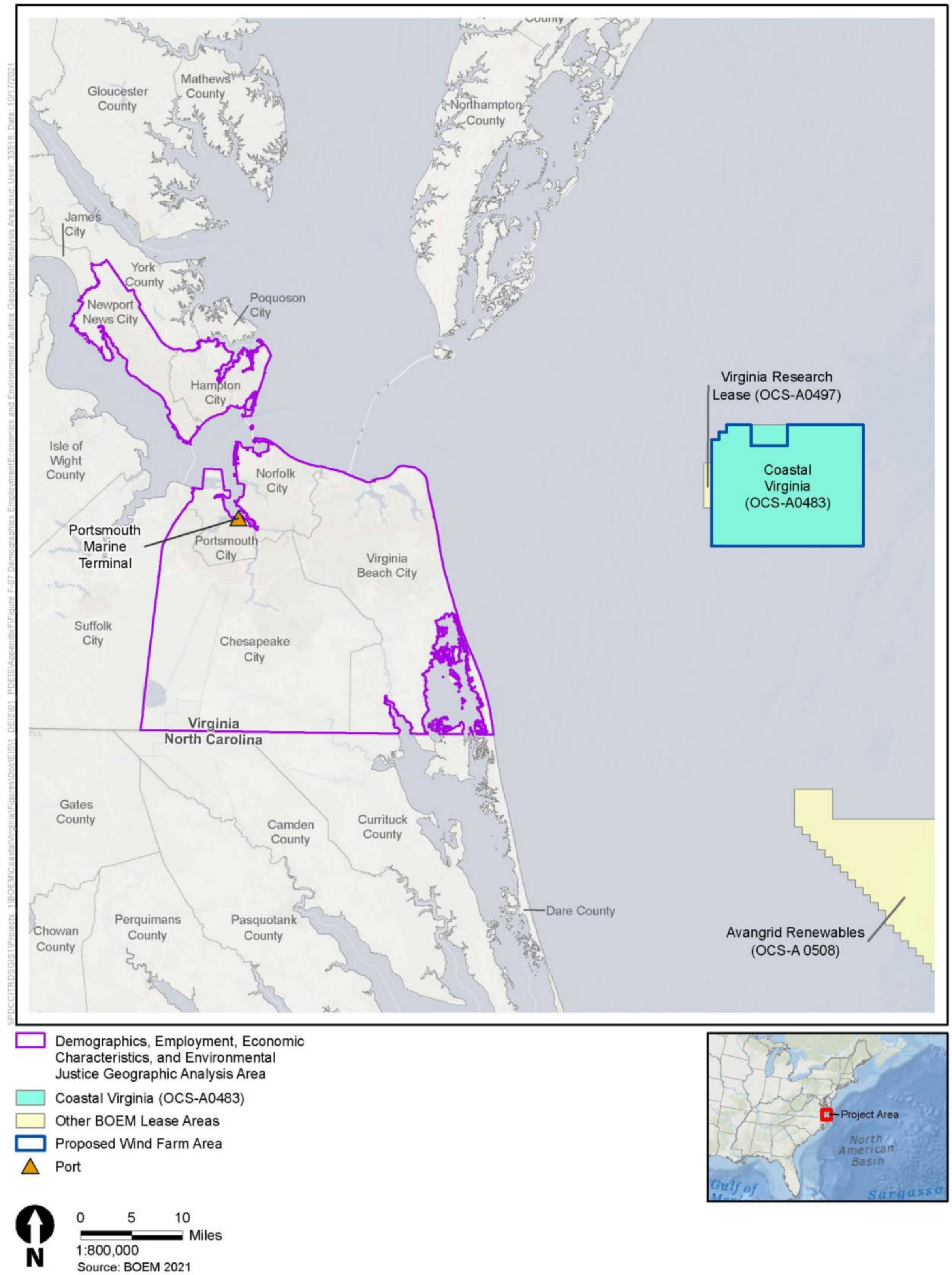

Figure 3.12-1 Demographics, Employment, Economic Characteristics, and Environmental Justice Geographic Analysis Area

The Commonwealth of Virginia's, Virginia Environmental Justice Act of 2020 defines an environmental justice community as "any low-income community or community of color." The Commonwealth of Virginia defines a "community in which a majority of the population are people of color," or community of color, as a group of individuals belonging to one or more of the following racial and ethnic categories: "Black, African American, Asian, Pacific Islander, Native American, other, non-white race, mixed race, Hispanic, Latino, or linguistically isolated" (VA Code § 56-576).

Additionally, these communities are defined as "any geographically distinct area where the population of color, expressed as a percentage of the total population of such area, is higher than the population of color in the Commonwealth expressed as a percentage of the total population of the Commonwealth" and notes that "if a community of color is comprised primarily of one of the groups listed in the definition of 'population of color,' the percentage population of such a group in the Commonwealth shall be used instead of the percentage population of color in the Commonwealth" (VA Code § 2.2-234). The Virginia Environmental Justice Act defines low-income as "having an annual household income equal to or less than the greater of (i) an amount equal to 80 percent of the median income of the area in which the household is located, as reported by the [U.S.] Department of Housing and Urban Development, and (ii) 200 percent of the Federal Poverty Level" and a low-income community as "any census block group in which 30 percent or more of the population is composed of people with low income" (VA Code § 2.2-234).

As shown in Figure 3.12-2, using this definition, environmental justice communities within the geographic analysis area occur in the City of Chesapeake, City of Hampton, City of Newport News, City of Norfolk, the City of Portsmouth, and the City of Virginia Beach, which contain populations that meet the income and/or minority criteria. Table 3.12-1 summarizes percentage of the non-white population within each incorporated city and the percentage of residents with household incomes below the federally defined poverty line in the counties studied in the geographic analysis area. All six incorporated cities have a higher percentage of non-white populations than that of the population of color for the Commonwealth of Virginia, which was used as the reference population. For the purposes of this analysis, this is considered meaningfully greater as the Commonwealth of Virginia does not provide a specific percentage or other quantitative measure to define "meaningfully greater." Additionally, all of the incorporated cities within the geographic analysis area, except for the City of Chesapeake and the City of Virginia Beach, have a higher percentage of the population below the federal poverty level than the Commonwealth of Virginia. Table 3.12-1 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the counties studied in the geographic analysis area. The non-white population percentage generally increased throughout the geographic analysis area between 2000 and 2019. The percentage of population living under the poverty level declined slightly between 2000 and 2010, but increased between 2010 and 2019.

Table 3.12-1 State and City Minority and Low-Income Status State and City Minority and Low-Income Status

Jurisdiction	Percentage of Population below the Federal Poverty Level			Non-White Population Percentage		
	2000	2010	2019	2000	2010	2019
Virginia	20%	11.1%	25%	30%	35%	38%
Chesapeake	16%	7.0%	21%	34%	39%	43%
Hampton	19%	11.8%	30%	52%	58%	62%
Newport News	20%	14.6%	36%	48%	57%	57%
Norfolk	26%	16.4%	39%	53%	56%	57%
Portsmouth	23%	18.1%	37%	55%	59%	62%
Virginia Beach	13%	7.5%	20%	31%	35%	38%

Sources: USCB 2000a, 2000b, 2010, 2019.
[1] Non-White population percentage is considered as White alone, not Hispanic or Latino population.

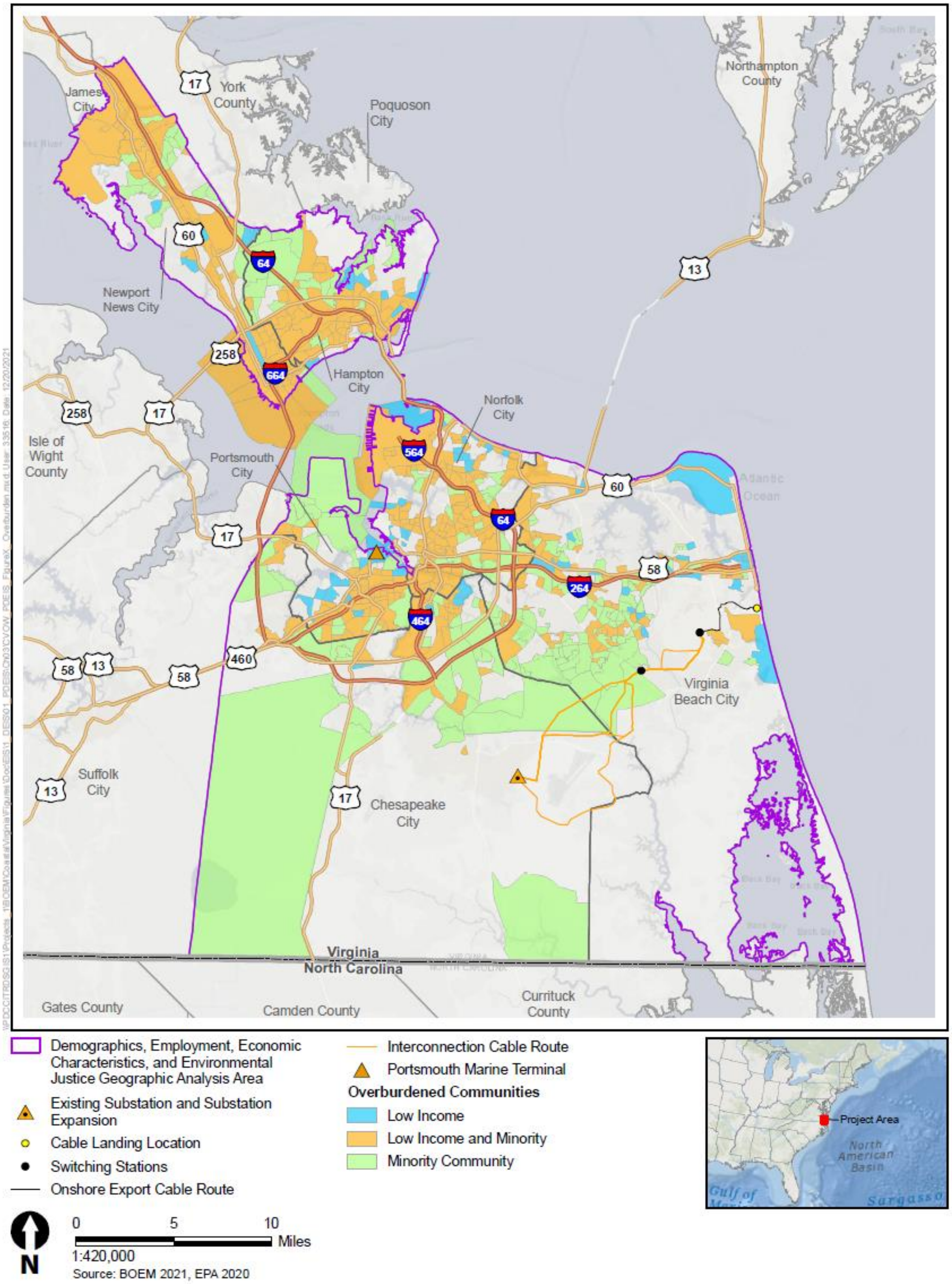

Figure 3.12-2 Environmental Justice Populations in Geographic Analysis Area

Low-income and minority workers may be employed in commercial fishing and related industries that provide employment on commercial fishing vessels, at seafood processing and distribution facilities, and in other trades related to vessel and port maintenance, operations at marinas, boat yards, and marine equipment suppliers and retailers, and therefore may be vulnerable to employment disruptions in the commercial fishing industry (National Guestworker Alliance 2016). Virginia’s total ocean economy, which includes marine construction, tourism and recreation, commercial fishing, aquaculture, and the seafood processing industry supports over 134,215 jobs (NOAA 2018).

NOAA has developed a social indicator mapping tool (NOAA 2022) that has been used to identify, within the geographic analysis area, environmental justice populations that also engage with, or rely on commercial or recreational fishing. The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to the coast communities in the geographic analysis area.

- Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high level indicates more engagement.
- Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates more reliance.
- Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates. A high rank indicates more engagement.
- Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community. A high rank indicates increased reliance.

Figure 3.12-3 depicts the level of commercial and recreational fishing engagement and reliance in the geographic study area. As outlined in Figure 3.12-3 the coastal communities of Virginia have a variety of social indicator levels. Newport News and Hampton, Virginia, have a high level of commercial fishing engagement. Norfolk and Virginia Beach, Virginia, have a medium level of commercial fishing engagement, and Portsmouth and Chesapeake, Virginia, have a low level of commercial fishing engagement. All communities have a low level of commercial fishing reliance. Within these communities that have a high level of commercial fishing engagement, Newport News and Hampton, Virginia, are both determined to contain environmental justice populations (Figure 3.12-2). Newport News, Hampton, Norfolk and Virginia Beach, Virginia, all have a high level of recreational fishing engagement, Portsmouth and Chesapeake, Virginia, have a low level of recreational fishing engagement. All communities have a low level of recreational fishing reliance. Within these communities that have a high level of recreational fishing engagement, Newport News, Hampton, Norfolk, and Virginia Beach, Virginia, are all determined to contain environmental justice populations (Figure 3.12-2). The PMT is also located in an area of identified environmental justice populations.

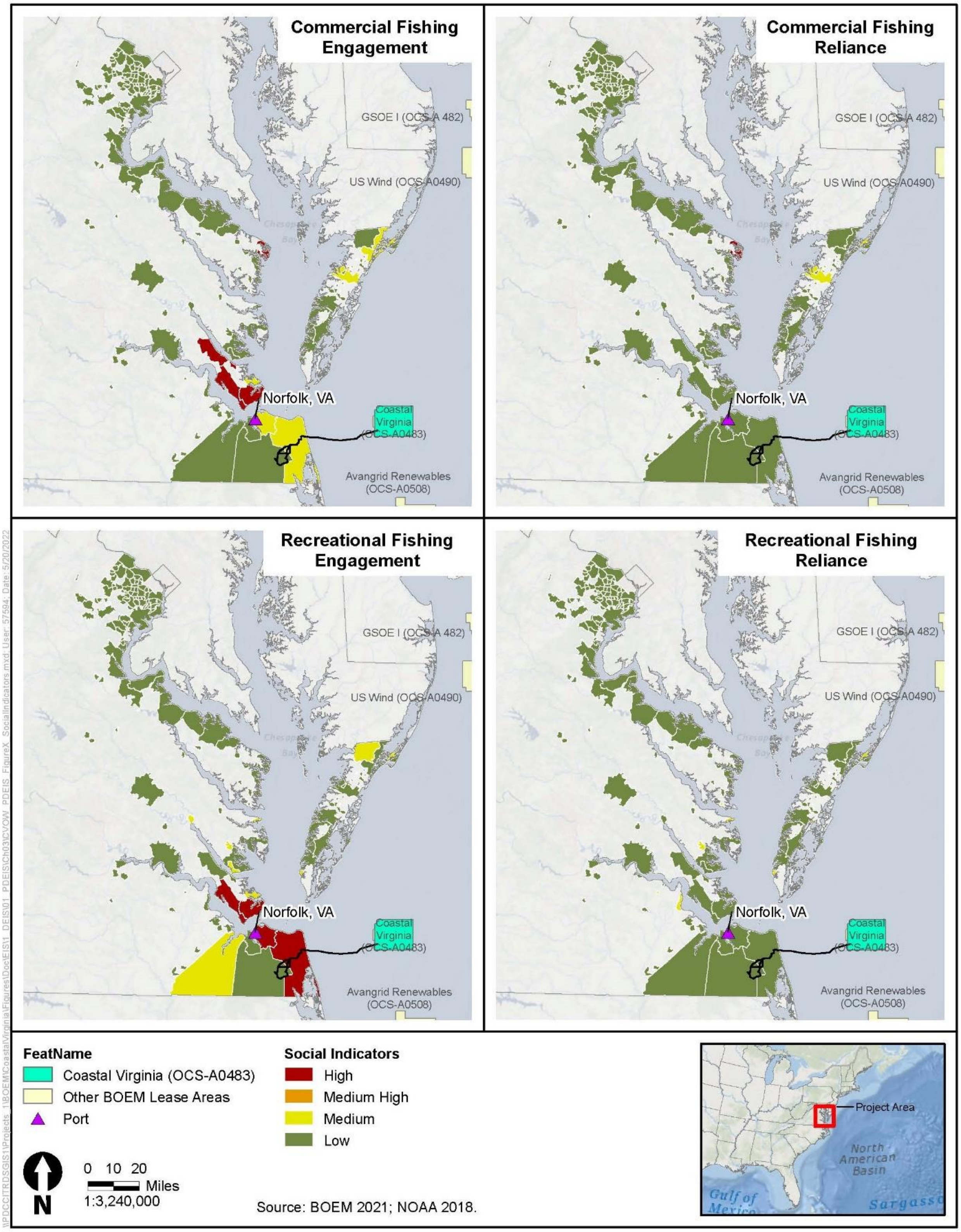

Figure 3.12-3 Commercial and Recreational Fishing Engagement or Reliance of Coastal Communities

In addition to NOAA's commercial and recreational fishing engagement and reliance maps, NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022). This map measures elements that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront. Gentrification indicators are related to housing disruption, retiree migration, and urban spawl.

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including changes in mortgage values. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years, population receiving social security or retirement income, and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

Similar to the commercial and recreational fishing engagement and reliance indices, the gentrification indices have varied levels. Newport News, Virginia, has a low level of housing disruption, Hampton, Portsmouth, Chesapeake and Virginia Beach, Virginia, have a medium level of housing disruption, and Norfolk, Virginia, has a medium high level of housing disruption. All communities have a low level of retiree mitigation and urban sprawl.

Environmental justice analyses must also address impacts on Native American tribes. Federal agencies should evaluate "interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action," and "recognize that the impacts within…Indian tribes may be different from impacts on the general population due to a community's distinct cultural practices" (CEQ 1997). Factors that could lead to a finding of significance to environmental justice populations include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016).

While there are no tribal lands within the geographic analysis area, BOEM has invited federally recognized tribes with ancestral associations to lands in the Project area to participate in government-to-government consultation and to participate in the NHPA Section 106 consultation process. BOEM has invited the following federally recognized tribes to participate in government-to-government consultation on the proposed Project: Chickahominy Indian Tribe, Chickahominy Indian Tribe, Eastern Division, Delaware Nation, Monacan Indian Nation, Nansemond Indian Nation, Pamunkey Indian Tribe, Rappahannock Tribe, Upper Mattaponi Indian Tribe, Coharie Tribe, Lumbee Tribe of North Carolina, Nottoway Indian Tribe of Virginia, and Patawomeck Indian Tribe of Virginia (Appendix K, *List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent*).

The Commonwealth of Virginia recognizes 11 tribes of which the United States federally recognizes 7 tribes. None of the tribes recognized by the Commonwealth of Virginia reside in the geographic analysis area. Though no tribes reside in the area, the Nansemond Indian Nation, located in Suffolk, Virginia is the closest tribe to the City of Norfolk. The Nansemond Indian Nation lived in settlements along the Nansemond River, where they fished, harvested oysters, hunted, and farmed (Nansemond Indian Nation n.d.).

3.12.2 Environmental Consequences

3.12.2.1. Scope of the Environmental Justice Analysis

To define the scope of the environmental justice analysis, BOEM reviewed the impact conclusions for each resource analyzed in Section 3.4 through Section 3.22 to assess whether the Proposed Action and action alternatives would result in major impacts that would be considered “high and adverse” and whether major impacts had the potential to affect environmental justice populations given the geographic extent of the impact relative to the locations of environmental justice populations. Major impacts that had the potential to affect environmental justice populations were further analyzed to determine if the impact would be disproportionately high and adverse. Although the environmental justice analysis considers impacts of other ongoing and planned activities, including other future offshore wind projects, determinations as to whether impacts on environmental justice populations would be disproportionately high and adverse are made for the Proposed Action and action alternatives alone.

As shown on Figure 3.12-2, onshore Project infrastructure including cable landfalls, onshore export cable routes, onshore substations, and points of interconnection are in areas where environmental justice populations have been identified and would, therefore, be potentially affected. Interconnection cables and the PMT are identified to be in areas of low-income and/or minority populations. The switching stations are identified as being on the cusp of minority populations. The Chicory Switching Station would only be constructed if Alternative D-2, Interconnection Cable Route Option 6 is selected (COP, Section 4.4.2, Dominion Energy 2022). Because onshore construction may affect environmental justice populations identified in the geographic analysis area, impacts associated with construction, O&M, and decommissioning of onshore Project components would be carried forward for further analysis of disproportionately high and adverse effects within the environmental justice analysis. Based on the geographic extent of onshore construction impacts relative to the location of environmental justice populations, BOEM concludes that environmental justice populations may experience disproportionately high and adverse effects related to construction, O&M, and decommissioning of onshore infrastructure.

Dominion Energy and the Port of Virginia have executed a lease agreement for PMT to support the staging of components and construction vessels for the Project. As shown on Figure 3.12-1 through Figure 3.12-3, the PMT is located within and near environmental justice communities. Dominion Energy is considering locations in Newport News, Portsmouth and Norfolk, Virginia, with Lambert’s Point, which is located on a brownfield site, as the preferred location, to serve as the O&M facilities for the Project. For both the PMT and the O&M facilities, in the event that upgrades or a new, build to suit, facility is needed for any purpose, construction would be undertaken by the lessor and would be separately authorized, as needed (COP, Section 3.2, Dominion Energy 2022).

Construction, O&M, and decommissioning of offshore structures (WTGs and OSSs) could have major impacts on some commercial fishing operations that use the Lease Area, with potential for indirect impacts on employment in related industries that could affect environmental justice populations. Cable emplacement and maintenance and construction noise would also contribute to impacts on commercial fishing. The long-term presence of offshore structures (WTGs and OSSs) would also have major impacts on scenic and visual resources and viewer experience from some onshore viewpoints that could affect environmental justice populations. Therefore, impacts of construction, O&M, and decommissioning of Offshore Project components are carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis under the IPFs for presence of structures, cable emplacement and maintenance, and noise.

Section 3.10, *Cultural Resources*, discusses marine cultural resources, which include pre-contact period Native American landscapes on the OCS, referred to as ancient submerged landforms (BOEM 2012), which have potential to contain Native American archaeological sites inundated and buried as the sea level rose at the end of the last ice age. It has been determined that no ancient submerged landforms were identified in the offshore export cable route corridor. However, six ancient submerged landforms were identified in the project Lease Area. An additional landform was identified immediately outside, but adjacent to the Lease Area. It has been determined that construction of offshore wind structures and cables could result in major impacts on ancient submerged landforms if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction. BOEM has committed to working with lessees, consulting parties, Native American tribes, and the Virginia Department of Historic Resources and the North Carolina State Historic Preservation Office (SHPO) to develop specific treatment plans to address impacts on ancient submerged landforms that cannot be avoided. Development and implementation of Project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on ancient submerged landforms. However, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these ancient submerged landforms can be avoided. The tribal significance of ancient submerged landforms identified in the Lease Area has not yet been determined, and consultation with tribes via NHPA Section 106 consultation and government-to-government consultation is ongoing. No other tribal resources such as cultural landscapes, traditional cultural properties, burial sites, archaeological sites with tribal significance, treaty-reserved rights to usual and accustomed fishing or hunting grounds, or other potentially affected tribal resources have been identified to date. BOEM will continue to consult with Native American tribes throughout development of this EIS and will consider impacts on tribal resources identified through consultation in the environmental justice analysis if they are discovered.

Other resource impacts that concluded less-than-major impacts for the Proposed Action and action alternatives or were unlikely to affect environmental justice populations were excluded from further analysis of environmental justice impacts. This includes impacts related to bats; benthic resources; birds; coastal habitat and fauna; finfish, invertebrates, and EFH; land use and coastal infrastructure; marine mammals; recreation and tourism; sea turtles; water quality; and wetlands. See Chapter 2, *Alternatives Including the Proposed Action*, Table 2-4 for a summary of impact levels determined for each of these resource topics.

3.12.2.2. Impact Level Definitions for Environmental Justice

This Draft EIS uses a four-level classification scheme to characterize potential impacts of alternatives, including the Proposed Action, as negligible, minor, moderate, or major as defined in Table 3.12-2. Determination of a "major" impact corresponds to a "high and adverse" impact for the environmental justice analysis. Major (or high and adverse) impacts will be further analyzed to determine if those impacts would be disproportionately high and adverse for low-income or minority populations. A determination of whether impacts are "disproportionately high and adverse" in accordance with Executive Order 12898 is provided in the conclusions sections for the Proposed Action and action alternatives.

Table 3.12-2 Impact Level Definitions for Environmental Justice

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on environmental justice populations would be small and unmeasurable.
	Beneficial	Beneficial impacts on environmental justice populations would be small and unmeasurable.
Minor	Adverse	Adverse impacts on environmental justice populations would be small and measurable but would not disrupt the normal or routine functions of the affected population.

Impact Level	Impact Type	Definition
	Beneficial	Environmental justice populations would experience a small and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Moderate	Adverse	Environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts.
	Beneficial	Environmental justice populations would experience a notable and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Major	Adverse	Environmental justice populations would have to adjust to significant disruptions due to notable and measurable adverse impacts. The affected population may experience measurable long-term effects.
	Beneficial	Environmental justice populations would experience a substantial long-term improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.

3.12.3 Impacts of the No Action Alternative on Environmental Justice

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

3.12.3.1. Impact of the No Action Alternative

Under the No Action Alternative, baseline conditions for environmental justice described in Section 3.12.1, *Description of the Affected Environment for Environmental Justice*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities that have the potential to affect environmental justice populations include onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; and commercial fishing operations. These activities support beneficial employment and also generate sources of air emissions, noise, lighting, and vehicle and vessel traffic that can adversely affect the quality of life in affected communities.

Coastal development that leads to gentrification of coastal communities may create space-use conflicts and reduce access to coastal areas and working waterfronts that communities rely on for recreation, employment, and commercial or subsistence fishing. Gentrification can also lead to increased tourism and recreational boating and fishing that provide employment opportunities in recreation and tourism. As described in Section 3.12.1, mapping of gentrification indices show medium high to medium levels of housing disruption in coastal Virginia communities such as Hampton, Portsmouth, Chesapeake, Virginia Beach at a medium level, and Norfolk at a medium-high level. Housing disruption may be caused by rising home values and rents, that can displace affordable housing, and have disproportionate effects for low-income populations, which are identified within these medium to medium high level areas. There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on environmental justice.

3.12.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Other planned non-offshore wind activities that may affect environmental justice populations include port utilization and expansion, construction, and maintenance of coastal infrastructure (marinas, docks, and bulkheads), and onshore coastal development that can lead to gentrification of coastal communities and working waterfronts (see Appendix F, Section F.2, for a description of ongoing and planned activities).

Planned non-offshore wind activities would have impacts like those of ongoing non-offshore wind activities and would be minor and minor beneficial. BOEM expects that most impacts of ongoing and planned activities would be minor because, while they would be measurable, they would not disrupt the normal or routine functions of the affected population. Impacts of gentrification are expected to be moderate because low-income populations would have to adjust somewhat in response to housing disruptions caused by rising home values and rents. These changes would be long term, but the intensity would vary across the geographic analysis area, with higher intensity in coastal communities with waterfront access and lower intensity in more inland areas. BOEM expects that improvements related to employment for ongoing and planned activities would be measurable but small and minor beneficial.

See Appendix F, Table F2-10 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for environmental justice.

Appendix F, Table F-3 identifies 29 future offshore wind projects, other than the Proposed Action, that could be constructed off the Atlantic Coast. Of these future offshore wind projects, only the proposed Kitty Hawk Wind North and Kitty Hawk Wind South projects would be located in the geographic analysis area for environmental justice.

BOEM expects future offshore wind development to primarily affect environmental justice communities as shown in Table 3.12-1 through the following IPFs.

Air emissions: Increased port activity associated with offshore wind projects would generate short-term, variable increases in air emissions, with the largest emissions anticipated during construction from diesel-powered equipment and vehicle or vessel activity. Emissions at offshore locations would have regional effects with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts depending on project infrastructure location and proximity to the ports used, the ambient air quality, and the increase in emissions at any given port.

Emissions are expected to be highly variable and limited in spatial extent at any given period. Emissions from vessels, vehicles, and equipment operating in ports could affect environmental justice communities adjacent or close to those ports. Emissions attributable to future offshore wind activities excluding the Proposed Action affecting any neighborhood have not been quantified; however, it is assumed that emissions would contribute a small proportion of the total emissions from those facilities. Air emissions during construction would have a small, short-term, variable impact on environmental justice communities due to temporary increases in air emissions during construction. The air emissions impact would be greater if multiple offshore wind projects simultaneously use the same port for construction staging.

As stated in Section 3.4, *Air Quality,* during the construction phase, the total emissions of criteria pollutants and ozone precursors from the Kitty Hawk Wind North and South are estimated to be 4,263 tons of CO, 15,586 tons of NO_X, 538 tons of PM_{10}, 521tons of $PM_{2.5}$, 264 tons of SO_2, 670 tons of

VOCs, and 963,302 tons of CO_2e (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F3-4); Appendix F, Table F3-4). The geographic analysis area for air quality is larger than that for environmental justice,[1] and most air quality impacts would remain offshore because the highest emissions would occur in the offshore region and the northerly and southwesterly prevailing winds would result in most emission plumes remaining offshore. However, ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases, even for overlapping projects.

Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. Estimated operational emissions from the Kitty Hawk Wind North and South would be 343 tons per year of CO, 869 tons per year of NO_X, 39 tons per year of PM_{10}, 36 tons per year of $PM_{2.5}$, 12 tons per year of SO_2, 43 tons per year of VOCs, and 64,216 tons per year of CO_2e (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F3-4). Operational emissions would overall be intermittent and dispersed throughout the Lease Area and the vessel routes from the onshore O&M facility, and would generally contribute to small and localized air quality impacts.

The power generation capacity of offshore wind development has the potential to lead to lower regional air emissions by displacing fossil fuel plants for power generation. See Section 3.4, *Air Quality*, for further analysis of reductions in regional GHG emissions. A 2019 study found that nationally, exposure to fine particulate matter from fossil fuel electricity generation in the United States varied by income and by race, with average exposures highest for Black individuals, followed by non-Hispanic white individuals. Exposures for other groups (i.e., Asian, Native American, and Hispanic) were somewhat lower. Exposures were higher for lower-income populations than for higher-income populations, but disparities were larger by race than by income (Thind et al. 2019).

Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. A 2016 study for the Mid-Atlantic region found that offshore wind could produce measurable benefits related to health costs and reduction in loss of life due to displacement of fossil fuel power generation (Buonocore et al. 2016). Environmental justice populations tend to have disproportionately high exposure to air pollutants, likely leading to disproportionately high adverse health consequences. Accordingly, offshore wind generation analyzed under the No Action Alternative would have potential benefits for environmental justice populations through reduction or avoidance of air emissions and concomitant reduction or avoidance of adverse health impacts.

Lighting: The view of nighttime aviation warning lighting required for offshore wind structures could have impacts on economic activity in locations where lighting is visible by being a consideration when tourists select which Mid-Atlantic coastal locations to visit. Service industries that support tourism are a source of employment for low-income workers. Impacts on tourism are anticipated to be localized, not industry-wide (Section 3.11, *Demographics, Employment, and Economics*) so would have negligible impact on environmental justice communities.

The Kitty Wind North and Kitty Hawk Wind South projects are anticipated to include up to 190 WTGs (Appendix F, Table F-2-1). Vegetation, topography, weather, and atmospheric conditions contribute to the visibility of aviation hazard lighting from WTGs. The long-term presence of WTGs associated with

[1] The air quality geographic analysis area, depicted on Figure 3.4-1, includes the airshed with 25 miles (40 kilometers) of the Wind Farm Area (corresponding to the OCS permit area) and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and ports that may be used for the Project.

future offshore wind may also cause major adverse impacts on scenic and visual resources in coastal communities that are within the viewshed of future offshore wind projects. The level of impact on onshore viewers would depend on the distance to the WTGs offshore, the number and height of the WTGs associated with each future offshore wind project, and the design of the aviation warning lighting system, which could introduce continuous nighttime lighting. Lighting impacts would be reduced if the emerging technology of ADLS is used. ADLS lighting would be activated only when an aircraft approaches (Section 3.20). Depending on exact location and layout of offshore wind projects, ADLS would likely limit the frequency of WTG aviation warning lighting use. This technology, if used, would significantly reduce the impacts of lighting. Aviation hazard lighting is evaluated as part of Section 3.20, *Scenic and Visual Resources,* and Section 3.18, *Recreation and Tourism*. The impacts on recreation and tourism-related economic activity, if any, would be continuous and long-term, which in turn could have impacts on environmental justice populations, specifically low-income employees of tourism-related businesses.

New cable emplacement and maintenance: New operating transmission cables would be installed to connect the offshore WTGs and substations to shore facilities. A new offshore export cable installation of 453 miles (729 kilometers) for the Kitty Hawk Wind North and South lease area is provided in Appendix F, Table F2-1. Assuming future projects use installation methods similar to those proposed in the COP, cable emplacement could displace other marine activities for a period of one day to several months. During the displacement for cable emplacement and during maintenance activities, commercial fishing operations may temporarily be less productive, resulting in potentially reduced hours and income for workers. Such business impacts could affect environmental justice populations due to the potential loss of income or jobs within the affected industries. Further discussion is found in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing.*

Noise: Construction noise associated with proposed offshore wind facilities, such as pile driving, could affect fish and marine mammal populations, which would create impacts on commercial fisheries and visitor-oriented services such as for-hire fishing and the marine sightseeing business. A reduction in catch volume by commercial fishing operations may result in reduced income for low-income or minority populations working in the industry but would also lead to short-term reductions in business volumes for seafood processing and wholesale businesses that depend on the commercial fishing industry. Additional information can be found the Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

Onshore construction noise would temporarily inconvenience visitors, workers, and residents near sites where onshore cables or substations are installed to support offshore wind, resulting in a short-term reduction in economic activity for businesses in these areas. Impacts would depend on where the onshore construction is in relation to businesses and environmental justice communities and are likely to be short-term and intermittent, comparable to the impacts of other onshore utility construction activity.

Noise generated by offshore wind staging operations at ports could have impacts on environmental justice communities if the port is near such communities. In the geographic analysis area, the PMT is within a low-income environmental justice community and is surrounded by low-income/minority and minority populations. The noise impacts from increased port utilization would be short term and variable, limited to the construction period, and would increase if a port is used for multiple offshore wind projects during the same time period. Noise impacts would be reduced if intervening buildings, roads, or topography lessen the intensity of noise in nearby residential neighborhoods, or if noise-reduction measures are used for motorized vehicles and equipment.

Port utilization: The PMT is within and near environmental justice communities with impacts on these communities resulting from increased air emission and noise generation by port utilization as described for the *Air emissions* and *Noise* IPFs. Port utilization and possible expansion resulting from offshore wind would have short-term, beneficial impacts for environmental justice populations during construction and decommissioning, resulting from new employment opportunities, the support for other local businesses by port-related activities and businesses, and employee expenditures. Beneficial impacts would continue during the port utilization during offshore wind operations, but those impacts would be of a lower magnitude.

Presence of structures: Construction, decommissioning, and, to a lesser extent, O&M of future offshore wind projects could affect employment and economic activity generated by commercial fishing and marine-based businesses. Commercial fishing vessels would need to adjust routes and fishing grounds to avoid offshore work areas during construction and to avoid WTGs and OSSs during operations. Concrete cable covers and scour protection could result in gear loss and would make some fishing techniques unavailable in locations where the cable coverage exists. Future offshore wind activities would generate increased vessel traffic, which would increase navigational complexity in offshore construction areas during construction and within each project's offshore wind lease area long term due to the presence of WTGs and OSSs. For-hire recreational fishing businesses would also need to avoid construction areas and offshore structures. A decrease in revenue, employment, and income within commercial fishing and marine industries could affect low-income and minority workers in communities with a high level of commercial fishing engagement or reliance. The impacts during construction would be short term and would increase in magnitude if multiple offshore construction areas are being used at the same time. Impacts during operations would be long term but may lessen in magnitude as business operators adjust to the presence of offshore structures and as any temporary marine safety zones needed for construction are no longer needed.

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

Views of offshore WTGs could also have impacts on individual locations and businesses serving the recreation and tourism industry, based on visitor decisions to select or avoid certain locations. Because the service industries that support tourism are a source of employment for low-income workers, impacts on tourism have the potential to result in impacts on environmental justice populations. However, as described in Section 3.11, *Demographics, Employment, and Economics*, a University of Delaware study found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity. While WTGs could be visible from the shore, depending on vegetation, topography, weather and atmospheric conditions, all proposed WTG positions in the geographic analysis area would be more than 15 miles from coastal locations. The impact of WTGs on recreation and tourism is likely to be limited to individual decisions by some visitors and is unlikely to affect most shore-based tourism businesses or the geographic analysis area's tourism industry as a whole.

Vessel traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operation, would generate increased vessel traffic, though projected vessel traffic for the proposed offshore wind project off the coast of Virginia is not known. More information on vessel traffic can be found in Section 3.16, *Navigation and Vessel Traffic*.

The volume of vessel traffic during construction would complicate marine navigation in areas of offshore construction and create the potential for vessel congestion and reduced capacity within and near the ports that support offshore construction, with additional potential competition for berths and docks. The temporary impacts on commercial fishing or recreational boating would affect some local boaters and would not have disproportionate impacts on residents or businesses in areas identified as environmental justice communities. Impacts may be on a greater magnitude, however, for individuals who fish for subsistence, or members of environmental justice communities who depend on jobs in commercial or for-hire fishing or marine industries for their livelihood. Vessel traffic generated by offshore wind project construction would have short-term, variable impacts on environmental justice communities due to the impacts on jobs, income, and subsistence fishing resulting from impacts on marine businesses, port congestion, and availability of berths. The magnitude of impact would depend on the navigation patterns and the extent of facility preparation and planning at the particular port. In addition to the temporary impacts related to navigation and port availability, the increased need for marine transportation to support offshore wind development could have beneficial impacts on environmental justice populations through the provision of jobs and support of businesses.

Land disturbance: Offshore wind development would require onshore cable installation, substation construction or expansion, and possible expansion of shore-based port facilities. The exact siting of the onshore facilities for the proposed offshore wind facility off the coast of Virginia has not been finalized. Depending on the siting, land disturbance could result in disturbances of neighborhoods and businesses comprising environmental justice communities near cable routes and construction sites due to expected construction impacts such as increased noise, dust, traffic, and road disturbances. Potential short-term, variable impacts on environmental justice communities could result from land disturbance, depending on the particular location of onshore construction for each offshore wind project. However, impacts of this IPF on environmental justice populations would not be high and adverse.

3.12.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, baseline conditions for environmental justice would continue to follow current regional trends and be modified by any IPFs introduced by other ongoing and planned activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts on environmental justice communities primarily though the following trends: ongoing coastal development and gentrification of coastal communities; ongoing commercial fishing, seafood processing, and tourism industries that provide job opportunities for low-income residents; and air emissions, noise, lighting, and traffic associated with onshore construction and land uses when these occur near environmental justice populations. BOEM anticipates that the impacts of these ongoing activities on environmental justice communities would be **minor** to **moderate** adverse and **minor** beneficial as BOEM also anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in beneficial effects on minority and low-income populations through economic activity and job opportunities in marine trades and the offshore wind industry. Additional minor beneficial effects may result from reductions in air emissions if offshore wind projects displace energy generation using fossil fuels.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and activities would continue, and environmental justice populations may continue to be affected by natural and human-caused IPFs. BOEM anticipates that the overall impacts associated with the No Action Alternative combined with all planned activities (including other offshore wind activities) in the geographic analysis area would result in **minor** adverse impacts on environmental justice communities. This reflects impacts on environmental justice communities from cable emplacement, construction-phase noise, air emissions, and vessel traffic, and the long-term presence of offshore structures, which could affect commercial fishing and for-hire fishing businesses, resulting in job losses for low-income workers. However, beneficial impacts associated with future offshore wind activities in the geographic analysis area, such as increased economic activities and job opportunities in marine and offshore wind industries are also anticipated. Additional beneficial effects may result from reductions in air emissions if offshore wind displaces energy generation from fossil fuels.

3.12.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Overall size of the Project and number of WTGs;
- The Project layout including the number, type, height, and placement of the WTGs and offshore substations, and the design and visibility of lighting on the structures;
- The extent to which Dominion Energy hires local residents and obtains supplies and services from local vendors;
- The PDE parameters that could affect commercial fishing and recreation and tourism as these activities affect employment and economic activity;
- Arrangement of WTGs and accessibility of the Wind Farm Area to recreational boaters; and
- The time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts on members of environmental justice communities who depend on subsistence fishing or jobs in commercial/for-hire fishing or marine recreation:

- **WTG number, size, location, and lighting:** More WTGs and larger WTG sizes closer to shore could increase visual impacts that affect local populations, onshore recreation and tourism, and recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- **WTG arrangement and orientation:** Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.

3.12.5 Impacts of the Proposed Action on Environmental Justice

Effects on environmental justice communities would occur when the Proposed Action's or Alternative A-1's adverse effects on other resources fall disproportionately within environmental justice communities, either due to the location of these communities in relation to the Proposed Action or due to their higher vulnerability to impacts.

Air emissions: Emissions at offshore locations associated with construction and O&M are expected to have regional impacts, with no disproportionate impacts on environmental justice communities. Emissions at onshore locations associated with the Proposed Action, such as the PMT, proposed onshore export cable corridors, and points of interconnection, could create disproportionate air quality impacts for existing environmental justice communities, depending on the chosen location for this infrastructure. The Proposed Action's contributions to increased air emissions at the PMT are anticipated to be minor during the construction, operation, and decommissioning, with the greatest quantity of emissions produced from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities. However, most emissions are expected to occur temporarily during construction at both onshore and offshore locations with Project infrastructure. These increased short-term and variable emissions from the Proposed Action construction and operations would have negligible to minor disproportionate, adverse impacts on environmental justice communities near the PMT, though they are not to be considered disproportionately high.

However, net reductions in air pollutant emissions resulting from the Proposed Action would result in long-term benefits to communities, regardless of environmental justice status, by displacing emissions from fossil fuel-generated power plants. Once operational, the Proposed Action would result in annual avoided emissions of 2,803 tons of NO_X, 375 tons of $PM_{2.5}$, 4,396 tons of SO_2, and 5,867,210 tons of CO_2. Estimates of annual avoided health effects would range from $257 to $518 million in health benefits and 23 to 53 thousand avoided mortality cases (Section 3.4, *Air Quality,* Table 3.4-3). Alternative A-1 could have slightly lower emissions from offshore construction and operation to the extent that this alternative would reduce the number of WTGs (three fewer WTGs compared to the Proposed Action). Emissions from onshore construction would be the same for the Proposed Action and Alternative A-1. Minority and low-income populations are disproportionately affected by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action or Alternative A-1 alone could benefit environmental justice communities by displacing fossil fuel power-generating capacity within or near the geographic analysis area.

Lighting: Nighttime aviation safety lighting on the 205 WTGs as part of the Proposed Action or up to 202 WTGs as part of Alternative A-1 could be visible up to 36.8 miles away from coastal locations in the geographic analysis area depending on weather and viewing conditions. Dominion Energy is considering the use of ADLS, which would activate the WTG safety lighting only when aircraft approach the WTGs, to minimize the number of hours per day that the aviation lighting is in full effect. If implemented, the system has the potential to decrease the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur under the standard continuous FAA hazard lighting. If ADLS is used, the lighting of offshore structures would result in a long-term, continuous, negligible impact on environmental justice communities as a result of the negligible impacts on recreation and tourism. There may also be impacts from nighttime light on vessels, which may potentially affect viewer experience. As described in Section 3.20, *Scenic and Visual Resources,* nighttime lighting from vessels would be possible and short-term during construction and decommissioning, and possibly long term, however, with less vessels, during O&M. The Proposed Action's, or Alternative A-1's impact of lighting on environmental justice communities is anticipated to be negligible. Therefore, BOEM has determined that impacts of the Proposed Action, or Alternative A-1 would not be disproportionately high and adverse for environmental justice populations.

New cable emplacement and maintenance: Offshore cable emplacement associated with the Proposed Action or Alternative A-1 would temporarily affect commercial and for-hire fishing businesses, and marine recreation during the cable installation and infrequent maintenance. As noted in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, the installation of submarine cables for the Proposed Action or Alternative A-1 would result in localized, temporary, and minor impacts on marine businesses such as commercial fishing or recreation businesses. Disruptions associated with cable emplacement and infrequent maintenance during the Project lifespan are expected to be temporary, but it is conceivable that low-income workers engaged in commercial fisheries and for-hire fishing would be more vulnerable to job or income losses should Project construction disrupt fishing activities. As described in Section 3.12.1, the majority of these low-income workers are members of minority or low-income groups. Cable emplacement would occur in offshore areas with medium commercial fishing engagement, high recreational fishing engagement, and low commercial and recreational fishing reliance (Figure 3.12-3). Cable installation could temporarily affect fish and mammals of interest for fishing and sightseeing through dredging and turbulence; however, species are expected to recover upon completion of installation activities (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat,* and Section 3.15, *Marine Mammals*). Specific cable locations associated with future offshore wind projects have not been identified in the geographic analysis area, but cable emplacement is expected to affect over 750 statute miles (Appendix F, Table F2-1). Installation of cables for the Proposed Action, or Alternative A-1 could, therefore, have a short-term, minor impact on low-income and minority workers in businesses that support commercial and for-hire recreational fishing.

Because impacts of Proposed Action cable emplacement and maintenance on environmental justice populations would be short term and minor, BOEM has determined that impacts of this IPF on environmental justice populations would not be high and adverse for the purpose of the environmental justice analysis.

Noise: Noise generated by equipment and vehicles used during the construction, O&M, and decommissioning of offshore facilities associated with the Proposed Action or Alternative A-1, primarily due to pile driving, has the potential to temporarily affect fish and marine mammal species, which has the potential to affect the fishing and sightseeing businesses that rely on these species, if the fishing or sightseeing coincides with pile-driving activity (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing,* and Section 3.11, *Demographics, Employment, and Economics*). This would result in a localized, short-term, negligible impact on low-income jobs supported by these businesses.

Noise generated by the Proposed Action's, or Alternative A-1's staging operations at ports could have impacts on environmental justice communities. The PMT is located within a low-income environmental justice community. This port has other ongoing commercial and industrial operations, as well as major roads, which would continue to generate ongoing noise. In addition, noise levels generated by onshore construction are expected for general construction activities using typical construction equipment, and for impact and vibratory pile driving implemented with noise mitigation strategies. Noise generated by construction, operation, and decommissioning of onshore infrastructure would be in areas with and without environmental justice populations. The installation of onshore interconnection cables, depending on whether installed entirely overhead or a combination of overhead and underground transmission facilities, leading ultimately to the PMT would occur in areas of environmental justice populations.

Noise from the Proposed Action or Alternative A-1 alone would have short-term, variable, minor impacts on environmental justice communities. Therefore, BOEM has determined that noise generated by construction, operation, and decommissioning of onshore infrastructure would not disproportionately affect environmental justice populations.

Port utilization: Dominion Energy plans on using a portion of the existing PMT in the City of Portsmouth, Virginia, to serve as the construction port for the Proposed Action, or Alternative A-1. The construction port would be used to store monopiles and transition pieces and to store and pre-assemble wind turbine generation components. Utilization of this port for activities related to manufacturing, staging, and loadout of WTG components of the Proposed Action or Alternative A-1 would be similar to existing and designated activities for the port and would not displace businesses in environmental justice communities or change the nature of land use at the ports. Air emissions and noise generated by the Proposed Action or Alternative A-1 activities could affect the environmental justice communities in and around the PMT (see discussions for the air emissions and noise IPFs). There would not be high and adverse effects on environmental justice populations, although impacts may be disproportionate. BOEM expects increased port utilization would also have minor beneficial impacts on environmental justice populations due to greater economic activity and increased employment at ports, primarily during construction and decommissioning and to a lesser extent during operations (Section 3.11, *Demographics, Employment, and Economics*).

Presence of structures: The construction of up to 205 WTGs and three offshore substations under the Proposed Action or up to 202 WTGs and three offshore substations as part of Alternative A-1 would result in both adverse and beneficial impacts for marine businesses and subsistence fishing. The reef effect created by the presence of the offshore structures has the potential to provide additional opportunity for subsistence fishing, charter boat tours, and for-hire recreational fishing businesses. Additionally, the WTGs themselves could create a new demand for sightseeing trips or charter tours. More information can be found in Section 3.18, *Recreation and Tourism*. It is possible that these benefits could be felt by environmental justice communities through increased job opportunities.

Impacts on commercial fishing and for-hire recreational fishing would have greater impacts on communities that have a high level of commercial or recreational fishing engagement or reliance. As shown on Figure 3.12-3, there is a high level of recreational fishing engagement and a medium level of commercial fishing engagement in the coastal communities of Hampton City, Norfolk City, and Virginia Beach. There are low levels of commercial and recreational fishing reliance across the geographic analysis area. Because there are medium to low levels of commercial fishing engagement and reliance across the geographic analysis area, and because impacts on commercial fishing would vary by fishery, BOEM determined that commercial fishing impacts on environmental justice populations in the geographic analysis area would be minor and would not be disproportionately high and adverse. However, some areas in the geographic analysis area have a high level of recreational fishing engagement, including areas where environmental justice populations are present. Impacts of the Proposed Action, or Alternative A-1 could include long-term minor adverse and minor beneficial impacts on for-hire recreational fishing due to space-use conflicts and the artificial reef effect as previously mentioned. Because of this, BOEM has determined that impacts of the Proposed Action on for-hire recreational fishing would not be disproportionately high and adverse for environmental justice populations.

The presence of the WTGs and offshore substations has the potential to alter marine usage as they present new navigational hazards, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hard cover, which could lead to possible equipment loss and limiting certain commercial fishing methods. Overall, the offshore structures for the Proposed Action or Alternative A-1 would have minor to moderate impacts on marine businesses, resulting in long-term, continuous, minor impacts on environmental justice populations due to the impact on low-income workers in marine industries and low-income residents who rely on subsistence fishing.

Section 3.20, *Scenic and Visual Resources*, identifies those areas where the proposed WTGs could be visible. There are several key observation points (KOPs) in the area with ranging impacts. There are five observation points in identified environmental justice communities. KOP-13 Cape Henry Lighthouse/Fort Story Military Base, KOP-15a North End Beach Residential View 1 – Daytime, KOP-15b North End beach Residential View 1 – Nighttime, KOP-22 King Neptune Statue/Boardwalk, and KOP-23 Naval Aviation Monument Park are all located in identified low-income areas. KOP-13, KOP-22 and KOP-23 carry a high sensitivity rate meaning that the residents in the area will have views of the project/presence of structures. Impacts on viewer experience within the geographic analysis area would range from minor to moderate. Views of WTGs would be sustained from many viewpoints across the geographic analysis area and would not disproportionately affect environmental justice populations. Therefore, BOEM has determined that impacts of the Proposed Action on viewer experience would not be disproportionately high and adverse for environmental justice populations.

Vessel traffic: The Proposed Action or Alternative A-1 would generate vessel traffic within and near the PMT in the City of Portsmouth, Virginia during construction and operations. Increased traffic near the port during construction is likely to have a short-term, minor impact on members of environmental justice communities that rely on subsistence fishing or employment and income from commercial fishing and marine recreation, due to increased vessel traffic near ports and potential displacement from berths and docks. Because vessel traffic is anticipated to be limited during operations, it would have a long-term, negligible impact on environmental justice communities. Impacts during decommissioning would be similar to the impacts during construction and installation. Further information can be found in Section 3.16, *Navigation and Vessel Traffic*.

Vessel traffic would increase if multiple offshore wind projects use the same ports during overlapping construction periods or during operations. It is anticipated to have a minor impact on commercial and for-hire recreational fishing (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*).

Land disturbance: Land disturbance for construction, operation and decommissioning of the onshore export cable and onshore substations would temporarily disturb neighboring land uses through construction noise, vibration and dust, and delays in travel along affected roads resulting in short-term disturbance and variable, negligible impacts on environmental justice communities. Impacts of land disturbance on environmental justice populations would be negligible because impacts would be small and measurable but would not disrupt the normal or routine functions of the affected population. Because impacts of Proposed Action or Alternative A-1 land disturbance on environmental justice populations would be short term and negligible, BOEM has determined that impacts of this IPF on environmental justice populations would not be high and adverse.

The Harpers Switching Station site is located north of Harpers Road in the City of Virginia Beach and is located in an environmental justice community. The switching station would be constructed in an area where there were previously no structures and would generate some operational noise, and portions of the route considered traverse through census block groups with environmental justice populations.

3.12.5.1. Cumulative Impacts of the Proposed Action

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

As noted in Appendix F, two other offshore wind projects (Kitty Hawk Wind North and Kitty Hawk Wind South) using ports in the geographic analysis area for environmental justice populations would overlap with the Proposed Action or Alternative A-1 construction and operations phase. Short-term air quality impacts during the construction phase would likely vary from minor to moderate. The impacts at PMT close to environmental justice communities cannot be evaluated because port usage has not been identified; however, most air emissions would occur at offshore locations rather than at the port. In addition to air emissions at ports, offshore wind within the Virginia and North Carolina lease areas would result in greater potential displacement of fossil fuel power generation than the Proposed Action or Alternative A-1 alone.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined air quality impacts on environmental justice populations from ongoing and planned activities would likely be negligible to minor, due to short-term emissions near ports. The Proposed Action or Alternative A-1 could also have beneficial effects for environmental justice populations, due to long-term reduction in air emissions from fossil fuel power generation.

The Proposed Action, or Alternative A-1, in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas. In context of reasonably foreseeable environmental trends, the Proposed Action, or Alternative A-1, in combination with ongoing and planned activities, would have minor to moderate adverse and minor beneficial impacts on environmental justice populations.

In the context of reasonably foreseeable environmental trends offshore cable emplacement impacts for the Proposed Action, or Alternative A-1, in combination with ongoing and planned actions, would likely result in a short-term and minor impact, resulting from the impact on employment and income from marine businesses.

In context of reasonably foreseeable environmental trends, noise from the Proposed Action or Alternative A-1, in combination with ongoing and planned activities, would have a variable, temporary, minor impact on environmental justice communities, reflecting existing ambient noise in the area, and ongoing and planned activities that could generate intermittent, short-term increases in noise levels.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined port utilization impacts on environmental justice populations from ongoing and planned activities, including the Proposed Action or Alternative A-1, would likely be negligible to minor adverse due to air emissions and noise, and there would also be minor beneficial impacts from port activities on environmental justice communities, due to increased employment opportunities and economic activity.

The Proposed Action or Alternative A-1 in combination with the other offshore wind energy projects in the environmental justice geographic analysis area would result in a greater number of offshore structures affecting a larger offshore area. In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined impacts on environmental justice populations from ongoing and planned activities would likely be long term, continuous, and minor to moderate and minor beneficial.

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to combined vessel traffic impacts on environmental justice populations from ongoing and planned activities would likely be short term and minor during construction due to the potential impacts of increased vessel traffic near ports on subsistence fishing and low-income employees of the commercial and for-hire recreational fishing industries and would be negligible during operations. There may also be beneficial impacts on environmental justice communities through increased employment and economic activity for marine transportation and supporting businesses.

The Proposed Action or Alternative A-1's onshore land disturbance activities are not anticipated to overlap in location with other offshore wind projects. If land disturbance overlaps with other offshore wind projects, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined onshore land disturbance impacts on environmental justice populations from ongoing and planned activities would likely be temporary, variable, and negligible to minor.

3.12.5.2. Conclusions

Impacts of the Proposed Action. In summary, BOEM anticipates that the impacts of individual IPFs from the Proposed Action or Alternative A-1 alone would be negligible to moderate on environmental justice populations in the geographic analysis area due to impacts during construction, operations and decommissioning on low-income employees of marine industries and supporting businesses, such as the commercial fishing and for-hire recreational fishing industry and subsequent onshore support services, as well as recreational fishing. The Proposed Action or Alternative A-1 would result in negligible impacts on environmental justice communities due to lighting and land disturbance. Air emissions and port utilization would result in negligible to minor impacts on environmental justice populations. Minor impacts on environmental justice populations would result from disruption of marine activities during offshore cable installation, noise, and vessel traffic. Minor to moderate impacts are anticipated on environmental justice populations from commercial and for-hire recreational fishing and viewer experience, based on the location of some of the KOPs in the geographic analysis area, due to the long-term presence of offshore structures in the geographical analysis area. Potentially beneficial impacts on environmental justice populations would result from port utilization and increased vessel traffic, and the resulting employment and economic activity. Beneficial impacts could also result if the Proposed Action or Alternative A-1 displaces fossil fuel energy generation in locations that improve air quality and health outcomes for environmental justice populations (Section 3.4, *Air Quality*).

None of the individual IPFs considered in this environmental justice analysis are expected to result in disproportionately high and adverse impacts on environmental justice populations. Considering the combined impacts of all IPFs, BOEM anticipates that the Proposed Action or Alternative A-1 would have overall **negligible** to **moderate** adverse impacts and **minor** beneficial impacts on all environmental justice populations.

Cumulative Impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the impacts of individual IPFs on environmental justice populations from ongoing and planned activities would range from **negligible** to **moderate** adverse impacts and **minor** beneficial impacts on all environmental justice populations. BOEM anticipates that the impacts of the Proposed Action on environmental justice communities would not be disproportionately high and averse. Impacts on low-income employees of marine industries and supporting businesses would be minor, based on the anticipated temporary disruption of marine activities due to offshore cable installation and construction noise and increased vessel traffic during construction, as well as long-term minor to moderate impacts on marine-dependent businesses resulting from the long-term presence of offshore structures.

The Proposed Action, or Alternative A-1 in combination with other offshore wind energy projects would result in additional offshore and onshore construction within the geographic analysis area. Considering all the IPFs collectively, BOEM anticipates that the combined impacts on environmental justice populations from ongoing and planned activities, in context of reasonably foreseeable environmental trends, would be **moderate** overall. The main drivers for the impact ratings are the long-term, minor to moderate impacts associated with the presence of offshore structures that affect marine-dependent businesses, such as commercial fishing, for-hire recreational fishing, boat tours, and other marine recreational businesses, that may hire low-income workers, as well as the viewer experience.

3.12.6 Impacts of Alternatives B and C on Environmental Justice

Impacts of Alternatives B and C. The impacts of Alternatives B and C on environmental justice communities would be the same as those of the Proposed Action except for the impact of the presence of structures. There would be no additional impacts on environmental justice communities in the direct vicinity of the onshore project components beyond the impacts already identified under the Proposed Action, because there would be no changes to the onshore project components of the project under Alternatives B and C. The impacts resulting from IPFs associated with construction, installation, operation, and decommissioning of the Project under Alternatives B and C would be similar to those described under the Proposed Action. Construction of Alternative B would involve the installation of up to 176 WTGs and associated export cables (29 fewer than the Proposed Action). Similarly, Alternative C would involve the installation of up to 172 WTGs (inclusive of two spare locations) and the removal of and relocation of WTGs and associated infrastructure to minimize impacts on priority sand ridge habitat. Alternatives B and C would reduce the offshore construction impact footprint and installation period compared to the Proposed Action.

Cumulative Impacts of Alternatives B and C. Impacts of Alternatives B and C would be similar to those of the Proposed Action for environmental justice communities. Alternatives B and C could reduce visual impacts due to the reduced number of WTGs and associated nighttime aviation safety lighting. However, this would not be noticeable to the casual viewer and would not have a substantial effect. Long-term, continuous, negligible impacts are still anticipated, as Alternatives B and C would not change the impacts on businesses that are a source of employment for low-income populations. Alternatives B and C could reduce gear entanglements and loss, as well as allisions, and recreational fishing may see a slight decrease compared to the Proposed Action due to fewer structures providing reef habitat for targeted species. Because of the reduced number of WTGs installed, fewer vessels and vessel trips would also be expected during construction, which would reduce the risk of discharges, fuel spills, and trash in the area.

3.12.6.1. Conclusions

Impacts of Alternatives B and C. Alternatives B and C would reduce the overall offshore footprint of the Project, which would slightly lessen the impacts on commercial and for-hire and recreational fishing vessels, which are a source of employment for low-income individuals. The impacts resulting from individual IPFs associated with Alternatives B and C would have slight improvements over the Proposed Action's impacts but would not change the overall impact magnitudes, which are anticipated to range from long-term and continuous **negligible** to **moderate** and **minor beneficial** on environmental justice communities. Because impacts would be negligible to moderate, BOEM determined that impacts of Alternatives B and C on low-income and minority populations would not be disproportionately high and adverse.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **moderate** adverse impacts with **minor beneficial** impacts.

3.12.7 Impacts of Alternative D on Environmental Justice

Impacts of Alternative D. The impacts of Alternative D on environmental justice communities would be similar to those of the Proposed Action. Alternative D would have the same offshore layout of project components and number of WTGs; however, Alternative D has two potential cable routes. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). Alternative D-2, Hybrid Interconnection Cable Route Option 6 would follow the same route as Interconnection Cable Route Option 1, except for the switching station, and would be installed via a combination of underground and overhead construction methods. Alternative D-1, Interconnection Cable Route Option 1 would be installed entirely overhead. The overall length of Alternative D-1 and Alternative D-2 would be the same at 14.2 miles (22.9 kilometers). The Chicory Switching Station associated with Alternative D-2 is not located in an environmental justice community. In comparison, the Harpers Switching Station would be constructed with Interconnection Cable Route Option 1 (Alternative D-1) and would be located in a census block group with a potential minority population. Alternative D-2 would reduce the potential for disproportionate adverse impacts to environmental justice communities with the construction of the Chicory Switching Station, which is not located in an environmental justice community.

Impacts of Alternative D on environmental justice communities would be similar to those of the Proposed Action. Alternative D-2 would reduce land disturbance impacts as the land sited for the Harpers Switching Station under the Proposed Action would remain vacant. Operational noise would not affect environmental justice communities, because Chicory Switching Station identified in Alternative D-2 is not located in an environmental justice community. Temporary, variable, and negligible to minor impacts on land disturbance are anticipated under Alternative D.

Cumulative Impacts of Alternative D. The impact of Alternative D in combination with future offshore wind projects would be similar to that described for the Proposed Action. In context of reasonably foreseeable environmental trends, Alternative D and the combined impacts on environmental justice populations from ongoing and planned activities are anticipated to range from **negligible** to **moderate** and **minor beneficial.**

3.12.7.1. Conclusions

Impacts of Alternative D. BOEM anticipates the impacts on environmental justice communities resulting from Alternatives D-1 or D-2 would be similar to those of the Proposed Action. The overall land-based footprint slightly lessens the impacts on land disturbance associated with the interconnection cable route corridor. Depending on which cable route is chosen, the switching station may or may not be in an environmental justice community. The Chicory Switching Station is not located in an environmental justice community, whereas the Harpers Switching Station would be, as it is identified as being constructed in census block group with a potential minority population. The impacts resulting from individual IPFs associated with Alternative D would have improvements over the Proposed Action's impacts but would not change the overall impact magnitudes on environmental justice communities, which are anticipated to be temporary and range from **negligible** to **moderate** and **minor beneficial**. Because impacts would be negligible to moderate, BOEM determined that impacts of Alternative D on low-income and minority populations would not be disproportionately high and adverse.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the combined impacts from individual IPFs on environmental justice from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **moderate** adverse and **minor beneficial**.

3.13 Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.13-1, includes the Northeast Continental Shelf Large Marine Ecosystem (LME),[1] which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, is likely to capture the majority of movement ranges for most invertebrates and finfish species. The entirety of the geographic analysis area includes only U.S. waters. Due to the size of the geographic analysis area, the analysis in this EIS focuses on finfish and invertebrates that would be likely to occur in the Project area and be affected by Project activities.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). This section provides a qualitative assessment of the impacts of each alternative on finfish, invertebrates, and EFH, which has been designated under the Magnuson-Stevens Fisheries Conservation and Management Act as "essential" for the conservation and promotion of specific fish and invertebrate species. More detailed information regarding the impact on species listed under the ESA, as well as on EFH, can be found in the EFH Assessment (BOEM 2022a) and the BA (BOEM 2022b). A discussion of benthic species is provided in Section 3.6, *Benthic Resources*, and a discussion of commercial fisheries and for-hire recreational fishing is provided in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.13.1 Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat

This section discusses existing finfish and invertebrate resources and their respective, designated EFH in the geographic analysis area for these aquatic organisms, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.13-1. Specifically, the geographic analysis area for finfish and invertebrates includes the Northeast Shelf LME, which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, and the Southeast Shelf LME, which extends from Cape Hatteras to Florida. The northern portion of the geographic analysis area includes only U.S. waters (Figure 3.13-1). Within this area, species discussed include deep water marine species, estuarine, and diadromous species that use both fresh and marine habitats within one of their life stages.

The coastal Project area falls within the southern extent of the Mid-Atlantic Bight (MAB). This portion of the MAB supports a diverse fish and invertebrate assemblage detailed in the COP Section 4.2.4.2; Dominion Energy 2022) and in Section 3.2.5.1 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment* (BOEM 2014b). Additional descriptions of fish and invertebrate species in the Project area can be found in other regional BOEM EISs (BOEM 2012, 2014a). The *Programmatic EIS for Alternative Energy Development* (MMS 2007) also describes the affected environment for this section of the Atlantic OCS.

Finfish

The geographic analysis area was selected based on the likelihood of capturing the majority of the movement range for most finfish species that would be expected to pass through the Project area. This area is large and has very diverse and abundant fish assemblages that can be generally categorized based

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

on life history and preferred habitat associations (e.g., pelagic, demersal, resident, and highly migratory species).

The MAB fish fauna is a mix of demersal and pelagic species with boreal and warm temperate, cold temperate, and subtropical affinities. At least 600 fish species use Virginia's coastal and offshore habitats (BOEM 2014b). A table listing the predominant demersal species and the biogeographic zones they use is found in the *Virginia Offshore Technology Revised Environmental Assessment* (BOEM 2014b).

At the family level, demersal species of the region are represented by a very diverse suite of taxa, including (but not limited to) skates (Rajiidae), dogfishes (Squalidae), requiem sharks (Carcharhinidae), searobins (Triglidae), hakes (Phycidae, Merlucciidae), anglerfishes (Lophiidae), seahorses and pipefishes (Syngnathidae), sculpins (Cottidae), seabasses (Serranidae), drums (Sciaenidae), scup (Sparidae), and flatfishes (Paralichthyidae, Pleuronectidae, Scophthalmidae; Robins and Ray 1986).

The MAB demersal assemblage characteristically varies over space and time driven primarily by seasonal changes in water temperature such as those driven by the seasonal evolution of the MAB cold pool (Fabrizio et al. 2014; Hopkins and Cech 2003; Kohut and Brodie 2019; Secor et al. 2018; Sims et al. 2001). When water temperatures increase in the spring, warm temperate, and some subtropical, fishes move into the MAB from the south; at the same time, several cold-water species migrate back to areas north of the MAB. After shelf waters cool during fall and early winter, warm temperate species migrate back south and offshore while some of the cold temperate forms move into the area (BOEM 2014a). Several fish species historically found south of the MAB have expanded their range northward into offshore Virginia waters and into the MAB. This expansion in range for some species has been attributed to increased seawater temperatures and a gradual shift of the Gulf Stream current to the northeast, moving close to the Virginia coastline (Pinsky et al. 2013; Andres 2016).

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

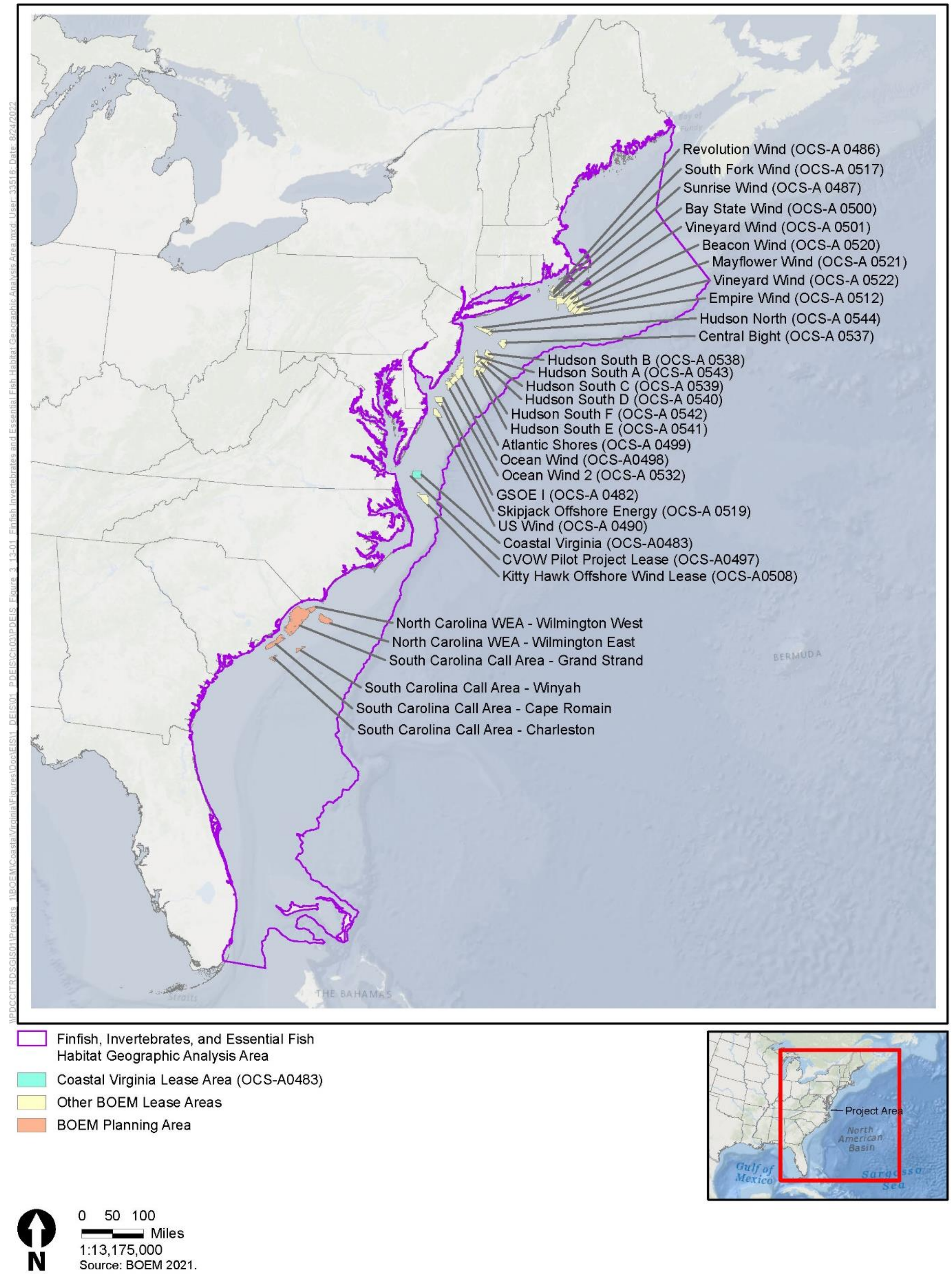

Figure 3.13-1 Finfish, Invertebrates, Essential Fish Habitat, and Scientific Research and Surveys Geographic Analysis Area

Demersal, epibenthic, and infaunal invertebrates found within the Offshore Project area include sea scallops (*Placopecten magellanicus*), surfclams (*Spisula solidissimus*), ocean quahogs (*Arctica islandica*), and the calico scallop (*Argopecten gibbus*) (Guida et al. 2017). These species reside either on the seafloor (scallops) or buried within the seafloor sediments (ocean quahog and surfclams). The primary pelagic macroinvertebrates in the region are longfin inshore squid (*Doryteuthis pealeii*) and northern shortfin squid (*Illex illecebrosus*). Longfin squid adults move offshore in fall and remain there until April, at which time adults and young migrate back into shelf waters for the summer. Longfin inshore squid egg clusters (known as mops) were found within the lease footprint and accounted for 33 percent of the total biomass for trawl samples collected during the NOAA 2017 survey (Guida et al. 2017). The presence and magnitude of the longfin squid egg mops biomass was acknowledged by Guida et al. (2017) as a notable finding since the Lease Area is well south of the longfin squid mop EFH (see also Welch et al. 2018). The magnitude of the biomass of longfin squid mop outside of its designated EFH should be considered relative to the potential impact benthic disturbance activities could cause during this immobile life stage of this important finfish prey species.

General patterns include (1) cross-shelf movements to offshore spawning areas, (2) movements along the shelf to southerly spawning areas, and 3) movements between coastal rivers and the coastal ocean for spawning or the reverse (diadromy) (BOEM 2014b; South Fork Essential Fish Habitat Assessment Appendix O 2019).

Invertebrates

Invertebrate resources assessed in this section include the planktonic zooplankton community and megafauna species that have benthic, demersal, or planktonic life stages. Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.6. *Benthic Resources*. In general, the sediments of the Virginia WEA are mostly sandy with large pockets of muddy sand on the western side, and increased gravel on the eastern side (Guida et al. 2017). The benthic infauna is dominated by polychaetes, while the epifauna is dominated by sand shrimp, snails, surfclams, calico scallops, hermit crabs, dog whelk snails, and sea slugs (Guida et al. 2017). Additional invertebrates within the geographic analysis area include crustaceans (e.g., amphipods, crabs, lobsters), mollusks (e.g., gastropods, bivalves), echinoderms (e.g., sand dollars, brittle stars, sea cucumbers), and various other groups (e.g., sea squirts, burrowing anemones) (Guida et al. 2017). Benthic invertebrates are commonly characterized by size (i.e., megafauna, macrofauna, or meiofauna). Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.6, *Benthic Resources*. In this section, the description of invertebrate resources focuses on the planktonic zooplankton community and megafauna species that have one or more of the following life stages: benthic, demersal, or planktonic.

Zooplankton

Zooplankton are a type of heterotrophic plankton in the marine environment that range from small, microscopic organisms to large species, such as jellyfish. These invertebrates play an important role in marine food webs and include both organisms that spend their whole life cycles in the water column and those that spend only certain life stages (larvae) in the water column (meroplankton). In the marine environment, zooplankton dispersion patterns vary on a large spatial scale (from meters to thousands of kilometers) and over time (hours to years). Zooplankton exhibit diel vertical migrations up to hundreds of meters; however, horizontal large-scale distributions over large distances are dependent on ocean currents and the suitability of prevailing hydrographic regimes. Northward shifts of more than 10 degrees latitude have been attributed to the increase in atmospheric temperatures (Burkill and Reid 2010), which heat ocean surface temperatures and therefore increased zooplankton regionally (Kane 2011).

Megafaunal Invertebrates Associated with Soft and Hard Substrates

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

No hard-bottom habitats were observed or detected within the offshore survey area during the most recent benthic survey (COP, Appendix D; Dominion Energy 2022). All samples were dominated by sand, with fine sand, accounted for 93.2% of all sample particle size distribution. Meanwhile, gravel only accounted for 3.7%, and 3.0% were total fines (COP, Appendix D; Dominion Energy 2022). This habitat supports soft-sediment invertebrates such as annelids (polychaete worms), mollusks (moon snails, whelks, quahogs), arthropods (horseshoe crabs, hermit crabs, spider crabs), and echinoderms (sand dollars). Nearly 90% of the benthic grab samples were annelids and arthropods (COP, Appendix D; Dominion Energy 2022). Amphipods were very common across all project samples, accounting for 34% of all identified individuals. These sessile species are more likely to be impacted by local disturbances and anthropogenic impacts. The biomass and number of benthic individuals are important factors in determining the availability of food resources to bottom-feeding organisms and fishes (Cutter and Diaz 1998).

General Biological Trends in Primary Invertebrate Species

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

The most recent trends in primary invertebrate species have been summarized in the State of the Ecosystem report for the Mid-Atlantic (NOAA 2021b). They indicated that long-lasting climactic events such as heatwaves can greatly impact invertebrate species, including those of commercial importance such as the lobster fishery. These industries have had to adapt as their target species shift north to cooler waters. In the same regard, changes in the cold pool were observed. The cold pool is a mass of colder water trapped on the ocean floor over the continental shelf. This distinctive feature of the MAB is becoming increasingly warmer, and the water column becomes homogenized earlier in the year. These physical changes to the ocean temperature contribute to ecosystem-level changes that are observed in many fishing industries.

3.13.1.1 Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act requires fishery management councils to:

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

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

3.2.5.1 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment* (BOEM 2014b) and Section 4.3.1.2 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment Research Activities Plan* (Tetra Tech 2015) provide a formal EFH assessment including relevant managed species within the Project area.

Three basic marine habitat types occur in the region: pelagic (water column), soft bottom demersal, and hard bottom demersal. Within inshore waters, additional biogenic habitats such as emergent vegetation, submerged vegetation, and oyster reefs are important. Various managed species use these inshore habitats for shelter, feeding, growth, and reproduction. MAB pelagic habitats support northern shortfin and longfin inshore squids, coastal pelagic fishes (Atlantic mackerel [*Scomber scombrus*], Atlantic herring [*Clupea harengus*], Atlantic butterfish [*Peprilus triacanthus*], bluefish [*Pomatomus saltatrix*], spiny dogfish [*Squalus acanthias*]), and oceanic pelagic fishes (tunas [*Thunnus* spp.], swordfish [*Xiphias gladius*], and sharks [Carcharhinidae, Lamnidae, Squalidae]). Members of the oceanic pelagic group (HMS) can span the entire MAB through migratory, feeding, and reproductive activity (NMFS 2006, 2017). Within this group, NMFS has incorporated FMPs for 12 Atlantic species that can range from the South Atlantic Bight (SAB) up into the Northern MAB on a seasonal basis (NMFS 2017; BOEM 2014b).

Managed soft bottom demersal species include Atlantic surfclam, Atlantic sea scallop, and ocean quahog. Soft bottom fishes with EFH in the Project area include summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), and spiny dogfish. Black seabass (*Centropristis striata*) is an example of a hard bottom species with EFH in the Project area. Inshore habitats provide shelter for early life stages of summer flounder, striped bass (*Morone saxatilis*), bluefish, weakfish (*Cynoscion regalis*), black seabass, and scup. All major MAB habitats produce prey such as benthic invertebrates, anchovies (Engraulidae), silversides (Atherinidae), herrings (Clupeidae), and sand lances (Ammodytidae), which are important to many managed species (Kritzer et al. 2016).

The fishery management councils also identify habitat areas of particular concern (HAPC) within FMPs. HAPCs are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation. The Project area and the cable routes do not overlap with any designated HAPC. However, sandbar shark and summer flounder HAPCs have been designated within potential vessel transit routes into Hampton Roads, Virginia. Additionally, the summer flounder HAPC has not been spatially defined by NOAA but does overlap with native species of macroalgae, seagrasses, and freshwater and tidal macrophytes within their defined EFH and the MAB. The Sandbar shark HAPC is in the lower Chesapeake Bay and mouth of the Bay and presented on Figure 3.13-2.

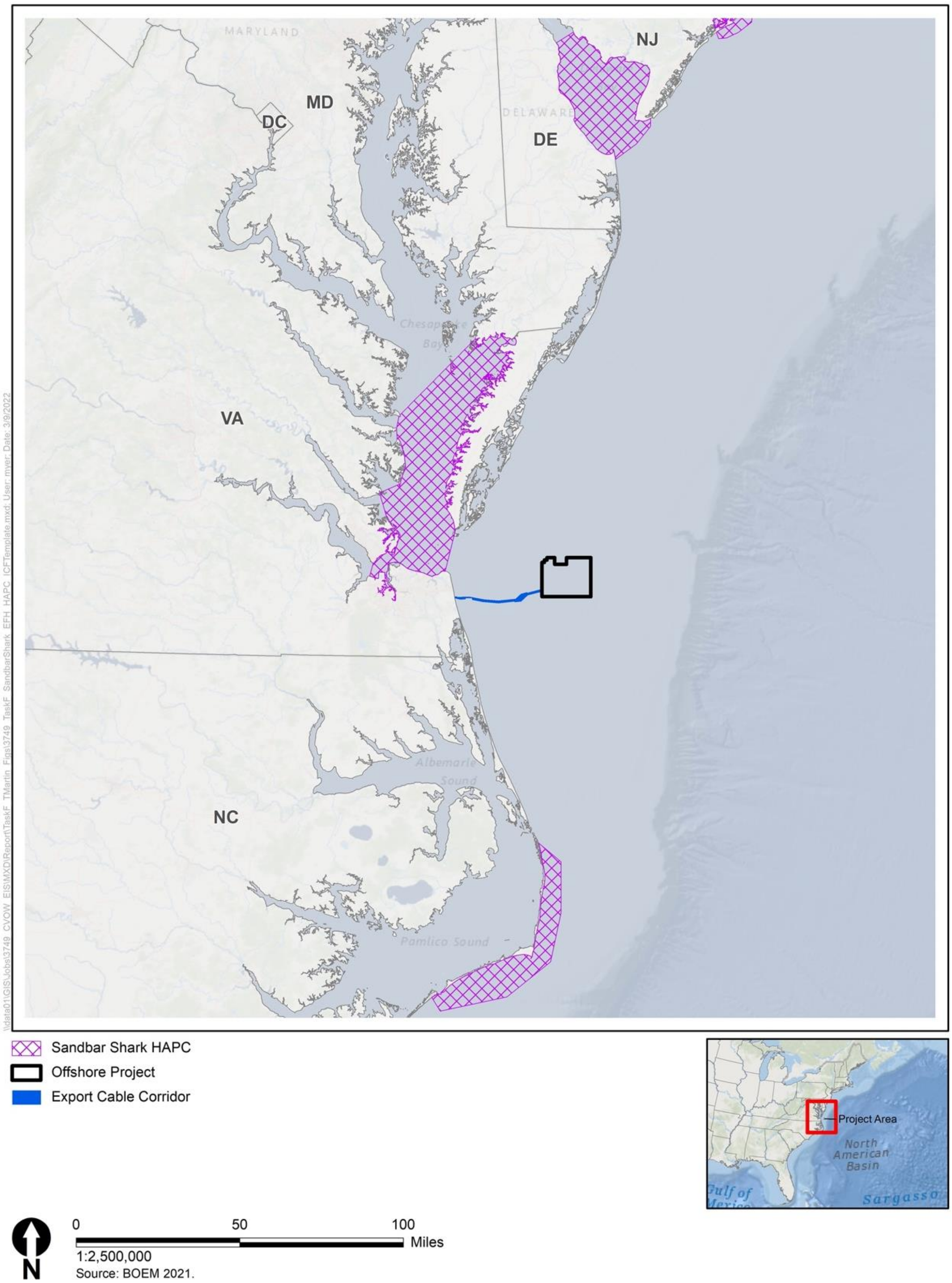

Figure 3.13-2 Sandbar Shark Habitat Areas of Particular Concern in the Project Area

3.13.1.1.1 ESA-Listed Species

Fish species from the geographic analysis area, and specifically within the Offshore Project area of offshore Virginia, listed under the ESA by NOAA as endangered are the shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus*) (NOAA Fisheries 2022). Three additional MAB fish species listed as threatened that occur offshore Virginia are the giant manta ray (*Mobula birostris*), oceanic whitetip shark (*Carcharhinus longimanus*), and scalloped hammerhead shark (*Sphyrna lewini*) (NOAA Fisheries 2022a). The giant manta and oceanic whitetip shark are listed as threatened throughout their range, while the scalloped hammerhead is listed as threatened within the central and southeast Atlantic distinct population segment (DPS). The scalloped hammerhead would most likely transit through the Project site following prey species migrations (herring, mackerel, sardines, and squid). The giant manta and oceanic whitetip sharks are found within New England and the MAB mainly from July through September when waters reach 19–22°C (NOAA Fisheries 2022b). More information on these ESA-listed species may be found in the Biological Assessment, which presents the analysis of the impacts related to the potential five species of ESA-listed finfish. Out of the five the Atlantic sturgeon was the only species that is demersal and may be resident within the Lease Area during construction and conceptual decommissioning operations. The two main IPFs that could impact the Atlantic sturgeon are noise impacts from pile driving and a potential for vessel strike. The Biological Assessment determined that all effects of the Proposed Action on Atlantic sturgeon may affect, but are not likely to adversely affect, ESA-listed marine fish within the Lease Area.

3.13.1.1.2 Other Fish Species

As identified in BOEM (2021b), finfish and invertebrate populations and the EFH they require within the geographic analysis area are affected by ongoing activities, especially commercial and recreational harvest, commercial bycatch, water quality impacts, dredging, and climate change. In the 2000s, the majority of commercially exploited stocks within the geographical analysis area were categorized as overfished. According to the most recent assessment, 17 fish stocks are in an overfished condition with another 5 stocks subject to overfishing (NOAA 2021a). NOAA (2021a) reports that unseasonably high water temperatures and elevated pH levels in the MAB have caused a shift in the distribution of surfclam and ocean quahogs. The ranges of both species have begun to overlap, with surfclam and ocean quahog distributions moving into deeper water and trending to the northeast (NOAA 2021a).

Changes in baseline abundance and distribution of fauna within the geographic analysis area arise from factors external to wind energy development and require quantification to separate potential Wind Energy Area impacts from other sources. Changes in fish and invertebrate fauna within coastal waters result from a variety of anthropogenic impacts, including water quality, extractive fishing, and climate change. Degradation of water quality can translate into impacts on estuarine and marine habitats and their corresponding food webs. Water quality may also be adversely affected by dredging activities for navigation, port development, and marine minerals extraction. Commercial fishing not only extracts finfish and invertebrates, affecting stocks and ecosystem function, but also generates sediment plumes and modifies the topography of the seafloor through the use of bottom trawls and dredge fishing methods. These fishing methods disturb benthic habitat on a seasonal basis. Bycatch of undersized fish and non-targeted finfish and invertebrates by both commercial and recreational fishing have an effect on the flow of energy within the food web. Commercial net fishing including gillnets, purse seines, longlines, and pot lines and some recreational fish equipment (i.e., cast nets) can result in lost and derelict equipment, the latter of which continues to capture and entangle fish and invertebrates, causing the mortality of many finfish and invertebrate species within broad swaths of the geographic analysis area. Trends in the decline and changing species distributions and assemblage structure of finfish and invertebrate species present within the geographic analysis area have been correlated to several factors, such as historical fishing pressure and recent climate change impacts, including a shift in the Gulf Stream towards the New England U.S. coastline. Recent NOAA recovery programs have returned some fisheries stocks to stable levels within the geographic analysis area, but assessments of fisheries distributions have shown shifts of species ranges related to warming trends within the Mid-Atlantic (NOAA 2021b). Collectively, baseline changes in species abundance and distribution will occur in the geographic analysis area arising to various degrees from water quality, fishing, and climate change.

Under the No Action Alternative, the proposed Project would not be built. If the Project is not approved, then impacts from the proposed Project (Section 3.13.5, *Impacts of the Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat*) would not occur as proposed. Impacts from ongoing, future non-offshore wind, and offshore wind activities would likely still occur resulting in similar impacts on finfish and invertebrates and their respective EFH. However, the exact nature of these impacts would not be the same due to spatiotemporal differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area.

3.13.2 Environmental Consequences

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

Definitions of potential impact levels are provided in Table 3.13-1. There are no beneficial impacts on finfish, invertebrates, and EFH.

Table 3.13-1 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

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

3.13.3 Impacts of the No Action Alternative on Finfish, Invertebrates, and Essential Fish Habitat

When analyzing the impacts of the No Action Alternative on finfish, invertebrates, and EFH, BOEM considered the impacts of ongoing non-offshore wind activities and ongoing offshore activities on the baseline conditions for finfish, invertebrates, and EFH. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.13.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.13.1, *Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH are generally associated with commercial harvesting and fishing activities, fisheries bycatch, water quality degradation and pollution, effects on benthic habitat dredging and bottom trawling, accidental fuel leaks or spills, and climate change.

Some mobile invertebrates can migrate long distances and encounter a wide range of stressors over broad geographical scales (e.g., longfin and shortfin squid). Their mobility and broad range of habitat requirements may also mean that limited disturbance may not have measurable effects on their stocks (populations). This would apply to finfish, where populations are composed largely of long-range migratory species; it would be expected that their mobility and broad ranges would preclude many temporary and short-term impacts associated with ongoing offshore impacts throughout the geographic analysis area. Invertebrates with more restricted geographical ranges or sessile invertebrates or life stages can be subject to the above stressors over time and can be more sensitive (Guida et al. 2017).

Seafloor habitat is routinely disturbed through dredging (for navigation, marine minerals extraction, and military purposes) and commercial fishing use of bottom trawls and dredge fishing methods. Abandoned or lost fishing gear remains in the aquatic environment for extended time periods, often entangling or trapping mobile invertebrate and fish species. Based on data from NOAA, bycatch affects many species throughout the geographic analysis area—most notably, windowpane flounder, blueback herring, shark species, and hake species; the majority of bycatch is a result of open area scallop trawls, large-mesh otter trawls, conch pots, and fish traps (Benaka et al. 2019). Water-quality impacts from ongoing onshore and offshore activities affect nearshore habitats, and accidental spills can occur from pipeline or marine shipping. Invasive species can be accidentally released in the discharge of ballast water and bilge water from marine vessels. The resulting impacts on invertebrates and finfish depend on many factors but can be widespread and permanent, especially if the invasive species becomes established and outcompetes native species.

Global climate change has the potential to affect the distribution and abundance of invertebrates and their food sources, primarily through increased water temperatures but also through changes to ocean currents and increased acidity. Finfish and invertebrate migration patterns can be influenced by warmer waters, as can the frequency or magnitude of disease (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold may affect the recovery of the American lobster fishery off the East Coast of the United States (Rheuban et al. 2017). Ocean acidification driven by climate change is contributing to reduced growth, and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016).

Based on a recent study, marine, estuarine, and riverine habitat types were found to be moderately to highly vulnerable to stressors resulting from climate change (Farr et al. 2021). In general, rocky and mud bottom, intertidal, special areas of conservation, kelp, coral, and sponge habitats were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Similarly, estuarine habitats considered most vulnerable to climate change include intertidal mud and rocky bottom, shellfish, kelp, submerged aquatic vegetation, and native wetland habitats (Farr et al. 2021). Riverine habitats found to be most vulnerable to climate change include native wetland, sandy bottom, water column, and submerged aquatic vegetation habitats (Farr et al. 2021). As invertebrate habitat, finfish habitat, and EFH may overlap with these habitat types, Farr et al.'s 2021 environmental study suggests that marine life and habitats could experience dramatic changes and decline over time as impacts from climate change continue.

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

- Continued O&M of the Block Island Project (5 WTGs) installed in state waters.

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

Ongoing O&M of the Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect finfish, invertebrates, and EFH through the primary IPFs of noise, presence of structures, and disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and seabed disturbance that are described in detail in Section 3.13.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.13.3.2 Cumulative Impacts of the No Action Alternative

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

Planned non-offshore wind activities that may affect finfish, invertebrates, and EFH include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, fisheries use, and management, global climate change, and oil and gas activities (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). These activities would result in the same types of impacts as described for ongoing non-offshore wind activities.

Appendix F, Table F1-11 provides additional information on finfish, invertebrates, and EFH impacts associated with ongoing and planned activities.

3.13.3.3 Offshore Wind Activities (without Proposed Action)

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

Accidental releases: Using the assumptions in Appendix F, *Planned Activities Scenario*, there would be a low risk of hydrocarbon products release from any of the more than 3,135 WTGs comprising approximately 36 offshore wind projects, with a total of approximately 27.4 million gallons (103.8 million liters) of fuel/fluids/hazardous materials contained in all offshore wind facilities (Appendix F, Table F2-3) (COP, Appendix Q, Dominion Energy 2022). According to BOEM modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,533 liters) is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years. The probability of an accidental discharge or spill occurring simultaneously from multiple WTGs is extremely low. Therefore, the potential of a spill larger than 2,000 gallons (7,571 liters) occurring and the resultant impacts are extremely unlikely. Based on these rates, the additional impact of releases from offshore wind facilities, the risk of which would primarily exist during construction, but also during operations and conceptual decommissioning, would fall within the range of accidental releases that already occur on an ongoing basis.

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

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

Electromagnetic fields: EMFs emanate continuously from installed electrical power transmission cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for alternating current (AC) cables (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) present near operating direct current (DC) cables (Hutchison et al. 2018). These impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMFs from undersea AC power cables negatively affect commercially and recreationally important fish species (CSA Ocean Sciences Inc. and Exponent 2019). The combined impacts of EMFs over the geographical extent of all of the wind energy lease areas on finfish, invertebrates, and EFH from ongoing and planned actions would likely range from negligible to minor.

Light: Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles (e.g., spawning), possibly leading to short-term impacts. Marine vessels have an array of lights, including navigational lights and deck lights. There is little downward-focused lighting and, therefore, only a small fraction of the emitted light enters the water.

Light impacts from vessels can be mitigated through application of BOEM's *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM 2021a). Light sources from the estimated 3,135 WTGs and multiple OSSs would occur during their operational phase, and these would be incrementally added over time. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM guidance. This would increase the amount of light over time within the geographic analysis area. The impacts from lighting related to the planned offshore wind activities is highly localized and spatially restricted in comparison to future non-offshore wind activities. In the context of reasonably foreseeable environmental trends, the combined impacts of this sub-IPF on finfish, invertebrates, and EFH from offshore wind activities would likely be short term and limited to highly localized attraction and include some potential disruption of spawning cycles. Light impacts on finfish and invertebrates would be considered negligible.

New cable emplacement and maintenance: The proposed offshore wind activities would require cable installation and maintenance activities that would disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local and limited to the cable corridor. Cable installation and maintenance would use jetting, jet-plowing, or dredging equipment to install and support cable burial maintenance operations. The total area of direct seafloor disturbance related to new cable emplacement and maintenance is estimated at up to 13,888 acres (5,620 hectares), though not all disturbance would be simultaneous. Cable installation and burial maintenance activities have the potential to disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations, depending on the benthic habitat type. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur (see also the IPF of *Sediment deposition and burial*). Overall, these impacts would likely be moderate but temporally short.

Noise: Anthropogenic noise on the OCS associated with offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to cause temporary effects on some finfish and invertebrate species and their EFH resources by displacing them and, potentially, temporarily changing their feeding and migratory behavior. BOEM anticipates that these impacts would be localized and temporary. Potential impacts could be greater if avoidance and displacement of finfish and invertebrates occurs during seasonal migration periods.

The type of effect will depend on the type of noise, the noise level to which an animal is exposed, and the duration of the exposure. Sources of anthropogenic noise can generally be categorized in two ways; impulsive noise which is characterized by a rapid increase in sound pressure over a short period of time, and non-impulsive noise, which does not have the characteristic rapid rise in sound pressure seen in impulsive sources. Noise can also be characterized as intermittent or continuous depending on how often noise is generated over time. Both types of noise may be produced by activities related to offshore wind projects. Acoustic thresholds, which represent the minimal sound level at which the onset of a particular effect may occur, are available for fish grouped either by size (less than 2 grams and greater than or equal to 2 grams) as recommended by the Fisheries Hydroacoustic Working Group (FHWG 2008) and adopted by the Greater Atlantic Region Fisheries Office (GARFO 2021) or by physiology as recommended by Popper et al. (2014), and are provided in Table 3.13-2.

Noise from construction and installation of approximately 3,135 WTGs and associated OSSs would result in local and temporary impacts on finfish and invertebrates (see also the sub-IPF for *Noise: Pile driving*). The main source of noise via construction would be through impact piling driving. Other sources of noise would be related to vessel operations supporting the construction and maintenance of offshore wind projects; high-resolution geophysical (HRG) survey activities in support of site characterization surveys before and during construction; vibratory pile driving used during installation of export cables; cable trenching activities; and operational noise produced by the WTGs.

In comparison to future non-offshore activities, vessel activities during the projected offshore wind activities would likely not lead to noticeable impacts on finfish, invertebrates, and their EFH resources.

Ongoing and future HRG surveys conducted for offshore wind development produce noise around sites of investigation. Equipment used during these surveys include both impulsive (e.g., sparker systems) and non-impulsive sources (e.g., compressed high-intensity radiated pulse sonar) (Crocker and Fratantonio 2016; Crocker et al. 2019). Fish and invertebrates are known to be sensitive to lower frequencies below approximately 2 kilohertz (Casper et al. 2013; Hawkins and Johnstone 1978; Lovell et al. 2005; Popper et al. 2014) which may overlap with noise produced by these equipment (Crocker and Fratantonio 2016; Crocker et al. 2019) and may, therefore, result in exposures for fish to above-threshold noise during these surveys. These activities can disturb finfish and invertebrates in the immediate vicinity of the survey and can cause temporary behavioral changes. Site characterization surveys are anticipated to occur infrequently in relation to the offshore wind development over the next 2 to 10 years. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary, and the *Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf* (Baker and Howson 2021) concluded that no ESA-listed fish species are likely to be adversely affected or experience long-term impacts from this activity. In the context of reasonably foreseeable environmental trends, the impacts from noise generated by surveys for proposed offshore wind development would likely be approximately equal to the sum of all of these impacts and would likely qualify as negligible.

During the operational phase of the offshore wind development, some finfish and invertebrates may be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Farm, this low-frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015), sound pressure levels would be expected to be at or below ambient levels at relatively short distances (approximately 164 feet [50 meters]) from WTG foundations. These low levels of elevated noise likely have little to no impact on finfish and invertebrates in close proximity to the source. As documented by English et al. 2017, there are very few field studies that have correlated pile driving with behavioral aspects of finfish or motile invertebrates (squid) that can demonstrate noise would adversely affect finfish, invertebrates, and EFH. Additionally, as discussed in the presence of structures IPF, the WTGs are likely to provide a new artificial reef habitat for many fish species, which will attract them to the sites, providing further evidence of the non-measurable, negligible impact of noise produced during operations.

Table 3.13-2 Acoustic Thresholds for Fish for Each Type of Impact for Impulsive and Non-Impulsive Noise Sources

Fish Category	Impulsive Sounds				Non-impulsive Sounds		
	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Behavior	Recoverable Injury	TTS	Behavior
Fish <2 grams	--	$L_{p,pk}$ 206 dB re 1 μPa $L_{E,24hr}$ 183 dB re 1 μPa^2 s	--	L_P 150 dB re 1 μPa	--	--	L_P 150 dB re 1 μPa
Fish ≥2 grams	--	$L_{p,pk}$ 206 dB re 1 μPa $L_{E,24hr}$187 dB re 1 μPa^2 s	--		--	--	
Fishes without swim bladders	$L_{p,pk}$ 213 dB re 1 μPa $L_{E,24hr}$ 219 dB re 1 μPa^2 s	$L_{p,pk}$ 213 dB re 1 μPa $L_{E,24hr}$216 dB re 1 μPa^2 s	$L_{E,24hr}$186 dB re 1 μPa^2 s		--	--	
Fishes with swim bladder not involved in hearing	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 210 dB re 1 μPa^2 s	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$203 dB re 1 μPa^2 s	$L_{E,24hr}$186 dB re 1 μPa^2 s		--	--	
Fishes with swim bladder involved in hearing	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 207 dB re 1 μPa^2 s	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 203 dB re 1 μPa^2 s	$L_{E,24hr}$ 186 dB re 1 μPa^2 s		L_P 150 dB re 1 μPa	L_P 150 dB re 1 μPa	
Eggs and larvae	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 210 dB re 1 μPa^2 s	--	--		--	--	

Sources: FHWG 2008; GARFO 2021; Popper et al. 2014.
- = not available for the fish category and/or impact type; μPa = micropascal; $L_{p,pk}$ = peak sound pressure level; $L_{E,24hr}$ = sound exposure level over 24 hours; L_P = root-mean-square sound pressure level.

Noise from impact pile driving is transmitted through water column and through the seabed. The intensity and magnitude of this energy could result in injury to finfish and invertebrates in a localized area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. Eggs, embryos, and larvae of finfish and invertebrates could also be affected and could result in developmental delays and malformations, and reduced rates of settlement for sessile species which could have broader implications for these populations (Weilgart 2018; Hawkins and Popper 2017). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable during pile driving activities. The extent of pile-driving acoustic impacts depends on pile size, hammer energy, and local acoustic conditions. Noise from pile driving from offshore wind farm construction would occur during installation of foundations for offshore structures for 2 to 3 hours per foundation or 4 to 6 hours per day over a 6- to 12-year period, increasing the risk of injury to finfish and invertebrates in a limited radius around each pile and short-term stress and behavioral changes to individuals over a broader area and would predominantly effect fishes that have swim bladders connected to the ear (otoliths) and some invertebrates such as squid that have lateral lines and statocysts that detect particle motion (water movement (Mooney et al. 2010; Solé et al. 2013]). However, ranges to the potential onset for injury assume, in part, that a fish will be present in the ensonified area for up to 24 hours which, with fish movement and behavior, is unlikely to occur as these species are highly motile.

Additionally, behavioral impacts are based on a root-mean-square sound pressure level (L_P) threshold of 150 decibel referenced to 1 micropascal (dB re 1 μPa) (Table 3.13-1), which has not been tested for biologically notable behavioral reactions in fish, and behavioral responses in fish may range from a heightened awareness of the noise to changes in movement, behavior (including abandonment of spawning activities)or feeding activity (Mahanty et al. 2017; Popper and Hastings 2009); therefore, it should be considered a conservative estimate for the onset of behavioral responses that may not account for differences in responses stemming from factors such as species-specific behaviors, life history stage, and past experience with noise exposures. Impact pile driving could mask biologically important noises during construction activities, which could indirectly affect reproduction, foraging, and predator avoidance (Alves et al. 2017; Weilgart 2018), but this would only be expected to result in population-level effects if there was long-term exposure such that there were no breaks in impact pile-driving activity. Because most planned offshore wind projects would likely be restricted to only conducting impact pile driving activities outside of the season when NARW are most likely to occur (see Section 3.15 for further discussion), finfish species would subsequently benefit from the quiet periods where no impact pile driving occurs. Noise produced by impact pile driving would be intermittent and temporary, and finfish and invertebrate populations would recover completely after construction. Additionally, all future proposed wind energy development projects would implement mitigation measures such as noise attenuation systems (e.g., bubble curtains) and protected species monitoring, so impacts from impact pile driving would be negligible to moderate.

Vibratory pile driving may be used on any pile (e.g., goal posts, coffer dams, foundations) prior to impact pile driving to reduce the risk of pile run for some offshore wind projects, export cable installations, and port facility construction. The precursory vibratory pile driving used for impact driven goal posts and WTG or OSS foundations would occur between 30 and 120 minutes to set the pile prior to impact pile driving. Typical noise levels generated by vibratory pile driving is not expected to exceed injury threshold for fish (Table 3.13-1) and may exceed the behavioral disturbance threshold a few kilometers from the source. However, as discussed for impact pile driving, the behavioral onset threshold should be viewed as conservative and does not necessarily correspond to biologically notable impacts for fish populations. Additionally, vibratory pile driving activities would occur over a very short time period, occurring over approximately 4 hours per pile for the foundations, and over several days for export cable installation. Given this low exposure probability and improbability of injury occurring, impacts on finfish, invertebrates, and EFH from vibratory pile driving activities would be negligible.

Trenching activities and burial methods conducted in support of cable installation are known to emit noise, comparable to those produced by use of vessels with DP thrusters. These disturbances are temporary, local, and extend only a short distance beyond the cable lay corridor. Impacts of this noise source are typically less prominent than the impacts arising from physical disturbance and subsequent sediment suspension. Cable burial maintenance operations would be infrequent over the life of the proposed offshore wind sites; related noise impacts would be temporary, local, and extend only a short distance beyond the cable corridor, resulting in negligible impacts that are temporary, short, and spatially localized to the trenching/burial operations.

Activities associated with the development of offshore wind projects will contribute to noise impacts on finfish, invertebrates, and EFH. These noise sources will be generated by aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic. The sub-IPF for impact pile driving may cause the greatest level of impact related to noise, but these impacts would be local and short in duration and considered moderate for finfish, invertebrates, and EFH in the geographic analysis area.

In the context of reasonably foreseeable environmental trends, the combined effect of pile-driving noise (both impact and vibratory) on finfish, invertebrates, and EFH from future proposed wind energy development, would likely qualify as moderate. Above-threshold noise may extend several kilometers from the source, and over a longer time scale, noise from impact pile driving could affect the same populations or individuals multiple times in one year or in sequential years, but it is currently unknown whether a reduction in impact would be possible if piles were driven either sequentially or concurrently (BOEM 2021b). However, it is expected that fish would move to avoid more severe impacts, and with mitigation such as noise attenuation systems (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2022), no long-lasting population-level impacts are expected.

Port utilization: The major ports in the U.S. are seeing increased numbers of vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 37 years. Multiple ports along the Atlantic seaboard are investing in expanding and modifying port facilities to accommodate supporting offshore wind energy projects. These development expansion activities are in part directly associated with the offshore wind developments within the geographic analysis area. Progressive increases in port utilization due to offshore wind energy development would lead to increased vessel traffic through 2030. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species, life stages, or both may lead to impacts on finfish and invertebrates beyond the vicinity of the port. Based on the expected level of port utilization and related activities (e.g., dredging), impacts on finfish, invertebrates, and EFH from offshore wind activities would be expected to be negligible.

Presence of structures: The addition of structure to an open sand bottom seascape can produce the potential for multiple IPFs on species of finfish and invertebrates and their associated EFHs within the geographic analysis area. The impacts can include direct displacement and possible mortality of some slow moving and infaunal invertebrate species. Other sub-IPFs will include attraction to these artificial substrates by both finfish and invertebrates and the loss of commercial and recreational fishing gear that is fouled with these structures. The risks of impact from the listed sub-IPFs are proportional to the amount of structure present. Offshore wind projects are estimated to add up to 3,135 WTGs foundations with potentially each WTG requiring scour protection to be emplaced around each foundation. Projects may also install additional offshore substations, buoys, and met towers. Using estimates for surface area to be affected (Appendix E, *Project Design Envelope and Maximum-Case Scenario*, Table E-2), the monopole foundations and scour protections will require nearly an acre (0.95 acre [0.4 hectare]) of seafloor per foundation (COP, Section 4.2.4.3, Table 4.2-17; Dominion Energy 2022). This would result in permanent impacts on benthic and demersal finfish, invertebrates, and their respective EFHs by approximately

2,684 acres (1,086 hectares) of habitat within the geographic analysis area, resulting in a moderate impact.

Impacts related to commercial and recreational gear loss is localized but can affect finfish and motile invertebrate assemblages and other marine vertebrates (e.g., marine mammals, sea turtles) through entanglement issues. This risk of entanglement and harm to individuals from fouled commercial and recreational gear on any offshore structure would increase with the addition of hard substrate. Fouled gear would result in highly localized, periodic, short-term impacts on finfish, invertebrates, and EFH. The occurrence of gear losses specifically related to WTGs is generally rare, and the impacts related finfish and invertebrates through this sub-IPF from proposed offshore wind project would likely be negligible.

Human-made structures, especially tall vertical structures that extend from the seafloor to the surface such as foundations for towers, continuously alter local water flow at a fine scale. Although water flow typically returns to background levels within a relatively short distance from a structure and impacts on finfish, invertebrates, and EFH are typically undetectable (BOEM 2021b), the cumulative effects of the presence of multiple structures on local or regional-scale hydrodynamic processes are not currently well understood. A recent study completed by BOEM assessed the mesoscale effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic responses will change after turbines are installed, particularly with regards to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). This study focused on the Massachusetts-Rhode Island marine areas where proposed wind energy lease areas are in the licensing review process. The modeling study assessed four post-installation scenarios. Two species of finfish (silver hake and summer flounder) and one invertebrate (Atlantic sea scallop) were selected as focal species. The results of this modeling effort indicate that, at a regional fisheries management level, these shifts are not considered overly relevant with regards to larval settlement. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are also not well understood. Overall, BOEM anticipates that offshore wind activities (exclusive of the Proposed Action) would cause a negligible impact on finish, invertebrates, and EFH through this sub-IPF based on currently available information.

A number of new structures will be installed within the geographic area of analysis through 2030. These added structures may attract finfish and invertebrates that approach the structures during routine movement or during migration. Such attraction could alter or slow migratory movements. However, temperature is expected to be a bigger driver for habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory fish and invertebrates have exhibited an ability to move away from structures unimpeded. In the context of reasonably foreseeable environmental trends, the presence of many distinct structures from ongoing and planned actions, exclusive of the Proposed Action, could increase the time required for migrations, resulting in a minor impact.

The geographic analysis area is primarily a homogeneous sandy seascape exhibiting both flat bottom relief and benthic features such as ripples, sand waves, and ridges (MARCO n.d.; Stevenson et al. 2004; USGS n.d.). Benthic features such as ripples and ridges are important contributors to diversity and abundance of benthic macrofauna (Stevenson et al. 2004). Areas of heterogenous, hard-bottom, and other complex habitats also exist within the geographic analysis area (MARCO n.d.; Stevenson et al. 2004; USGS n.d.). Habitat complexity is an important contributor to diversity and abundance of a large number of commercially and ecologically important fish and invertebrate species (e.g., through facilitating refuge from prey during early life stages, providing areas of post-larval settlement; Coen and Grizzle 2007; Malatesta and Auster 1999). Wind energy structures, including WTG foundations and the scour protection around the foundations, create uncommon relief in areas that are predominately flat sandy seascapes. Structure-oriented fishes are attracted to these hard substrate installations. Impacts on the soft sediment habitats from structure presence are local and can be short-term to permanent for the life of each wind energy project, potentially for as long as each structure remains in place. Fish aggregations found in association with seafloor structures can provide localized, short-term to permanent, beneficial impacts on some fish species due to increased prey species availability. Initial recruitment to these hard substrates may result in the increased abundance of certain fish and epifaunal invertebrate species (Claisse et al. 2014; Smith et al. 2016; BOEM 2021b); such recruitment may result in the development of diverse demersal fish and invertebrate assemblages. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). Further, colonization by non-indigenous biota (e.g., invasive or nuisance species) may alter localized benthic or epipelagic communities (Glasby et al. 2007). Considering the above information, BOEM anticipates that the impacts of the presence of structures on finfish, invertebrates, and EFH would be minor and include minor beneficial impacts. All impacts would be permanent as long as the structures remain.

Regulated fishing effort: While primarily an ongoing activity, regulated fishing effort impacts finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates and can also influence bycatch of non-regulated species. Offshore wind development other than the proposed Project could influence finfish, invertebrates, and EFH through this IPF by influencing the management measures chosen to support fisheries management goals, which may alter the nature, distribution, and intensity of fishing-related impacts on finfish, invertebrates, and EFH. Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*, provides additional details.

Seabed profile alterations: The process of cable installation can cause localized short-term impacts (habitat alteration, change in complexity) through seabed profile alterations, as well as through sediment mobilization and redeposition. Assuming the extent of such impacts is proportional to the length of cable installed (Appendix E, *Project Design Envelope and Maximum-Case Scenario*, Table E2), such impacts from offshore wind activities could be extensive within the proposed inter-array cables and offshore export cable routes proposed. Dredging would most likely occur in sand wave areas where typical jet-plowing is insufficient to meet cable burial target depths. Sand waves that are dredged would likely be redeposited in areas containing similar like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance. However, the habitat function would largely recover post-disturbance, although full recovery of faunal assemblage may require several years (Boyd et al. 2005). Therefore, seabed profile alterations, while locally intense, are expected to have minor impacts on finfish, invertebrates, and EFH on a regional scale.

Sediment deposition and burial: Cable installation and burial activities supporting the proposed offshore wind development projects will be the primary cause for sediment deposition and burial impacts within the geographic analysis area. Cable installation activities in certain regions of the geographic analysis area would use jet-plowing and dredging installation methodologies to install and bury the IARs and ECR cables associated for each project. Generally, permit requirements for these operations will mandate mitigation activities to reduce the temporal and spatial impacts related to both dredging and jet-plow activities. Even with stringent adherence to mitigation procedures, sediment dispersion and redisposition could have negative impacts on eggs and larvae of finfish and invertebrates. This is particularly critical for demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial (BOEM 2021b). Impacts related to sediment deposition and burial may vary based on season/time of year and regional conditions within each proposed future project area. In the context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on finfish, invertebrates, and EFH from offshore wind development projects would likely be minor.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, have the potential to result in long-term, potentially high-consequence risks to finfish and invertebrates and EFH.

Ocean acidification has been shown to have negative impacts on the settlement and survival of shellfish (BOEM 2021b citing PMEL 2020). These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing. Appendix F, Table F1-1, provides more details on the expected contribution of offshore wind to climate change. The intensity of impacts resulting from climate change are uncertain but are anticipated to qualify as minor to moderate.

3.13.3.4 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative finfish, invertebrates, and EFH would continue to be affected by existing environmental trends. Ongoing activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on finfish, invertebrates, and EFH. These effects are primarily driven by offshore construction impacts and presence of structures.

Ongoing activities and offshore wind would continue to have temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on finfish, invertebrates, and EFH primarily through resource exploitation/regulated fishing effort, dredging, bottom trawling, bycatch, anthropogenic noise, new cable emplacement, the presence of structures, and climate change. Ongoing activities, especially interactions with commercial fisheries, bottom disturbance, and climate change, would be **moderate**. In addition to ongoing activities, the impacts of planned actions other than offshore wind development, including new submarine cables and pipelines, marine minerals extraction, port expansions, and the installation of new structures on the OCS would be **minor**. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** impacts on finfish, invertebrates, and EFH in the geographic analysis area.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and finfish, invertebrates, and EFH would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on finfish, invertebrates, and EFH due to increased offshore construction and operations. Considering all the IPFs together, the overall impacts associated with offshore wind activities in the geographic analysis area would result in minor to moderate adverse impacts but could include **moderate** beneficial impacts because of presence of structures. Most of the offshore structures in the geographic analysis area would be a result of the development of offshore wind if each proposed project is installed. Finfish and invertebrates that use soft-bottom, sandy habitats would lose access related to the placement of WTGs and scour protection features, but structure-oriented organisms would gain an estimated 1,890 acres (765 hectares) of hard-bottom habitat. Potentially, this increase in demersal and demersal-pelagic finfish and invertebrates would increase the biomass and carrying capacity of these habitats. The ongoing activities and planned offshore wind development would also be responsible for most of the impacts related to new cable emplacement and pile-driving noise; however, impacts on finfish and invertebrates and EFH resulting from these IPFs would be localized and temporary and result in **minor** impacts.

3.13.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The number, size, and location of WTGs and placement of the OSSs.
- The time of year during which construction occurs.

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

- **WTG number and location:** the level of impact related to the installation of WTGs and the concomitant scour protection is proportional to the number of WTGs installed; fewer WTGs would present less hazard to soft-bottom, demersal finfish and invertebrates and their associated EFHs.
- **Season of construction:** The diversity and abundance of the offshore assemblage of finfish and invertebrates is typically highest in late spring through early fall (Eklund and Targett 1991). Construction/installation activities occurring outside of these timeframes would have a reduced impact on finfish and invertebrates, particularly as compared to construction occurring during the active spring spawning and summer migratory seasons.

3.13.5 Impacts of the Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

Accidental releases: Vessels associated with the Proposed Action or Alternative A-1 may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Proposed Action or Alternative A-1 would comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on finfish, invertebrates, and their respective EFHs resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Project personnel, reducing the likelihood of occurrence to a very low risk. Likewise, utilizing BMPs for ballast or bilge water releases specifically from vessels transiting from foreign ports would reduce the likelihood of accidental release. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and temporary negligible impacts on finfish, invertebrates, and EFH resulting from these accidental releases.

Anchoring: Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). Impacts from anchoring relative to the Proposed Action or Alternative A-1 occur during construction and installation but would be limited. The use of DP vessels would preclude the use of anchors, while utilization of jack-up vessels or spud barges would directly affect the benthos. Further, the placement of up to 205 (Proposed Action) to 202 (Alternative A-1) WTGs, three OSSs, corresponding scour protection, and the emplacement of offshore export cables and inter-array cables would affect the benthos, with potential for impacts on demersal finfish and invertebrate species. These impacts would include increased turbidity levels and potential for contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. Impacts related to sensitive resources would be avoided by following mitigation measures and BMPs when operating near or within the any areas with sensitive resources. All impacts would be localized; turbidity would be temporary; impacts from anchor, spud can, or leg contact would recover in the short term. The amount of anchoring that would occur under Alternative A-1 would be less than the Proposed Action because of fewer vessel trips due to three fewer WTGs. Therefore, potential impacts on finfish, invertebrates, and EFH from anchoring would be less when compared to the Proposed Action. However, the difference in potential impacts from having three fewer WTGs than the Proposed Action's 205 WTGs is anticipated to be negligible. Construction operations under the Proposed Action or Alternative A-1 would not occur simultaneously, and the footprint of each anchor, spud can, or leg placement would be relatively small, of short duration, and would represent a minor impact on the demersal portions of the finfish and invertebrate community.

EMF: EMF emanates continuously from installed electrical power transmission cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean

Sciences Inc. and Exponent 2019; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts from EMF are localized and affect the animals only while they are within relatively close proximity to the EMF source. There is no evidence to indicate that EMFs from undersea AC power cables negatively affect commercially and recreationally important fish species (CSA Ocean Sciences Inc. and Exponent 2019; see Section 3.9). EMFs would emanate from AC cables during operation. Under the Proposed Action or Alternative A-1, the shielding and burial depths would minimize EMF intensity and extent (Normandeau et al. 2011). Alternative A-1 would have slightly less inter-array cabling than the Proposed Action because three fewer WTGs would be constructed; however, EMFs produced under Alternative A-1 are not anticipated to be substantively different than the Proposed Action. Although the EMFs would exist as long as a cable was in operation, previous studies indicate that the EMFs from AC cables within the Project area are not expected to affect commercial and recreational fisheries (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015). Therefore, impacts on pelagic finfish species would be expected to be negligible, and impacts on bottom-dwelling finfish and motile invertebrate species would be expected to be minor.

Light: The Proposed Action or Alternative A-1 incremental contribution of 205 (Proposed Action) or 202 (Alternative A-1) WTGs and three OSSs would all be lit with navigational and Federal Aviation Administration (FAA) hazard lighting. Per BOEM guidance (BOEM 2021a) and outlined in the COP Section 3.5.3 (Dominion Energy 2022), each WTG would be lit in accordance with USCG, FAA, and BOEM requirements and only a small fraction of the emitted light would enter the water. Therefore, light resulting from the Proposed Action would be minimal and would be expected to lead to a negligible impact, if any, on finfish, invertebrates, and EFH.

The expected negligible impact of the Proposed Action or Alternative A-1 alone would not noticeably increase the impacts of light beyond the impacts described under the No Action Alternative (Section 3.13.3). Under the expanded planned action scenario, over 3,207 offshore structures would have lights, and these would be incrementally added over time beginning in 2022 and continuing through 2030. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021a) guidance.

New cable emplacement and maintenance: The Proposed Action or Alternative A-1 would potentially result in up to 7,173.22 acres (2,902.89 hectares) of seafloor being temporarily disturbed by cable installation and 70 acres (28 hectares) of permanent impact. The resultant impacts include turbidity effects that have the potential to displace finfish and motile invertebrates and cause the mortality of infaunal invertebrates within the cable corridor during emplacement (COP, Table 4.2-17; Dominion Energy 2022). These impacts would be temporary and localized. Some infaunal invertebrate species such as Atlantic surfclam, ocean quahogs, Atlantic sea scallops, and calico scallops could be displaced, or mortality may result from cable emplacement due to potential direct burial impacts. More broadly, impacts on infaunal invertebrate populations and communities are expected to be temporary and localized to the emplacement corridor. However, recovery of these infaunal invertebrate assemblages would be expected to occur within months after cable emplacement resulting in minor impacts, if any, on the infaunal assemblages or populations and would be expected given the localized and temporary nature of the impacts. Suspended sediment concentrations during activities other than cable emplacement would be within the range of natural variability for this location.

Noise: A short-term increase in underwater noise is the most likely IPF that could affect finfish, invertebrates, and EFH, predominantly during installation of the WTG and OSS foundations, cofferdams, and nearshore goal post structures during construction of the Proposed Action or Alternative A-1. The Project PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations OSS jacket foundations, as well as vibratory pile driving, which would be used to install the cofferdams and impact pile driving of the nearshore (goal post piles [COP, Appendix Z;

Dominion Energy 2022]). All these activities have potential to produce noise above recommended fish acoustic thresholds (Table 3.13-1). Underwater acoustic modeling was conducted for the Project (COP, Appendix Z; Dominion Energy 2022) for both activities, and the results are summarized in Table 3.13-3. Results represent the thresholds for potential mortal injury for impact pile driving and recoverable injury for vibratory pile driving. For the purposes of this assessment, the deep modeling location using the maximum hammer energy with all noise attenuation is provided for each modeled scenario in Table 3.13-3.

Effects on finfish, invertebrates, and their respective EFH could occur during the construction phase of the Proposed Action or Alternative A-1, because of equipment noise, particularly impact pile-driving noise. Potential impacts on finfish and invertebrates, as described in Section 3.13.3, include injury and behavioral disturbances. Potential for injury is characterized using two metrics, peak sound pressure level ($L_{p,pk}$) and sound exposure level over 24 hours ($L_{E,24hr}$). The $L_{p,pk}$ metric characterizes the potential for injury resulting from the rapid rise in sound pressure that occurs within the immediate vicinity of the pile when it is struck by the hammer, whereas the $L_{E,24hr}$ metric characterizes the potential for injury resulting from cumulative exposure to sound above a given threshold (Table 3.13-1) within a full 24-hour period. Potential injury from the $L_{p,pk}$ metric is unlikely to occur, as the maximum range with 10 decibels noise attenuation is 2,355.6 feet (718 meters) which would be easily avoided by fish during construction consider the physical space occupied around the pile by the noise mitigation system and other mitigation measures in place during impact pile driving (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2022). With a 6 dB noise attenuation, the $L_{E,24hr}$ threshold may be exceeded out to approximately 5.5 miles (8.9 kilometers) depending on the type of fish. However, as previously stated, this is based on fish remaining within the ensonified area for a full 24-hour period which is unlikely to occur. Additionally, though their primary focus is marine mammals and sea turtles, the implementation of mitigation measures (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2022) will inadvertently benefit finfish and invertebrates by decreasing the total amount of time the water column is ensonified to above-threshold levels within a 24-hour period. This reduces the risk of exposure and injury to fish during pile driving under the Proposed Action and is, therefore, unlikely to occur.

Table 3.13-3 Distances to Acoustic Thresholds (in meters) from the Underwater Acoustic Modeling Conducted for the Coastal Virginia Offshore Wind Commercial Project Construction and Operations Plan

Scenario	Noise Attenuation (dB)	Fish with No Swim Bladder		Fish with Swim Bladder Not Involved in Hearing		Fish with Swim Bladder Involved in Hearing		Eggs and Larvae		Fish <2 g		Fish ≥2 g		Behavioral (L_P)
		$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	All Fish
Standard Driving Installation – Impact Pile Driving	0	605	810	1,007	1,729	1,007	2,348	1,007	1,729	1,105	14,940	1,105	11,907	36,030
	6	344	489	605	1,021	605	1,301	605	1,021	663	8,653	663	6,131	20,512
	10	242	352	402	748	402	955	402	748	445	6,131	445	4,501	15,010
Standard Driving Installation – Vibratory Pile Driving	0	--	--	--	--	--	--	--	--	--	3,188	--	2,199	2,528
	6	--	--	--	--	--	--	--	--	--	1,831	--	1,216	1,359
	10	--	--	--	--	--	--	--	--	--	1,216	--	796	903
Hard-to-Drive Installation – Impact Pile Driving	0	605	906	1,007	1,968	1,007	2,683	1,007	1,968	1,105	16,655	1,105	12,722	36,030
	6	344	540	605	1,120	605	1,466	605	1,120	663	9,302	663	6,824	20,512
	10	242	389	402	829	402	1,041	402	829	445	6,824	445	5,085	15,010
Hard-to-Drive Installation – Vibratory Pile Driving	0	--	--	--	--	--	--	--	--	--	2,476	--	1,641	2,528
	6	--	--	--	--	--	--	--	--	--	1,338	--	886	1,359
	10	--	--	--	--	--	--	--	--	--	886	--	601	903
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	0	605	1,121	1,007	2,439	1,007	3,315	1,007	2,439	1,105	20,786	1,105	14,787	36,030
	6	344	672	605	1,386	605	1,860	605	1,386	663	11,508	663	8,291	20,512
	10	242	477	402	1,042	402	1,266	402	1,042	445	8,291	445	5,880	15,010

Scenario	Noise Attenuation (dB)	Fish with No Swim Bladder		Fish with Swim Bladder Not Involved in Hearing		Fish with Swim Bladder Involved in Hearing		Eggs and Larvae		Fish <2 g		Fish ≥2 g		Behavioral (L_P)
		$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	All Fish
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	0	--	--	--	--	--	--	--	--	--	3,822	--	2,666	2,528
	6	--	--	--	--	--	--	--	--	--	2,191	--	1,442	1,359
	10	--	--	--	--	--	--	--	--	--	1,442	--	961	903
OSS Piled Jacket – Impact Pile Driving	0	172	536	311	1,231	311	1,599	311	1,231	344	10,069	344	7,306	13,641
	6	35	310	172	696	172	907	172	696	197	5,959	197	4,000	8,243
	10	0	213	74	488	74	633	74	488	94	4,000	94	2,959	5,530
OSS Piled Jacket – Vibratory Pile Driving	0	--	--	--	--	--	--	--	--	--	1,664	--	1,088	991
	6	--	--	--	--	--	--	--	--	--	887	--	569	540
	10	--	--	--	--	--	--	--	--	--	569	--	427	393
Cofferdam Installation – Vibratory Pile Driving	0	--	--	--	--	--	--	--	--	--	567	--	506	470
	6	--	--	--	--	--	--	--	--	--	389	--	317	349
	10	--	--	--	--	--	--	--	--	--	317	--	206	248
Goal Post Pile Installation – Impact Pile Driving	0	--	--	--	--	--	--	--	--	--	--	--	--	6,750
	6	--	--	--	--	--	--	--	--	--	--	--	--	2,700
	10	--	--	--	--	--	--	--	--	--	--	--	--	1,450

-- = not applicable; dB = decibel; $L_{p,pk}$ = peak sound pressure level in units of dB referenced to 1 micropascal; $L_{E,24hr}$ = sound exposure level accumulated over 24 hours in units of dB referenced to 1 micropascal squared second; L_P = root-mean-square sound pressure level in units of dB referenced to 1 micropascal.

The predominant impact expected during impact pile driving on finfish and invertebrates is behavioral responses such as startle responses or avoidance of the ensonified area during construction. However, as discussed in Section 3.13.3, the recommended threshold for the onset of behavioral disturbances is based on observations of fish in captivity and should be viewed as a conservative estimate of potential impacts as they are based on studies of fish studied in an enclosed area and may therefore not capture how free-ranging fish may behave. Overall, the duration of impact pile driving activities would be relatively short term (~4 hours per day) and only occurring as a singular installation operation and once construction is complete and pile driving has ceased impacts from this sub-IPF would dissipate. While Alternative A-1 would result in a slightly reduced duration of underwater noise due to the construction of fewer WTGs compared to the Proposed Action, potential impacts on finfish, invertebrates, and EFH are anticipated to be the same. Due to the temporary, localized nature of noise produced by impact pile driving under the Proposed Action or Alternative A-1 and the implementation of mitigation measures (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2022), which would minimize the risk of exposure to above-threshold noise levels, moderate impacts on finfish, invertebrates, and EFH would be expected. Similarly, ranges to the injury and behavioral thresholds for vibratory pile driving proposed for the foundations were all smaller than those estimated for impact pile driving (Table 3.13-3), and because this activity would only occur for up to 90 minutes per pile (COP; Dominion Energy 2022), no injury or biologically notable behavioral impacts would occur during vibratory pile driving for foundation installation. The mitigation measure proposed by Dominion Energy but not finalized consists of a double big bubble curtain (BBC) for far field noise mitigation. Acoustic studies completed by Dominion used two different sound attenuation levels: 6 dB reduction and 10 dB reduction (COP, Table 4.2-23; Dominion Energy 2022). The use of noise-reduction technologies during all pile-driving activities to ensure the minimum attenuation of 6 dB would reduce the area of high noise levels during construction and subsequently minimize potential noise-related impacts to surrounding water column. A BBC system is a compressed air system (air bubble barrier) for sound absorption in water. Sound stimulation of air bubbles at or close to their resonance frequency effectively reduces the amplitude of the radiated sound wave by means of scattering and absorption effects. A BBC functions as follows: air is pumped from a separate vessel with compressors into nozzle hoses lying on the seabed, which then escapes through holes that are provided for this purpose. Thus, bubble curtains are generated within the water column due to buoyancy. Noise emitted by pile driving must pass through those ascending air bubbles and is thus attenuated.

Vibratory pile driving during installation of the cofferdams may exceed acoustic injury thresholds up to approximately 1,040 feet (317 meters) from the source with 10 dB noise attenuation (Table 3.13-3); however, this is based on the $L_{E,24hr}$ metric, which, as discussed for impact pile driving, requires fish to remain in the ensonified area for the full duration of the activity, which is unlikely to occur. Behavioral threshold may be exceeded up to 813 feet (248 meters) from the source but given the nearshore location of potential vibratory pile driving activities and the limited duration (i.e., a few hours) no long-lasting, population-level effects would be expected, and impacts on finfish, invertebrates, and EFH would be negligible.

All other noise-producing activities under the Proposed Action or Alternative A-1 (i.e., HRG survey activity, vessel activity, WTG operations, cable trenching) would not be expected to exceed the impacts expected under the No Action Alternative described in Section 3.13.3. The additional vessels, HRG survey equipment, and WTGs would result in a nominal increase in potential sources within the context of reasonably foreseeable environmental trends and impacts would similarly be negligible.

Port utilization: The Proposed Action or Alternative A-1 would not be anticipated to cause any port expansion or otherwise affect finfish, invertebrates, and EFH that are present near ports to be used under the Proposed Action, and impacts are anticipated to be negligible.

Presence of structures: A primary impact on finfish, invertebrates, and EFH the Proposed Action or Alternative A-1 would be the construction and placement of WTGs and OSSs in the Project site. These hard structures would displace and cause mortality among the soft bottom non-motile, infauna, and demersal soft bottom fauna that use this habitat. Each WTG would require approximately 0.97 acre (0.39 hectare [COP Table 4.2-17; Dominion Energy 2022]) of surface area, most of which is related to the scour protection apron. The area of substrate needed for all WTGs under the Proposed Action is estimated at 198.8 acres (80.5 hectares). Along with the WTGs for both the Proposed Action and Alternative A-1, three OSSs would be installed, resulting in another 12 leg supports with a scour protection area required for each leg. The total seafloor surface needed for the three OSSs would be 2.86 acres (1.16 hectares). In total, 272 acres (110 hectares) (COP, Table 4.2-17; Dominion Energy 2022) of seafloor habitat would be permanently affected as a result of the installation of the WTGs, inter-array cables, and offshore export cable for Proposed Action and slightly less for Alternative A-1. Species such as the summer flounder, Atlantic surfclam, Atlantic sea scallops, calico scallops, and the longfin squid would have their available habitat resources reduced, resulting in a minor impact.

The placement of each WTG for the Proposed Action or Alternative A-1 would additionally attract structure-oriented species that would benefit from the creation of hard substrate (Claisse et al. 2014; Smith et al. 2016); however, the diversity of these structure-associated assemblages may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). The impacts of invasive species that might settle the introduced hard structure on finfish, invertebrates, and EFH depend on many factors but could be widespread and permanent. Releases of invasive species may or may not lead to the establishment and persistence of invasive species. Invasive species becoming established as a result of offshore wind activities is possible. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020), the impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent if the species were to become established and outcompete native fauna or modify habitat. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities. For example, colonial sea squirt is already an established species in New England with documented occurrence in subtidal areas, including on Georges Bank, where numerous sites within a 56,834-acre (23,000-hectare) area are 50 to 90 percent covered by colonial sea squirt (Bullard et al. 2007).The placement of the structures outlined under the Proposed Action or Alternative A-1 would be expected to result in habitat alteration from soft bottom to hard bottom "reefing" habitat. This would result in short-term to permanent impacts on soft bottom habitat within the proposed Lease Area and would impart minor impacts on finfish, invertebrates, and EFH. Localized impacts would likely be greater, particularly in the triangle reefs area.

The expected minor impacts of the Proposed Action or Alternative A-1 alone would not increase beyond the impacts described under the No Action Alternative. The Planned Activities Scenario (Appendix F) indicates that there could be over 3,135 WTGs within the geographic analysis area. The Proposed Action or Alternative A-1 would add up to 205 or 202 WTGs, respectively. The structures associated with the Proposed Action or Alternative A-1 and the consequential impacts would remain at least until conceptual decommissioning is complete (33-year Project lifetime).

Regulated fishing effort: Regulated fishing effort can affect finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). See Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*, for the contribution of the Proposed Action or Alternative A-1 and other future wind projects on regulated fishing effort. The intensity of impacts on finfish, invertebrates, and EFH under future fishing regulations is uncertain, but would likely be similar to or less than under the status quo and would be moderate.

Seabed profile alterations: Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples, with some isolated patches of mud and gravel. These features would temporarily be disturbed by pre-construction grapnel runs, seabed preparation, foundation placement, scour protection installation, anchoring, clearing, and trenching for offshore export and inter-array cable installation, and cable protection activities. Sand ripples and waves disturbed by offshore export and inter-array cable installation would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that formed them initially (COP, Section 4.2; Dominion Energy 2022; Kraus and Carter 2018). Under the Proposed Action or Alternative A-1, the primary technology that may impact the seabed profile would be a jet-plow where an estimated up to 7,174 acres (2,903 hectares) (COP, Table 4.2-17; Dominion Energy 2022) of seafloor could be disturbed. The impacts related to jet-plowing would be very localized and temporary and would recover completely without mitigation. However, in areas where seabed conditions might not allow for cable burial to the desired depth, other methods of cable protection would be employed, such as rocks, geotextile sand containers, or concrete mattresses which would permanently alter the seabed profile. Therefore, overall, impacts on finfish, invertebrates, and EFH from seabed profile alterations under the Proposed Action or Alternative A-1 would be minor.

The minor impacts of the Proposed Action or Alternative A-1 alone would not increase the impacts beyond those of the No Action Alternative because dredging is not anticipated. Although the amount of seabed profile alteration in the No Action Alternative is not known, it would occur

Sediment deposition and burial: The Proposed Action or Alternative A-1 would cause sediment deposition of up to approximately 7,174 acres (2,903 hectares); however, as presented in the cable emplacement IPF discussed previously, sediment deposition impacts on finfish, invertebrates, and EFH would be expected to range between negligible and minor. Sediment deposition and burial under the Proposed Action or Alternative A-1 could cause impacts on sensitive life stages, such as demersal eggs.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, have the potential to result in long-term, potentially high-consequence risks to finfish, invertebrates, and EFH. Ocean acidification has been shown to have negative impacts on the settlement and survival of shellfish (PMEL 2020). These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing. Appendix F, Table F1-1 provides more details on the expected contribution of offshore wind to climate change. These sub-IPFs would contribute to potential alterations in finfish migration patterns or reductions in growth or decline of invertebrates that have calcareous shells. Because these sub-IPFs are a global phenomenon, the impacts through this IPF from the Proposed Action or Alternative A-1 would be practically the same as those under the No Action Alternative (Section 3.13.3.2, *Offshore Wind Activities (without Proposed Action)*). The intensity of impacts resulting from climate change are uncertain but would be anticipated to qualify as minor to moderate.

3.13.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action reflect the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

Accidental Releases: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be localized and temporary due to the likely limited extent and duration of a release and result in negligible impacts.

Anchoring: The expected minor incremental impact of the Proposed Action or Alternative A-1 combined with the planned actions would result in seafloor disturbance and associated turbidity from anchoring. In the context of reasonably foreseeable environmental trends, the combined anchoring impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, could occur if impacts are in close temporal and spatial proximity. However, these impacts from anchoring would be expected to be minor and would expect to recover completely.

EMF: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be localized and long term and result in negligible to minor impacts.

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

New cable emplacement and maintenance: The expected minor impact of the Proposed Action or Alternative A-1 combined with the planned actions would result in seafloor disturbance from the offshore export cable and inter-array cables. In context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, could occur if impacts are in close temporal and spatial proximity. While Alternative A-1 would require slightly less inter-array cables than the Proposed Action, impacts from seabed disturbance for cable emplacement on finfish, invertebrates, and EFH are anticipated to be the same. Impacts from cable emplacement under the Proposed Action or Alternative A-1 would be expected to be moderate but temporally short and would recover completely.

Noise: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be moderate for finfish, invertebrates, and EFH. The main activity that would result in adverse effects on these resources is impact pile driving during installation of WTG and OSS foundations. The expected moderate incremental impact from pile driving under the Proposed Action or Alternative A-1 combined with offshore wind activities would result in increased underwater noise levels during construction starting in 2022 and continuing through 2030. Alternatively, these sound impacts from this activity would be removed once piling had stopped. All other noise-producing activities under the Proposed Action or Alternative A-1 are expected to result in negligible impacts on these resources, and combined impacts with ongoing and planned actions would similarly be negligible. Impacts from other noise-producing activities are lower in intensity relative to impact pile driving, and impacts would be localized, temporary, and not biologically notable for finfish or invertebrates and would not result in any notable effects on EFH.

Port utilization: In the context of reasonably foreseeable environmental trends, combined port utilization impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be negligible.

Presence of structures: In the context of reasonably foreseeable environmental trends, the combined impacts arising from the presence of structures from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to range from negligible to moderate based on the sub-IPFs and may result in minor beneficial impacts due to the large number of structures and "reefing" effect. A majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action or Alternative A-1, as the Proposed Action or Alternative A-1 would account for approximately 6.5 percent (up to 205 or 202 of over 3,135) of the new WTGs on the OCS.

Regulated fishing effort: See Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*, for the contribution of the Proposed Action or Alternative A-1 and other future wind projects on regulated fishing effort. The intensity of impacts on finfish, invertebrates, and EFH under future fishing regulations is uncertain, but would likely be similar to or less than under the status quo and would be moderate.

Seabed profile alterations: In context of reasonably foreseeable environmental trends, the combined impacts of this IPF on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action or Alternative A-1, would likely be minor.

Sediment deposition and burial: In the context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on finfish, invertebrates, and EFH from ongoing and planned actions, the Proposed Action, or Alternative A-1 would likely be minor.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, have the potential to result in long-term, potentially high-consequence risks to finfish, invertebrates, and EFH. The impacts of this IPF on finfish, invertebrates, and EFH from ongoing and planned actions, the Proposed Action, or alternative A-1 are uncertain but would be anticipated to qualify as minor to moderate.

3.13.5.2 Conclusions

Impacts of the Proposed Action. Project construction and installation and conceptual decommissioning would introduce noise, lighting, EMF, and new structures to the geographic analysis area, as well as result in habitat conversion impacting finfish, invertebrates, and EFH to varying degrees depending on the location, timing, and species affected by an activity. Impacts associated with the Proposed Action or Alternative A-1 activities would be specific to the life stage and habitat requirements of a species as well. Impacts from Project operation and maintenance would occur, although at lower levels than those produced during construction and conceptual decommissioning. Offshore structures would also result in long-term effects to pelagic habitat. BOEM anticipates the impacts resulting from the Proposed Action or Alternative A-1 alone would range from **negligible** to **moderate**, including the presence of structure, which may result in **minor beneficial** impacts. Therefore, BOEM expects the overall impact on finfish, invertebrates, and EFH the Proposed Action or Alternative A-1 alone would be **minor** because the effect would be localized and, for the most part, temporary. Dominion Energy’s proposed mitigation measures (as outlined in COP Section 4.2.4.4, Table 4.2-18) and any future additional mitigation measures set forth by BOEM or other federal agencies could further reduce impacts (but would most likely not change the impact determinations).

Cumulative Impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action or Alternative A-1, would range from **negligible** to **moderate** and **minor beneficial**. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action, would result in **moderate** impacts on finfish, invertebrates, and EFH in the geographic analysis area. The main drivers for this impact rating are fishing mortality, climate change, recurring bottom disturbance from bottom-tending fishing gear, and mortality resulting from offshore construction. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through the temporary disturbance due to new cable emplacement and permanent impacts from the presence of structures (cable protection measures and foundations). Therefore, the overall impacts on finfish, invertebrates, and EFH would likely qualify as **moderate** because a notable and measurable impact is anticipated, but the resource would likely recover completely when the WTGs are removed and/or remedial or mitigating actions are taken.

3.13.6 Impacts of Alternatives B and C on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternatives C and B. The primary difference between Alternative B and the Proposed Action is the development of exclusion areas established in the Lease Area to avoid impacts on artificial reefs, shipwrecks, and complex habitats. Alternative B would exclude the Fish Haven area within the northern portion of the Lease Area from development, reducing the number of WTGs to up to 176. Alternative B would remove 29 WTGs and concomitantly reduce the length required for inter-array cable networks connecting the removed 29 WTGs. The avoidance of the Fish Haven area from development under Alternative B would reduce soft-bottom habitat impacts of the Proposed Action by 28.1 acres (11.4 hectares). The number of cables within the offshore export corridor would not change, but the length of the offshore export cables would be reduced by 70.2 miles (112.1 kilometers) and the length of inter-array cables would decrease by 80.1 miles (127.2 kilometers). With the removal of inter-array cables between WTGs and rerouting of the export cables there would be a reduction of 150.3 acres (483.7 hectares) in temporary disturbance to the benthic habitat related to cable installation for Alternative B.

With the exception of the reduction in the number of WTGs and reduction in the length of inter-array and export cables for Alternative B, impacts from the construction and installation, operations, and maintenance, non-routine activities, and conceptual decommissioning of Alternative B would be similar to those described under the Proposed Action. However, the micrositing of WTGs to avoid the NOAA-designated Fish Haven area and shipwrecks under Alternative B would decrease impacts related to the duration of noise impacts from pile-driving and jet-plowing operations and the potential displacement of soft-bottom organisms within the footprint of each construction activity. Avoiding the Fish Haven area would greatly reduce the potential impacts on the demersal and pelagic finfish species that utilize the artificial reef structures. Structure-oriented finfish species documented on the reef habitats identified during fisheries surveys include species such as monkfish, red hake, black sea bass, scup, spiny dogfish, tunas and sharks (COP, Section E.2.3.3; Dominion Energy 2022). The decrease in overall seafloor impacts would be reduced between 15 percent for the WTG impacts and 21 percent in relation to cable installation for Alternative B. When compared to the Proposed Action, impacts would remain minor.

NMFS has identified the sand ridge habitat within the Lease Area as significant and unique benthic resources to be avoided to reduce the Project impact on the finfish, invertebrates, and EFH that use these unique resources. Offshore ridge/trough complexes within the MAB OCS have been shown to support diverse finfish and invertebrate assemblages with faunal differences found between the ridge top and trough habitats (Rutecki et al. 2014). Multiple MAB species of finfish and invertebrates utilize the ridge trough complexes for several ecological services such as migration, spawning, foraging and larval recruitment (Rutecki et al. 2014). Preserving viable natural fish habitat may be more beneficial and outweigh any beneficial impacts related to the artificial reef effect related to WTG and OSS presence of structure. The sand ridge habitat area encompasses 17 WTG locations, one OSS location, and associated inter-array and offshore export cables. Alternative C has been developed to avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of removal, relocation, and micrositing of Project infrastructure. Alternative C as designed would remove four WTGs and one OSS from the sand ridge habitat and their associated inter-array cables. The OSS is to be moved from its original position to a site that will provide a 500-foot (152.4-meter) buffer from any significant sand ridge habitats. Dominion Energy has minimized the impact on the high priority sand ridge habitats under Alternative C by removing 4 WTGs and their associated inter-array cables, moving an OSS, and rerouting the OECC cable routes to avoid the sand ridge habitats as much as possible. A secondary minimization will develop by extending the cross-cutting trenching activities between two summer construction seasons. Separating the construction seasons with a 6-month recovery period will allow the ridge habitats to recover and reestablish their unique sand ridge benthic invertebrate and finfish assemblages. All WTGs in Alternative

C would be 14 MW, and under Alternative C a total of up to 172 WTGs would be installed in the Lease Area. This alternative would result in a reduction of benthic and pelagic resource impacts within the Lease Area in comparison to the Proposed Action. Approximately 169.7 acres (68.7 hectares) of benthic resources would be permanently impacted due to the installation of the up to 172 WTGs and the scour protection pad installed around each WTG foundation. Under the Proposed Action it is estimated that 201.7 acres (81.6 hectares) of benthic habitat would be permanently impacted. If Alternative C was selected as part of the Project design and there is a reduction of 4 WTGs from Alternative B (up to 176 WTGs) the permanent impact on benthic resources would be reduced by 32 acres (13 hectares). There would be an additional reduction in the impacts related to cable installation with the removal of the inter-array cables connecting the 4 removed WTGs in Alternative C. Alternative C would result in a reduction of 16 percent of soft bottom converted to hard-bottom habitat within the Lease Area.

With the exception of the reduction in the number of WTGs and length of inter-array and export cables installed for Alternative B and the Sand Ridge Impact Minimization Alternative C, impacts from the construction and installation, operations, and maintenance, non-routine activities, and conceptual decommissioning of these alternatives would be similar to those described under the Proposed Action. However, the micrositing of WTGs to avoid the NOAA-designated Fish Haven area and shipwrecks for Alternative B and avoidance of complex sand ridge habitat in Alternatives C would decrease impacts. The impacts reduced are related to the duration of noise impacts from pile-driving, jet-plowing operations, the potential of displacement of soft-bottom organisms within the footprint of each construction activity, and the permanent conversion of soft bottom to hard substrate. The decrease in overall seafloor impacts would be reduced to 15 to 16.8 percent for Alternatives B and C when compared to the Proposed Action. With this reduction in impacts, however, the impact level would remain minor and predominately permanent due to the conversion of existing soft-bottom habitat to hard-bottom habitat in relation to the WTG scour protection pads.

Cumulative Impacts of Alternatives C and B. In the context of reasonably foreseeable environmental trends, the combined impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including Alternative B or C, would be similar to those described under the Proposed Action.

3.13.6.1 Conclusions

Impacts of Alternatives C and B. The Proposed Action and Alternative B or C may result in fewer impacts on NOAA trust resources, including finfish and invertebrates, that use soft-bottom habitats; the final impact determinations would not differ from those noted under the Proposed Action. Population-level effects for soft-bottom organisms under Alternative B or C would be slightly lower but close to the same level as under the Proposed Action, and they would remain **minor**. This impact rating is driven primarily by ongoing IPFs such as climate change, as well as disturbance and habitat removal associated with WTG and cable emplacement activities. As described for the Proposed Action, Dominion Energy's proposed mitigation measures (as outlined in COP Section 4.2.4.4, Table 4.2-18; Dominion Energy 2022) and any future additional mitigation measures set forth by BOEM or other federal agencies could further reduce impacts (but would most likely not change the impact determinations).

Cumulative Impacts of Alternatives C and B. In the context of reasonably foreseeable environmental trends, the combined impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including Alternative B or C, would be similar to those described under the Proposed Action, with individual IPFs leading to impacts ranging from **negligible** to **moderate** with potentially **minor beneficial** impacts.

3.13.7 Impacts of Alternative D on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternative D. Alternative D differs from the Proposed Action only regarding onshore routing of the interconnection cable. Because the onshore portion of the Project lies outside of the zone of influence for finfish, invertebrates, and EFH, the Alternative D1 or D2 onshore export cable route extends from the trenchless installation landing (HDD) in Virginia Beach with two proposed terrestrial routes utilizing both buried cable and aerial routes to onshore switching stations. Both Alternative D1 and D2 are designed to minimize impacts on aquatic habitats (streams and wetlands) with an undetectable level of impact on the marine environmental offshore Virginia. Impacts of Alternatives D would be the same as those under the Proposed Action and would range from negligible to moderate depending on the IPF. Overall impacts would be minor.

Cumulative Impacts of Alternative D. For the same reason, overall impacts on finfish, invertebrates, and EFH in the context of reasonably foreseeable environmental trends and planned actions would be the same (i.e., moderate) under Alternative D.

3.13.7.1 Conclusions

Impacts of Alternative D. Although Alternative D would minimize impacts on onshore habitats, BOEM does not anticipate a measurable benefit for finfish, invertebrates, and EFH in the geographic analysis area. Therefore, overall potential impacts would be same the Proposed Action and would range from **negligible** to **moderate**.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action, with individual IPFs leading to **negligible** to **moderate** impacts, with potential for **minor beneficial** impacts. While Alternative D is designed to minimize impacts on onshore habitats, the overall impacts of Alternative D on finfish, invertebrates, and EFH would be the same as under the Proposed Action and would remain **moderate**.

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3.14. Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.14-1, includes the City of Chesapeake; City of Hampton; City of Newport News; City of Norfolk; City of Portsmouth; and City of Virginia Beach, and municipal boundaries surrounding the ports that may be used for the Project.

3.14.1 Description of the Affected Environment for Land Use and Coastal Infrastructure

Within the Project area (subset of City of Virginia Beach and Chesapeake City), land use is diverse, including open water, wetlands, shrub/scrub, forest, and developed and undeveloped land uses.

The proposed cable landing location would be on a proposed[1] surface parking lot that is designated as commercial land use and adjacent to an SMR, which is owned by the Commonwealth of Virginia and primarily used for on-site training for the Virginia National Guard.

The onshore export cable route corridor would be installed underground from the cable landing location to a common location north of Harpers Road, Virginia Beach. The dominant land uses along the onshore export cable route corridor include low-, medium-, and high-intensity developed lands and open space. In addition, the route follows a relatively limited passage through cultivated cropland, deciduous forestland, emergent herbaceous wetlands, evergreen forestland, pastureland, open water, and herbaceous and woody wetlands. The route corridor crosses Lake Christine, General Booth Boulevard, and a tidal tributary area west of General Booth Boulevard (COP, Section 4.4.3.1; Dominion Energy 2022).

The switching station would be located at either a location north of Harpers Road (City of Virginia Beach) (Harpers Road switching station) or a location north of Princess Anne Road (City of Virginia Beach) (Chicory Switching Station) (COP, Section 3.4.2.2; Dominion Energy 2022). The switching station potentially located north of Harpers Road is located on a mix of forested and developed land use and surrounded by similar land uses in addition to cultivated crop and wetland land uses. The switching station potentially located north of Princess Anne Road is located on a mix of forested and wetland land uses and surrounded by similar land uses in addition to some low-intensity developed land (COP, Section 4.4.3.1; Dominion Energy 2022). The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the Harpers Switching Station (BOEM and Dominion Energy 2022). The interconnection cables would transfer the electricity from the common location north of Harpers Road to the existing Fentress Substation (onshore substation, the point of interconnection). The onshore substation would be located on developed land but is surrounded by forested and wetland areas (COP, Section 3.3.2.5; Dominion Energy 2022).

[1] The SMR plans to independently build the parking lot. The parking lot is not expected to be developed as part of the proposed Project. The operational footprint for the cable landing location is anticipated to be approximately 2.8 acres (1.1 hectares).

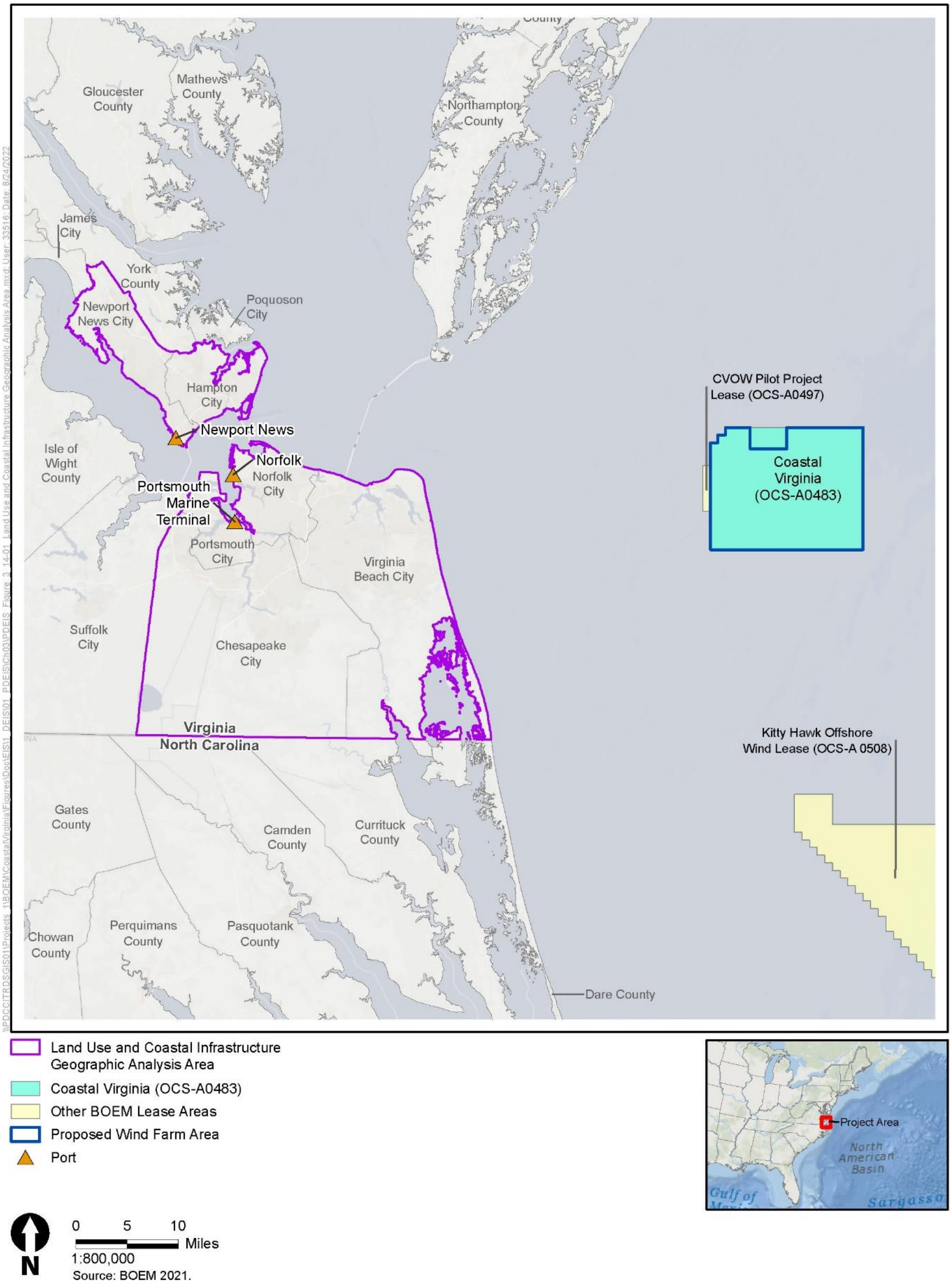

Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area

The interconnection cable routes would be constructed either fully overhead or a hybrid of overhead and underground and span a variety of land uses, including cultivated cropland, developed areas (residential and open space), forest, open water, and wetlands. The six interconnection cable routes are also adjacent to or traverse prominent landscapes, including the developed cities of Virginia Beach and Chesapeake, the Intracoastal Waterway, as well as portions of the Gum Swamp. The routes also traverse federal land in some areas (COP, Section 1.1 and Table 3.3-9; Dominion Energy 2022).

Important landscape features in the Project area include a combination of natural views such as beaches, shorelines, and scenic vistas, and human-made views such as unique buildings, landscaping, parks, and other cultural features.

3.14.2 Environmental Consequences

3.14.2.1. Impact Level Definitions for Land Use and Coastal Infrastructure

Definitions of potential impact levels are provided in Table 3.14-1.

Table 3.14-1 Impact Level Definitions for Land Use and Coastal Infrastructure

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on area land use would not be detectable.
	Beneficial	Beneficial impacts on area land use would not be detectable.
Minor	Adverse	Adverse impacts would be detectable but would be short term and localized.
	Beneficial	Beneficial impacts would be detectable but would be short term and localized.
Moderate	Adverse	Adverse impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
	Beneficial	Beneficial impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
Major	Adverse	Adverse impacts would be detectable, long term, and extensive, and result in permanent land use change.
	Beneficial	Beneficial impacts would be detectable, long term, and extensive, and result in permanent land use change.

3.14.3 Impacts of the No Action Alternative on Land Use and Coastal Infrastructure

When analyzing the impacts of the No Action Alternative on land use and coastal infrastructure, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for land use. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.14.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for land use and coastal infrastructure described in Section 3.14.1, *Description of the Affected Environment for Land Use and Coastal Infrastructure*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure are generally associated with onshore construction. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect land use and coastal infrastructure through temporary and permanent land use change, development projects, and port expansion.

The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and regulations. Most construction projects in the geographic analysis area would likely affect land that has already been disturbed from past development, although some development on undeveloped land may also occur. Ports in the geographic analysis area would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs. A channel-deepening project at the Port of Virginia is currently underway and is anticipated to be completed in 2024 (Virginia Port Authority 2019). Dredging and port improvements would allow larger vessels to use the port and may result in increased port use and conversion of surrounding land use if the ports are expanded. See Appendix F, Table F1-12 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for land use and coastal infrastructure.

There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure.

3.14.3.2. Cumulative Impacts of the No Action Alternative

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

BOEM expects future offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazardous materials may increase because of future offshore wind activities. Accidental release risks would be highest during construction, but would still pose a risk during operation and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. The overall impact of accidental releases on land use and coastal infrastructure is anticipated to be localized and short term and could result in temporary restrictions on use of adjacent properties and coastal infrastructure during the cleanup process. The extent of impacts would depend on the locations of landfall, substations, and cable routes, as well as the ports that support future offshore wind energy projects. The impacts of accidental releases on land use and coastal infrastructure would be localized and short term (except in the case of very large spills that affect a large land or coastal area).

Lighting: As described in Section 3.20, *Scenic and Visual Resources*, aviation hazard lighting on portions of Kitty Hawk Wind North and South (encompassing 190 WTGs) could be visible from beaches and coastal areas in the geographic analysis area. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The majority of the WTG positions associated with other offshore wind activities would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

Nighttime lighting from onshore electrical substations could affect the ability to use nearby properties or decisions about where to establish permanent or temporary residences. Nighttime lighting impacts would be localized, constant, and long term. However, it is likely that other offshore wind projects would expand or construct new substations near existing substations, or would construct new substations in areas where land development regulations (i.e., zoning and land use plan designations) allow such uses. For new or expanded substations in business or industrial areas, lighting would have no adverse impacts on land uses. Lighting impacts would depend on the proposed substation locations, but would generally be negligible.

Port utilization: Offshore wind energy projects would make productive use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts, such as greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind. In particular, the Virginia Port Authority is planning improvements to the PMT to support offshore wind development (COP, Section 3.3.2.6; Dominion Energy 2022).

There are two additional planned offshore wind projects (Kitty Hawk Wind North and South) in the geographic analysis area that would overlap with construction of the Proposed Action (Appendix F, Table F2-1). Offshore wind energy projects that are constructed at the same time and rely on the same ports have the potential to stress port resources and could increase the marine and road traffic, noise, and air pollution in the area. Overall, the No Action Alternative would have constant, long-term, beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity, as well as localized, short-term, adverse impacts in cases where individual ports are stressed due to simultaneous project activity. Kitty Hawk Wind Projects would use ports in the Lower Chesapeake Bay area for staging project components and construction vessels (Kitty Hawk Wind North 2021: Section 3.1.1; Kitty Hawk Wind South 2022: Section 3.1.1). Improvements may be made to these ports to accommodate offshore wind construction and staging activities; port improvements and the associated permitting activities will support multiple projects up and down the Eastern Seaboard and will be the responsibility of port owners/operators (Kitty Hawk Wind North 2021: Section 3.1.11; Kitty Hawk Wind South 2022: Section 3.1.1).

Presence of structures: During operations, the views of offshore wind WTGs from coastal locations on the coastlines of Northampton County and the City of Virginia Beach, Virginia could have effects on land use through impacts on recreation, tourism, and property values, if the views influence visitors in selecting coastal locations to visit or buy. While WTGs could be visible from shoreline areas of the Delmarva Peninsula, Virginia Beach, and the Carova and Corolla Beach areas of North Carolina, visual impacts are expected to range from negligible to moderate (COP, Section 4.3.4.3; Dominion Energy 2022). Visibility would vary with distance from shore, topography, and atmospheric conditions and impacts would generally be localized, constant, and long term.

The presence of onshore infrastructure is anticipated to have minor long-term impacts on land use. BOEM anticipates that new substations for offshore wind projects would be within or near existing substations, or in locations designated for such uses. Transmission cables would most likely be above or belowground and collocated with roads or other utilities. As a result, onshore infrastructure would affect existing and planned land uses for the local area.

Land disturbance: Future offshore wind installation would require installation of onshore transmission cable infrastructure that would require land-disturbing activities and could temporarily affect access to adjacent properties. These impacts would only last through construction and occasionally during maintenance events. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.

Noise: Future offshore wind projects would generate noise, primarily associated with onshore cable trenching and switching station or substation construction. Noise from offshore wind construction activities is not expected to reach the geographic analysis area. This IPF may affect land use if noise levels influence business activity or residents' and visitors' decisions on where to visit or live. Ongoing noise from human activity (e.g., transportation, construction projects) occurs frequently in populated areas in the Mid-Atlantic states. The intensity and extent of noise from construction are difficult to generalize, but impacts would be local and temporary. Noise from onshore construction activity is anticipated to be similar to noise from other ongoing construction projects in the geographic analysis area and would be temporary.

Traffic: Future offshore wind projects could result in increased road traffic and congestion that may affect land use and coastal infrastructure because traffic volumes may dictate where residents and businesses choose to locate. Onshore construction of cables and switching stations for future offshore wind projects would likely disrupt road traffic for a short period of time. Occasional, temporary traffic delays would result from repairs and maintenance. The extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.

3.14.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on land use and coastal infrastructure. These effects are primarily driven by onshore construction impacts and the presence of structures.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, and land disturbance, noise, and traffic from construction.

BOEM anticipates that the impacts of ongoing activities, especially onshore and coastal commerce, industry, and construction projects, would have both **minor** beneficial and **minor** adverse impacts on land use in the geographic analysis area. Accidental releases and land disturbances could have temporary adverse impacts on local land uses, but overall, ongoing use and development sustains the region’s diverse mix of land uses and provides support for continued maintenance and improvement of coastal infrastructure.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and land use and coastal infrastructure would continue to be affected by natural and human-caused IPFs. Planned activities other than offshore wind, primarily increased port maintenance and expansion and construction activity, would have impacts similar to those of ongoing activities, with **minor** beneficial and **minor** adverse impacts. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** beneficial and **minor** adverse impacts on the IPFs affecting land use and coastal infrastructure.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities near the geographic analysis area, combined with ongoing and planned activities other than offshore wind, would result in **minor** adverse impacts and **minor** beneficial impacts. Future offshore wind would adversely affect land use through land disturbance (during installation of onshore cable, switching stations, and substations) and accidental releases during onshore construction, as well as through the presence of offshore lighting on wind energy structures and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind would support the productive use of ports and related infrastructure designed or appropriate for future offshore wind activity (including construction and installation, O&M, and decommissioning).

3.14.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The number, size, and design of the turbines. The appearance of the turbines and the offshore component of the Project as a whole could affect property use and value.
- The location of the switching station. The proposed Harpers Road switching station is located on and around more disturbed land than the proposed Chicory Switching Station.
- Interconnection cable route paths. The onshore interconnection cable routing and switching station variants in the Onshore Project area cross different land uses and important landscapes, such as the Gum Swamp.
- The time of year during which construction occurs. The Project area experiences a peak tourism season in the summer. If Project construction were to occur during this season, impacts on roads and land uses during the busy tourist season would be exacerbated.

Changes to the turbine design capacity could alter the maximum potential impacts on land use and coastal infrastructure for the Project because the capacity could affect onshore infrastructure or port utilization. For example, turbines with a higher capacity would require a greater turbine height, which may affect port utilization by increasing construction duration and intensity.

3.14.5 Impacts of the Proposed Action on Land Use and Coastal Infrastructure

The Proposed Action or Alternative A-1 would likely result in localized impacts that would lead to minor alterations to the overall character of land use and coastal infrastructure in the geographic analysis area. The most impactful IPFs would likely include land use change from switching station construction and substation expansion; land disturbance during cable installation; the visual impact of offshore WTGs; and the utilization of ports.[2] Dominion Energy has indicated that the Virginia Port Authority is planning to improve the PMT to support broadscale offshore wind development and anticipates that the port upgrades would meet the needs for construction of the Project (COP, Section 3.3.2.6; Dominion Energy 2022). Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction but may also occur during operations and decommissioning.

Accidental releases: Accidental releases from the Proposed Action could include release of fuel/fluids/hazardous materials as a result of port usage, installation of the onshore cables, switching station, and substation, and substation operation. Potential contamination may occur from unforeseen spills or accidents, and any such occurrence would be reported and addressed in accordance with the local authority. The impact of accidental releases on land use and coastal infrastructure could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, short-term, negligible to minor impacts on land use. The risk of spills from offshore structures under Alternative A-1 would be less than the Proposed Action due to the removal of three WTGs. However, the difference in potential impact from having three fewer WTGs than the Proposed Action’s 205 WTGs is anticipated to be negligible.

[2] The Proposed Action or Alternative A-1 would not directly require any upgrades to port infrastructure but would make productive use of existing ports.

Lighting: The Proposed Action would include the installation and continuous use of aviation hazard avoidance lighting on WTGs and OSSs during low-light and nighttime conditions. At onshore facilities, downward-projecting lights and lights triggered by motion sensors would be used to mitigate light pollution (COP, Section 4.2.2.2; Dominion Energy 2022). During operations, lighting from the Proposed Action's up to 205 WTGs (or up to 202 WTGs under Alternative A-1) could be visible from certain coastal and elevated locations in the geographic analysis area. Field observations associated with visibility of FAA hazard lighting under clear-sky conditions indicate that FAA hazard lighting may be visible at 40 miles (64 kilometers) or more from the viewer. Darker-sky conditions may increase this distance due to increased contrast of the light dome (reflections from the ocean) and cloud reflections caused by the hazard lights. As a result, WTG lighting of the Proposed Action or Alternative A-1 alone would have a long-term, continuous, negligible to minor impact on land use and coastal infrastructure in the geographic analysis area, due to potential effects on property use and value.

Port utilization: The Proposed Action includes no port expansion activities but would use ports that would expand to support the wind energy industry generally. Port upgrades and expansions may occur independent of the Proposed Action. For instance, the Virginia Port Authority is planning improvements to the PMT to support regional offshore wind development (COP, Section 3.3.2.6; Dominion Energy 2022). Under Alternative A-1, port utilization would generally be the same as the Proposed Action, although there would be slightly less ship traffic at the ports because three fewer WTGs would be constructed, operated, maintained, and decommissioned.

Land uses and coastal infrastructure affected by construction of offshore components includes the PMT, which would be used to support component and construction vessel staging. The Proposed Action and Alternative A-1 would also involve temporary construction laydown area(s) at port(s) in Europe or North America (COP, Section 3.1; Dominion Energy 2022). These ports are expected to be used during construction but have independent utility and would not be dedicated to the Proposed Action or Alternative A-1. Proposed uses at existing port facilities would be consistent with the current land uses occurring at these locations.

Activities associated with Proposed Action or Alternative A-1 construction would generate noise, vibration, and vehicular traffic at the ports temporarily used for construction described above. These impacts are typical for industrial ports and would not hinder other nearby land uses or use of coastal infrastructure.

Dominion Energy is currently evaluating several alternatives to lease portions of existing facilities in the Hampton Roads, Virginia Region for an O&M facility for the Proposed Action or Alternative A-1. The preferred lease location for an onshore O&M facility for the Proposed Action and Alternative A-1 is Lambert's Point, which is on a brownfield site in Norfolk, Virginia (COP, Section 3.3.2.6; Dominion Energy 2022). Lambert's Point is an existing port facility operated by Norfolk Southern. Dominion Energy and the Port of Virginia are also evaluating leasing portions of the existing facilities at the Virginia Port Authority's PMT or Newport News Marine Terminal. Dominion Energy anticipates that they would require a building with an area of up to approximately 0.8 acre (0.3 hectare), and a height of up to approximately 45 feet (13.7 meters) to meet the needs of an O&M facility for an offshore wind farm off the coast of Virginia (COP, Section 3.3.2.6; Dominion Energy 2022).

O&M of the Proposed Action or Alternative A-1 offshore components would require daily activity at the chosen O&M facility. The increased activity at the chosen port and nearby areas would be consistent with current land uses and provide a source of investment in the coastal infrastructure.

Overall, the construction and installation of offshore components, O&M, and decommissioning for the Proposed Action or Alternative A-1 alone would have minor beneficial impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

Presence of structures: WTGs could be visible from certain coastal and elevated mainland areas, depending on vegetation, topography, and atmospheric conditions for both the Proposed Action and Alternative A-1. WTGs would not dominate offshore views as a result of their proposed distance from shore, even under ideal weather and atmospheric conditions for viewing. The Proposed Action or Alternative A-1 alone would have a long-term, continuous, minor impact on land use and coastal infrastructure in the geographic analysis area due to views of WTGs and the potential effects on property use and value.

The visual impacts of the WTGs from the Proposed Action or Alternative A-1, as well as other future offshore wind development, visible from coastlines and elevated inland locations, could have long-term impacts on land use if the views influence visitor decisions on locations or properties to visit or purchase. Portions of up to 205 WTGs from the Proposed Action (or up to 202 WTGs from Alternative A-1) and portions of the Kitty Hawk Wind North and South Projects could be visible from coastal and elevated locations near the geographic analysis area. As noted in Section 3.18, *Navigation and Vessel Traffic*, impacts on recreation and tourism activities would be minor. Accordingly, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined visual impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be localized, long term, and minor to moderate.

The cable landing location of the Proposed Action and Alternative A-1 is located on a proposed surface parking lot that is on an SMR.[3] The onshore cable route crosses several water bodies, including Lake Christine, where HDD would be used for construction. The entry and exit pits for the HDD construction would be located on previously disturbed lands and along roadways, to the extent practicable, which would minimize impacts to land use. The Proposed Action and Alternative A-1's interconnection cable infrastructure would be installed either fully overhead (Interconnection Cable Route Option 1) or via a hybrid of overhead and underground installation methods (Hybrid Interconnection Cable Route Option 6). The interconnection cable route variations cross federal property in some areas and also city-owned land, including the Virginia Beach National Golf Club; however, installation corridors would be predominantly located within existing roadways to minimize impacts on existing land use. Because the offshore export cable route and interconnection cable routes would follow mostly existing road rights-of-way, there would be minimal impacts on existing land uses. Where the onshore cable routes would cross currently undeveloped areas, there would be a permanent conversion of land to utility right-of-way or easement. The height of the overhead cables for all interconnection cable route option would be between 75 feet (22.9 meters) and 170 feet (51.8 meters), which would be well above the minimum height required by Virginia Administrative Code (Code of Virginia § 33.2-210) and sight lines.

The Harpers Switching Station would require approximately 7.1 acres (2.9 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course. These acreages are included in the overall acreage of 45.4 acres (18.4 hectares) for the Harpers Switching Station (BOEM and Dominion Energy 2022). The location of the Harpers Switching Station is on and near previously disturbed land and would result in minimal or no changes to existing land use. The onshore substation would be developed through upgrades and expansion of an existing substation. The parcel identified for the onshore substation contains forested land, and some vegetation removal would be necessary to accommodate the proposed upgrades/expansion of the onshore substation. However, the proposed upgrades/expansion of the onshore substation would be consistent with existing uses due to the presence of an existing substation, as well as transmission lines to the north and northeast of the onshore substation site (COP, Section 4.4.3.1; Dominion Energy 2022).

[3] The SMR plans to independently build the parking lot. The parking lot is not expected to be developed as part of the proposed Project. The operational footprint for the cable landing location is anticipated to be approximately 2.8 acres (1.1 hectares).

Landfall construction methods would minimize land use impacts and areas would be restored to their previous condition after construction. Temporarily increased noise levels, lighting, and traffic during construction may affect local sensitive receptors (e.g., schools, medical facilities), but would be minimized through BMPs and would not change existing land uses. Dominion Energy has committed to implementing a construction schedule to minimize impacts to the extent practicable where appropriate and as deemed necessary by local authorities (COP, Section 4.4.4.2; Dominion Energy 2022). This would include coordination with localities, including the Virginia SMR.

Land disturbance: Based on the existing conditions along the proposed onshore export cable route, the Project would use a combination of open trenches, HDD, and duct banks at varying depths along the selected route (COP, Section 3.4.2.1; Dominion Energy 2022). Construction and installation of the interconnection cable would include a combination of vibrated/driven pipe piles and open trench interconnect ducting depending on the interconnection cable route option.

Installation of the cable landfall sites, cable routes, and construction and expansion of the switching station and substation would temporarily disturb neighboring land uses through construction noise, vibration, dust, and travel delays along the affected roads. These impacts are anticipated to last for the duration of construction; following construction, the cable route corridors and temporary staging areas for switching station and substation construction would be returned to their previous condition and use. In particular, the portion of the parcel not required for long-term operation of the substation would be restored to previous conditions (COP, Section 4.4.3.2; Dominion Energy 2022). The corridors would be maintained through regular vegetation trimming and herbicide application. Installation of the onshore export and interconnection cables would occur within temporary construction corridors. The maximum area of temporary disturbance for the onshore export cable is approximately 26.6 acres (10.8 hectares) (BOEM and Dominion Energy 2022).

Permanent disturbance: The total permanent disturbance for Interconnection Cable Route Option 1 to accommodate new permanent structures (i.e., transmission towers) would be 1.0 acre (0.4 hectare) (BOEM and Dominion Energy 2022). O&M would not result in land disturbance except in the event that cable maintenance or replacement is required. Land use impacts would be minimized through the use of existing ROWs, co-locating Project components, using land that is primarily zoned for commercial or industrial development, and restoring areas to pre-disturbed conditions following construction (COP, Section 4.4.3.1; Dominion Energy 2022).

The Harpers Switching Station is located in industrial district. The onshore substation parcel is zoned A-1 Agricultural and R-15S Residential. Interconnection Cable Route Option 1 would travel from a common location north of Harpers Road to the onshore substation and would traverse mainly industrial, business, office, planned developments, residential, and agricultural districts (COP, Section 4.4.3.1; Dominion Energy 2022; City of Virginia Beach 2008, 2017). The construction of the interconnection cable route, new switching station, and expansion of the onshore substation would result in temporary and permanent impacts to land use. In order to implement a zoning use in a district that currently does not allow a specific use, a Conditional Use Permit is typically submitted to the local zoning department for review and approval. Under Virginia law, if a public utility is granted a Certificate of Public Convenience and Necessity from the Virginia State Corporation Commission, the Certificate of Public Convenience and Necessity approval shall be deemed to satisfy the requirements of all local zoning ordinance (COP, Section 4.4.3.1; Dominion Energy 2022; Code of Virginia § 56-265.2).

Noise: The Proposed Action and Alternative A-1 would comply with Virginia Beach City and Chesapeake City Code noise regulations (COP, Section 4.1.4.1; Dominion Energy 2022), to the extent practicable, to minimize impacts on nearby communities. Typical construction equipment ranges from a generator or refrigerator unit at 73 A-weighted decibels (dBA) at 50 feet to an impact pile driver at 101 dBA at 50 feet. Given the extended distances between the Offshore Project area and coastal shorelines (approximately 28 and 42 miles [45 and 67 kilometers]), noise from offshore construction is not expected to result in negative impacts in the Onshore Project area (COP, Section 4.1.4.2; Dominion Energy 2022). Temporarily increased noise levels during construction of onshore components may affect local sensitive receptors (such as religious locations, recreational areas, schools, and other places that are particularly sensitive to construction) but would be minimized through BMPs and would not change existing land uses.

Traffic: Cable installation within the roadway under the Proposed Action or Alternative A-1 could result in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways with temporary detours. Best management practices and maintenance of traffic plans would be developed and coordinated with local and state agencies. Traffic impacts would be limited to the immediate construction area. Roadways would be returned to pre-construction conditions and changes to the existing land use would not result. Prior to beginning construction, Dominion Energy would develop a Traffic Management Plan to offset any traffic-related impacts as applicable to offset any anticipated traffic-related impacts. Traffic-related impacts include Project-related construction, temporary modifications to roadway traffic patterns during construction, and an increase in O&M vehicle traffic. The Traffic Management Plan would include, but would not be limited to, highly visible markings, signage, and lighting of active construction sites construction parking areas, and development of vehicular travel routes to and from construction sites (COP, Section 4.4.4.2; Dominion Energy 2022).

3.14.5.1. Cumulative Impacts of the Proposed Action

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

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the accidental release impacts on land use and coastal infrastructure from ongoing and planned activities would increase the risk of (and, thus, the potential impacts from) accidental releases of fuel/fluids/hazardous materials in the geographic analysis area and would result in localized, short-term, negligible to minor impacts on land use and coastal infrastructure.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to WTG lighting impacts on land use and coastal infrastructure from ongoing and planned activities would be continuous, long term and negligible.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined impacts on land use and coastal infrastructure from ongoing and planned activities would have long-term, minor beneficial impacts. Future offshore wind development, including the Proposed Action or Alternative A-1, would require port facilities for shipping, berthing, and staging, and development activities would support ongoing or new activity at authorized ports.

In context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action or Alternative A-1 to the combined onshore transmission cable infrastructure impacts on land use and coastal infrastructure from ongoing and planned activities are anticipated to be minor. Assuming that new switching stations or substations for offshore wind projects would be in locations designated for industrial or utility uses, and above or belowground cable conduits would primarily be co-located with roads or other utilities, operation of switching stations, substations and cable conduits would not affect the established and planned land uses for a local area.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the land disturbance impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be minor due to construction-related disturbance, access limitations along the cable routes, and land use changes due to the construction of the switching station and onshore substation expansion. Impacts on land use and coastal infrastructure would be additive if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity.

Construction of onshore components of new offshore wind projects near the geographic analysis area would be required to comply with the same or similar noise regulations as the Proposed Action and Alternative A-1 and noise levels are anticipated to be similar to noise levels from other ongoing activities.

Impacts on land use and coastal infrastructure would be additive only if construction associated with one or more other projects generates traffic in close spatial and temporal proximity. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to traffic impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be minor, localized, and short term.

3.14.5.2. Conclusions

Impacts of the Proposed Action. In summary, BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action or Alternative A-1 alone would range from **negligible** to **minor** with **minor** beneficial impacts. The Proposed Action or Alternative A-1 would have minor beneficial impacts resulting from port utilization, minor impacts resulting from land disturbance during onshore installation of the cable route and resulting from land use changes from the construction and expansion of the switching station and substation, and negligible to minor impacts resulting from accidental spills. Noise and traffic from onshore construction would have localized, short-term, minor impacts on land use and coastal infrastructure.

Cumulative Impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, impacts resulting from individual IPFs would range from **negligible** to **minor** and **negligible** to **minor** beneficial impacts. Considering all of the IPFs collectively, BOEM anticipates that the contribution of the Proposed Action or Alternative A-1 to the impacts associated with ongoing and planned activities would result in **minor** adverse impacts and **minor** beneficial impacts on land use and coastal infrastructure in the geographic analysis area. The main drivers for this impact rating are the beneficial impacts of port utilization, minor impacts on the viewshed due to the presence of offshore structures, and minor impacts of land disturbance and land use change. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable, switching station, and substation installation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

3.14.6 Impacts of Alternatives B and C on Land Use and Coastal Infrastructure

Impacts of Alternatives B and C. The impacts resulting from individual IPFs on land use and coastal infrastructure under Alternatives B and C would be the same as those described under the Proposed Action except for the presence of structures. Compared to the Proposed Action, Alternative B would remove 29 WTGs (for a total of up to 176 WTGs). Alternative C would remove 33 WTGs (for a total of up to 172 WTGs) from the Offshore Project area. All other offshore and onshore projects components would stay the same. As a result, Alternatives B and C would slightly modify the visibility of the WTGs from coastal and elevated onshore areas in the geographic analysis area, which could affect the potential effects on property use and values compared to the Proposed Action. However, as under the Proposed Action, the majority of the WTGs would still be visible, and there would be no meaningful difference in impacts on land use and coastal infrastructure.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of the Proposed Action

3.14.6.1. Conclusions

Impacts of Alternatives B and C. Alternatives B and C would decrease the number of WTGs, resulting in slightly decreased visual impacts of WTGs on coastal communities compared to the Proposed Action and Alternative A-1 but would not change the overall impact magnitudes. Impacts on land use and coastal infrastructure would be long-term and range from **negligible** to **minor** with **minor** beneficial impacts. Impact ratings associated with individual IPFs would not change.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of the Proposed Action, ranging from **negligible** to **minor** impacts for onshore land use and infrastructure and **minor** beneficial impacts. The overall impacts of Alternative B and C combined with ongoing and planned activities on land use would be similar to those of the Proposed Action: **minor** adverse impacts and **minor** beneficial impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change.

3.14.7 Impacts of Alternative D on Land Use and Coastal Infrastructure

Impacts of Alternative D. The impacts resulting from the majority of IPFs on land use and coastal infrastructure under Alternative D would be the same as those described under the Proposed Action except for land disturbance. Alternative D-2 would approve only the Hybrid Interconnection Cable Route Option 6, which would connect with the switching station north of Princess Anne Road (Chicory Switching Station). Alternative D-1 would approve only Interconnection Cable Route Option 1, which would connect with the Harpers Switching Station. The Chicory Switching Station would be located in agricultural and residential districts and would have a smaller total footprint at 35.5 acres (14.4 hectares) than the Harpers Switching Station (45.4 acres or 18.4 hectares), which would be located within an industrial district (COP, Section 3.3.2.3; Dominion Energy 2022). Interconnection Cable Route Option 1 (Alternative D-1) has the smallest construction/installation corridor area (254.4 acres) of the two interconnection cable route options (COP, Table 3.4-6; Dominion Energy 2022). As a result and depending on the chosen interconnection cable route and associated switching station under the Proposed Action, Alternative D-1 would result in the fewest land-disturbing impacts from construction of the onshore components followed by Hybrid Interconnection Cable Route Option 6 (Alternative D-2).

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action.

3.14.7.1. Conclusions

Impacts of Alternative D. The Proposed Action and Alternative D considers two interconnection cable route options. Interconnection Cable Route Option 1 (Alternative D-1) would have the smallest construction footprint on a whole. The Chicory Switching Station location associated with Hybrid Interconnection Cable Route Option 6 (Alternative D-2) covers a smaller footprint but would be in a less disturbed area than the Harpers Switching Station associated with overhead Interconnection Cable Route Option 1 (Alternative D-1). Impacts on land use and coastal infrastructure would range from **negligible** to **minor** with **minor** beneficial impacts. Impact ratings associated with individual IPFs would not change.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action, long-term and ranging from **negligible** to **minor** impacts for onshore land use and infrastructure and **minor** beneficial impacts. The overall impacts of Alternative D combined with ongoing and planned activities for land use would also be the same as those of the Proposed Action: long-term **minor** adverse impacts and **minor** beneficial impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change.

3.15 Marine Mammals

This section discusses marine mammal resources in the geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and illustrated on Figure 3.15-1, specifically the Scotian Shelf, Northeast Shelf, and Southeast Shelf LME. This broad geographic area is likely to capture the majority of the movement range for most species in this group.

3.15.1 Description of the Affected Environment for Marine Mammals

Marine mammals are highly mobile animals that typically use the waters of the Project area for foraging and/or migration; some individuals may remain year-round in the area while others are transitory. Species occurrence in the Project area is not uniform as some species are pelagic and occur farther offshore, some are coastal and are found nearshore, and others occur in both near and offshore areas. Additionally, some species prefer offshore continental shelf waters either seasonally or while feeding due to changes in the abundance and locations of their prey species; however, at other times of the year, these same species can occur in shallower depths closer to shore.

A total of 38 marine mammal species, including 7 large whale, 20 dolphin (includes two distinct common bottlenose dolphin [*Tursiops truncates*] stocks), 5 beaked whale, 1 porpoise, 1 manatee, and 4 seal species, are known to occur year-round, seasonally, and/or incidentally in the Mid-Atlantic OCS, which encompasses the Project area (Table 3.15-1). Current species abundance estimates can be found in the NOAA marine mammal stock assessment reports (SAR) (Hayes et al. 2019, 2020; NMFS 2021; Pace 2021), which use data from a photo-identification recapture database for North Atlantic right whales (*Eubalaena glacialis*) (NARWs), with available records through January 2021; the 2016 NOAA shipboard and aerial surveys; and the 2016 Northeast Fisheries Science Center (NEFSC) and Department of Fisheries and Oceans Canada survey (NMFS 2021). These reports indicate generally patchy and seasonally variable marine mammal density in the Mid-Atlantic OCS region. Table 3.15-1 summarizes the presence, distribution, and population status of marine mammal species known to occur in and around the Offshore Project area.

The *Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment 2021* (NMFS 2021) indicated that there are insufficient data to determine population trends for most marine mammal species found regularly in the coastal and oceanic waters of Virginia. However, there are data that show the NARW population declined in abundance from 2011 to 2018. During the 2021 calving season, 18 calves were observed (up from 10 during the 2020 season), but births remain significantly below what was expected, and the species continues to be in decline (Pettis et al. 2021, 2022; Pace 2021). Data indicate a 23.5 percent decline in annual abundance since 2011 (NMFS 2021). Documented human-caused mortality and serious injury for the NARW is 7.7 individuals per year, averaged over the period between 2015 and 2019, though this likely represents an underestimate as not all mortalities are recorded (NMFS 2021). Modeling suggests the mortality rate could be as high as 27.4 animals per year (NMFS 2021). Importantly, NARW mortalities exceed the species' calculated potential biological removal (0.7 individuals per year). When coupled with the species' low fecundity and small population size, all human-caused mortalities have the potential to impact their population status. The species' high mortality rate is driven primarily by fishing gear entanglement and vessel strike (NMFS 2021). The humpback whale (*Megaptera novaeangliae*) was previously federally listed as endangered. However, based on the revised listing completed by NOAA in 2016, the Distinct Population Segment (DPS) of humpback whales that occurs along the East Coast of the United States (West Indies DPS; inclusive of the Gulf of Maine Stock, which occurs in the Project area) is no longer considered endangered or threatened (Hayes et al. 2020, 2021). The Commonwealth of Virginia has retained the endangered state listing status for the humpback whale (VDWR 2020). The Gulf of Maine stock exhibits a positive population trend, with an estimated increase in abundance of 2.8 percent per year (Hayes et al. 2020).

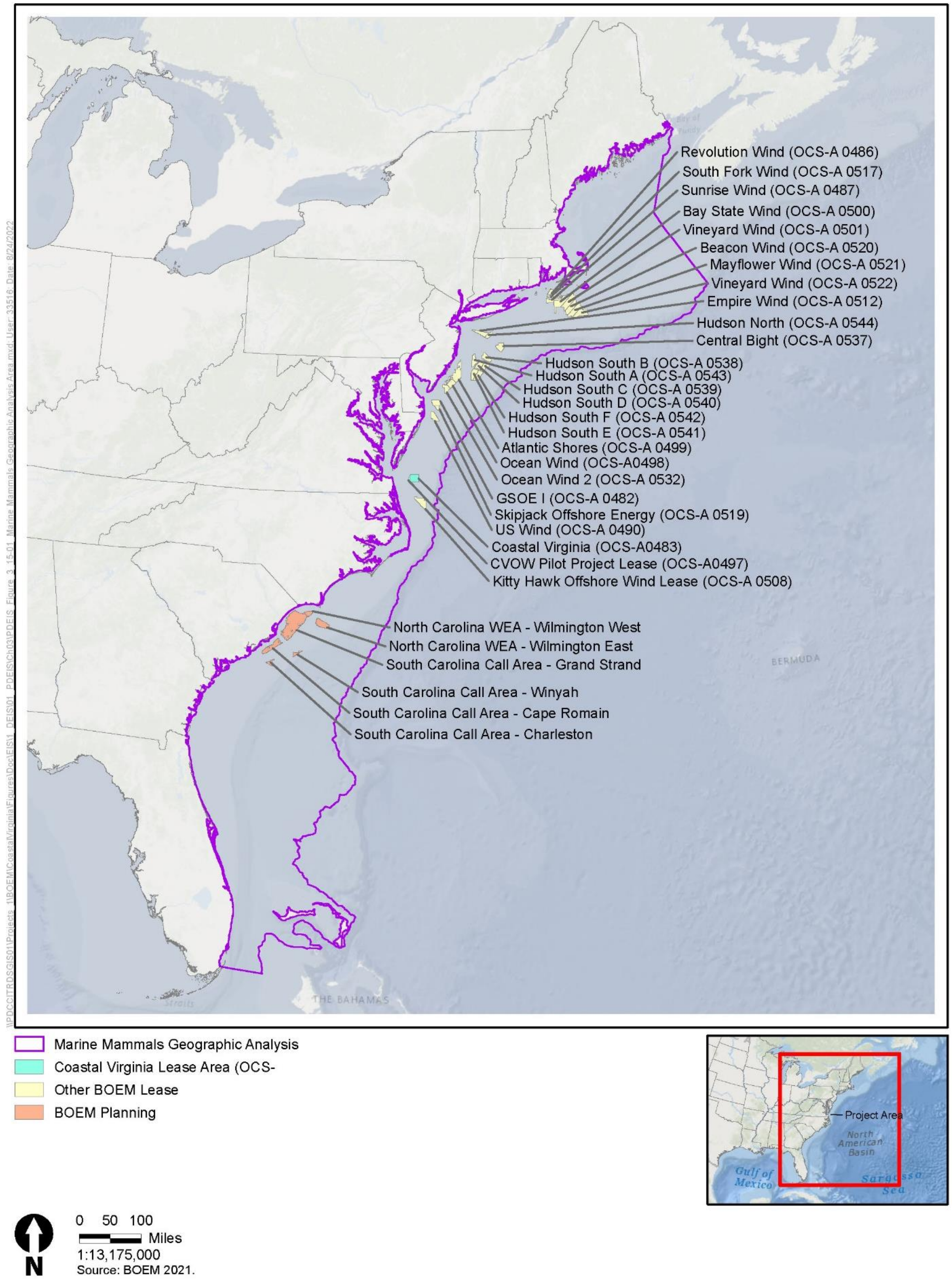

Figure 3.15-1 Marine Mammals Geographic Analysis Area

Table 3.15-1 Presence, Distribution, and Population Status of Marine Mammal Species Known to Occur in Coastal and Oceanic Waters of Virginia Around the Project Area

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status	Virginia Threatened and Endangered Population Status
Odontocetes (Toothed Whales)								
Phocoenidae (Porpoises)								
Harbor Porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	95,543	Shallow, inshore and nearshore, estuarine and coastal waters	Common	Winter/Spring	MMPA–non-strategic	–
Delphinidae (Dolphins)								
Atlantic Spotted Dolphin	*Stenella frontalis*	Western North Atlantic	39,921	Continental shelf and slope	Common	Year-Round	MMPA–non-strategic	–
Atlantic White-Sided Dolphin	*Lagenorhynchus acutus*	Western North Atlantic	93,233	Continental shelf and slope	Uncommon	Fall/Winter/Spring	MMPA–non-strategic	–
Common Bottlenose Dolphin	*Tursiops truncatus*	Western North Atlantic, Offshore	62,851	Deeper, offshore waters	Common	Year-Round	MMPA–non-strategic	–
		Western North Atlantic, Southern Migratory Coastal	3,751	Shallow, inshore and nearshore, estuarine and coastal waters	Common	Year-Round	MMPA–strategic	–
Clymene Dolphin	*Stenella clymene*	Western North Atlantic	4,237	Deeper, offshore waters	Extralimital	Summer	MMPA–non-strategic	–

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status	Virginia Threatened and Endangered Population Status
Dwarf Sperm Whale	*Kogia sima*	Western North Atlantic	7,750	Continental shelf and deeper, offshore waters	Uncommon	Variable	MMPA–non-strategic	–
False Killer Whale	*Pseudorca crassidens*	Western North Atlantic	1,791	Continental shelf and deeper, offshore waters	Uncommon	Variable	MMPA–non-strategic	–
Fraser's Dolphin	*Lagenorhynchus hosei*	Western North Atlantic	Unknown	Deeper, offshore waters	Uncommon	Variable	MMPA–non-strategic	–
Killer Whale	*Orcinus orca*	Western North Atlantic	Unknown	Continental shelf and deeper, offshore waters	Uncommon	Year-Round	MMPA–non-strategic	–
Long-Finned Whale	*Globicephala melas*	Western North Atlantic	39,215	Continental shelf	Common	Year-Round	MMPA–non-strategic	–
Short-Finned Whale	*Globicephala macrorhynchus*	Western North Atlantic	28,924	Continental shelf	Uncommon	Year-Round	MMPA–non-strategic	–
Pan-Tropical Spotted Dolphin	*Stenella attenuata*	Western North Atlantic	6,593	Deeper, offshore waters	Uncommon	Summer	MMPA–non-strategic	–

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status	Virginia Threatened and Endangered Population Status
Melon-Headed Whale	*Peponocephala electra*	Western North Atlantic	Unknown	Continental shelf and deeper, offshore waters	Uncommon	Variable	MMPA–non-strategic	–
Pygmy Killer Whale	*Feresa attenuata*	Western North Atlantic	Unknown	Deeper, offshore waters	Uncommon	Variable	MMPA–non-strategic	–
Pygmy Sperm Whale	*Kogia breviceps*	Western North Atlantic	7,750	Continental shelf and deeper, offshore waters	Uncommon	Year-Round	MMPA–non-strategic	–
Risso's Dolphin	*Grampus griseus*	Western North Atlantic	35,215	Continental shelf	Common	Year-Round	MMPA–non-strategic	–
Rough Toothed Dolphin	*Steno bredanensis*	Western North Atlantic	136	Continental shelf and deeper, offshore waters	Uncommon	Year-Round	MMPA–non-strategic	–
Common Dolphin	*Delphinus delphis*	Western North Atlantic	172,974	Continental shelf and slope	Common	Year-Round	MMPA–non-strategic	–
Sperm Whale	*Physeter macrocephalus*	North Atlantic	4,349	Deeper, offshore waters and slope	Uncommon	Year-Round	MMPA–strategic; ESA Endangered	Endangered

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status	Virginia Threatened and Endangered Population Status
Spinner Dolphin	*Stenella longirostris orientalis*	Western North Atlantic	4,102	Deeper, offshore waters and slope	Uncommon	Year-Round	MMPA–non-strategic	–
Striped Dolphin	*Stenella coeruleoalba*	Western North Atlantic	67,036	Deeper, offshore waters and slope	Uncommon	Year-Round	MMPA–non-strategic	–
White Beaked Dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	536,016	Continental shelf	Uncommon	Variable	MMPA–non-strategic	–
Ziphiidae (Beaked Whales)								
Blainville's Beaked Whale	*Mesoplodon densirostris*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon	Spring/Summer	MMPA–non-strategic	–
Cuvier's Beaked Whale	*Ziphius cavirostris*	Western North Atlantic	5,744	Deeper, offshore waters	Uncommon	Variable	MMPA–non-strategic	–
Gervais' Beaked Whale	*Mesoplodon europaeus*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon	Spring/Summer	MMPA–non-strategic	–
Sowerby's Beaked Whale	*Mesoplodon bidens*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon	Variable	MMPA–non-strategic	–
True's Beaked Whale	*Mesoplodon mirus*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon	Spring/Summer	MMPA–non-strategic	–

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status	Virginia Threatened and Endangered Population Status
Mysticetes (Baleen Whales)								
Blue Whale	*Balaenoptera musculus*	Western North Atlantic	402[2]	Continental shelf and deeper, offshore waters	Uncommon	Year-Round	MMPA–strategic; ESA Endangered	Endangered
Fin Whale	*Balaenoptera physalus*	Western North Atlantic	6,802	Continental shelf and deeper, offshore waters	Common	Year-Round	MMPA–strategic; ESA Endangered	Endangered
Humpback Whale	*Megaptera novaeangliae*	Gulf of Maine	1,396	Continental shelf and coastal waters	Common	Fall/Winter/Spring	MMPA—non-strategic[2]	Endangered[3]
Minke Whale	*Balaenoptera acutorostrata*	Canadian East Coast	21,968	Continental shelf	Common	Year-Round	MMPA–non-strategic	–
Sei Whale	*Balaenoptera borealis*	Nova Scotia	6,292	Continental shelf	Uncommon	Summer/Fall/Winter	MMPA–strategic; ESA Endangered	Endangered
Balaenidae (Right and Bowhead Whales)								
North Atlantic Right Whale	*Eubalaena glacialis*	Western Atlantic	368	Continental shelf and coastal waters	Common	Year-Round[4]	MMPA–strategic; ESA Endangered	Endangered

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status	Virginia Threatened and Endangered Population Status
Sirenia (Sea Cows)								
Trichechidae (Manatees)								
West Indian Manatee	*Trichechus manatus*	Florida	4,834	Coastal, bays, estuaries, and inlets	Extralimital	Variable	MMPA–strategic; ESA Threatened	Endangered
Pinnipeds (Eared and Earless Seals)								
Phocidae (Earless Seals)								
Gray Seal	*Halichoerus grypus*	Western North Atlantic	27,300	Coastal, bays, estuaries, and inlets	Uncommon	Fall/Winter/Spring	MMPA–non-strategic	–
Harbor Seal	*Phoca vitulina*	Western North Atlantic	61,336	Coastal, bays, estuaries, and inlets	Common	Fall/Winter/Spring	MMPA–non-strategic	–
Harp Seal	*Pagophilus groenlandicus*	Western North Atlantic	Unknown	Coastal, bays, estuaries, and inlets	Uncommon	Winter/Spring	MMPA–non-strategic	–
Hooded Seal	*Cystophora cristata*	Western North Atlantic	Unknown	Coastal, bays, estuaries, and inlets	Extralimital	Summer/Fall	MMPA–non-strategic	–

Sources: Hayes et al. 2019, 2020, 2021; NMFS 2021; Roberts et al. 2018, 2020; VDWR 2020.
Status denoted as (–) indicates no regulatory status for that species under federal or Virginia authority.
[1] Relative occurrence defined as:
Common: species sightings regularly documented, Project area within typical range of the species.
Uncommon: species sightings occasionally documented. Project area within typical range of the species.
Extralimital: few species sightings have been documented. Project area considered outside the typical range of the species.
[2] No best population estimate exists for the blue whale (*Balaenoptera musculus*); the minimum population estimate is presented here (Hayes et al. 2021).
[3] The humpback whale (*Megaptera novaeangliae*) was previously federally listed as endangered; however, based on the revised listing completed by NOAA Fisheries in 2016, the DPS of humpback whales that occurs along the East Coast of the U.S., the West Indies DPS, is no longer considered endangered or threatened. The Commonwealth of Virginia has retained the endangered state listing status for the humpback whale.
[4] NARWs have the potential to occur in the Project area year-round; the overall likelihood of occurrence is highest during the late winter and early spring.

All marine mammal species are protected under the Marine Mammal Protection Act of 1972, as amended in 1994 (MMPA 1972). Of the 38 species known to occur in the Project area year-round, seasonally, or incidentally, 6 species are listed under the ESA; these are the sperm whale (*Physeter macrocephalus*), NARW, fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), and West Indian manatee (*Trichechus manatus*). Generally, the ESA-listed whale species are migratory and, as such, were historically thought to be present seasonally. However, they are increasingly seen throughout the summer and fall months while foraging and in the winter while migrating to warmer waters. Additionally, some individuals from the larger whale species are known to remain year-round (Salisbury et al. 2016, 2018).

North Atlantic right whales have the potential to occur in the Project area year-round. The relative abundance and density of the NARW peaks in late winter along the nearshore portions of the continental shelf, declines in spring, and is lowest during summer and fall, according to predictive density mapping based on long-term survey data (Roberts et al. 2022; Tetra Tech 2022). Fin whales are present year-round throughout Virginia's offshore waters, especially along the continental slope (NOAA Fisheries 2020). Likelihood of occurrence begins to increase in winter, peaks in spring and early summer, and declines in fall (Roberts et al. 2022; OBIS 2020). Using the definitions of occurrence from Table 3.15-1; fin whales are expected to be common year-round with higher likelihood for encounters during winter and spring, particularly along the eastern portion of the Lease Area (COP, Figure 4.2-24; Dominion Energy 2022). The relative abundance and density of humpback whales peaks in early spring along the continental slope, declines in summer, and is lowest in fall and early winter, according to predictive density mapping based on long-term survey data (Roberts et al. 2018; COP, Figure 4.2-27; Dominion Energy 2022). In general, sperm, blue, and sei whales are more pelagic and/or northern species, and their presence in the Project area is unlikely (Waring et al. 2007, 2009, 2012, 2013).

Dolphins, especially some bottlenose (*Tursiops truncatus*) stocks, are known to be resident in Virginia coastal regions (Gubbins 2002). The West Indian manatee has been infrequently sighted in Virginia waters and is considered a transient in the region. Despite a general and historical preference for colder northern waters, there is now regular seasonal occurrence of seals, including harbor seals (*Phoca vitulina*) and gray seals (*Halichoerus grypus*), between fall and spring in the geographic analysis area (Navy Marine Species Monitoring 2018). Harbor seals are the predominantly observed pinniped species. Species that are not expected to occur in this area are not considered further in this EIS. A comprehensive description of marine mammal species present in the geographic analysis area may be found in Section 4.2.5.1 of the COP (Dominion Energy 2022) and Section 3.2.6.1 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment* (BOEM 2015).

Critical habitat is designated for both the NARW and West Indian manatee; however, no critical habitat is located in the geographic analysis area. The offshore waters of Virginia, including waters in and near the Project area, are used as a migration corridor for North Atlantic right whales and are considered a Biologically Important Area for migrations between their feeding grounds off the Northeast United States and calving grounds off the Southeast United States (LaBrecque et al. 2015).

3.15.2 Environmental Consequences

3.15.2.1 Impact Level Definitions for Marine Mammals

Definitions of potential impact levels for adverse effects are provided in Table 3.15-2 and for intensity, extent, and reversibility are provided in Table 3.15-3. Definitions for duration and significance criteria are provided in Section 3.3. Beneficial impacts are also described, as applicable, for each IPF. Beneficial impacts are those that result in a positive effect on marine mammals. Impact levels are intended to serve NEPA purposes only and they are not intended to incorporate similar terms of art used in other statutory or regulatory reviews. For example, the term “negligible” is used for NEPA purposes as defined here and is not necessarily intended to indicate a negligible impact or effect under the MMPA. Similarly, the use of “detectable” or “measurable” in the NEPA significance criteria is not necessarily intended to indicate whether an effect is “insignificant” or “adverse” for purposes of ESA Section 7 consultation.

Table 3.15-2 Impact Level Definitions for Marine Mammals

Impact Level	Impact Type	Definition
Negligible	Adverse	The impacts on individual marine mammals or their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.
	Beneficial	Impacts on species or habitat would be beneficial but so small as to be unmeasurable.
Minor	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals or their habitat would not lead to population-level effects.
	Beneficial	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals or their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.
	Beneficial	Beneficial impacts on species would not result in population-level effects. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of severe intensity, can be long lasting or permanent, and would be extensive. Impacts on individuals and their habitat would have severe population-level effects and compromise the viability of the species.
	Beneficial	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

Table 3.15-3 Criteria Used to Characterize Impact Level Definitions for Marine Mammals

Criteria	Description	Definition
Intensity	Expected size or severity of the impact	**Low**: Project is likely to result in one or more of the following: • Localized alteration of habitat including exceedances of underwater noise Level B harassment (behavioral or temporary threshold shift [TTS]) thresholds • Temporary disruption of critical activities (e.g., breeding, nursing) or localized damage to sensitive or critical habitats **Medium**: Project is likely to result in one or more of the following: • Localized alteration of habitat including exceedances of underwater noise Level A harassment (personal threshold shift [PTS]) thresholds and non-auditory injury thresholds for explosions • One or more death or injury of a non-listed population • Regular disruption of critical activities (e.g., foraging, breeding or nursing grounds) or localized damage to sensitive or critical habitats **Severe**: Project is likely to result in one or more of the following: • Widespread degradation of habitat in excess of underwater noise thresholds (both Level A and Level B harassment) as well as non-auditory mortality thresholds for explosions • One or more death or injury of a species at risk • Extensive disruption of critical activities (e.g., foraging, breeding or nursing grounds) or damage to sensitive or critical habitats
Geographic Extent	Spatial scale over which the impact is expected to occur	**Localized**: Effects confined to the Offshore Project area (WTGs and their foundations, OSSs and their foundations, scour protection for foundations, inter-array and substation interconnection cables, and offshore export cables) and vessel transit routes. **Extensive**: Effect extends beyond the localized area and into the greater geographic analysis area.
Frequency	How often the activity causing the effect is expected to occur	**Infrequent**: Effect occurs once or rarely (less than once per year) over the specified duration of the Project. **Frequent**: Effect occurs repeatedly (monthly to yearly) over the specified duration of the Project. **Continuous**: Effect occurs continuously (weekly or more frequently) over the specified duration of the Project.
Likelihood	The probability of the effect caused by the impacts to occur	**Low**: Past experience and professional judgment indicate that the effect is unlikely but could occur. **Moderate**: Past experience and professional judgment indicate that there is a moderate likelihood that the effect could occur **High**: Past experience and professional judgment indicate that the effect is likely to occur.

3.15.3 Impacts of the No Action Alternative on Marine Mammals

When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of ongoing non-offshore wind activities and other offshore activities on the baseline conditions for marine mammals. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.15.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for marine mammals described in Section 3.15.1, *Description of the Affected Environment for Marine Mammals*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals are generally associated with vessel traffic. Marine mammals in the geographic analysis area are currently subject to a variety of ongoing human-caused IPFs. The main known contributors to mortality events include collisions with vessels (ship strikes), entanglement with fishing gear, and fisheries bycatch. Other important IPFs considered include underwater noise from anthropogenic sources, disturbance of marine and coastal environments, disturbance of benthic habitats, accidental and intentional release of hazardous substances, and climate change. Impacts associated with climate change have the potential to reduce reproductive success, increase individual mortality and disease occurrence, and affect the distribution and abundance of prey resources due to changing water temperatures, ocean currents, and increased acidity (as outlined in BOEM 2019). Climate-related impacts, as well as vessel strike and fisheries interactions, could have population-level implications for some at-risk species. Many marine mammal migrations cover long distances, and these factors individually and in combination can have impacts on individuals over broad geographical and temporal scales. IPFs with the greatest potential impact on marine mammals (i.e., vessel strike and fisheries interactions) within the geographic analysis area are briefly discussed below.

Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and have been identified as one of the primary causes of death to NARWs and humpback whales during the current and ongoing Unusual Mortality Events for both species (NOAA Fisheries 2022a, 2022b). For NARW specifically, there have been a total of 11 mortalities, 2 serious injuries, and 1 sublethal injury documented since the Unusual Mortality Event was declared in 2017 that have been attributed to vessel strikes (NOAA Fisheries 2022a). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world (Schoeman et al. 2020). Vessel speed and size are important factors for determining the probability and severity of vessel strikes. Vessels more than 262 feet (80 meters) in length are more likely to cause lethal or severe injury to large whales (Laist et al. 2001). Vanderlaan and Taggart (2007) reported that the probability of whale mortality increased with vessel speed, with greatest increases occurring between 8.6 and 15 knots, and that the probability of death declined by 50 percent at speeds less than 11.8 knots. As a result of these findings, NMFS implemented a seasonal, mandatory vessel speed rule in certain areas along the U.S. East Coast in 2008 to reduce the risk of vessel collisions with NARWs. Seasonal Management Areas require vessels 65 feet (19.8 meters) or larger to maintain speeds of 10 knots or less and to avoid Seasonal Management Areas when possible. Additional voluntary 10-knot speed restrictions are implemented for areas with aggregating NARWs outside of established Seasonal Management Areas in the form of Dynamic Management Areas and Slow Zones.

Fisheries interactions can have adverse effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands of individuals each year (Read et al. 2006; Reeves et al. 2013; Thomas et al. 2016). Entanglement in fishing gear is listed as a threat to humpback whales, NARWs, blue whales, fin whales, sei whales, common bottlenose dolphins, and gray seals (Hayes et al. 2020, 2021; NMFS 2021). There is limited information regarding entanglements of blue, fin, sei, and minke whales; however, evidence of fishery interactions causing injury or mortality has been noted for each of these species in the Greater Atlantic Regional Fisheries Office/NMFS entanglement/stranding database (Hayes et al. 2021; NMFS 2021). Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species' recovery (Knowlton et al. 2012; NOAA Fisheries 2022a). Since the Unusual Morality Event was declared for NARW in 2017, 56 of the 91 mortalities, serious injuries, and sublethal injuries documented have been attributed to entanglements (NOAA Fisheries 2022a). Marine mammals can also ingest or become entangled in marine debris (e.g., ropes, plastic) that is lost (i.e., ghost gear) from fishing vessels and other offshore activities. In the Atlantic, bycatch occurs in various gillnet and trawl fisheries off the Mid-Atlantic Coast, with hotspots driven by marine mammal density and fishing intensity (Benaka et al. 2019; Lewison 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, which allows them to be taken up in fishing gear. Additionally, bottom trawling and benthic disruption have the potential to result in impacts on prey availability and distribution.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include:

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

Ongoing O&M of the Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect marine mammals through the primary IPF of vessel traffic. Ongoing offshore wind activities would have the same types of impacts from noise, emplacement and maintenance of cables, and presence of structures that are described in detail in Section 3.15.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.15.3.2 Cumulative Impacts of the No Action Alternative

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

Planned non-offshore wind activities that may affect marine mammals include new submarine cables and pipelines, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar), marine transportation, biological and oceanographic research initiatives, and installation of new structures on the U.S. Continental Shelf (see Appendix F, Section F.2 for a description of ongoing and planned activities). These activities could result in temporary or permanent displacement and injury to or mortality of individual marine mammals.

BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **moderate** impacts on marine mammal species, primarily driven by vessel traffic and ship strike risk, entanglement with fishing gear, anthropogenic noise, and climate change; these IPFs will likely result in impacts that are detectable and measurable, though populations are expected to sufficiently recover for species with annual mortality and serious injury below their respective potential biological removal value. Given the life history, current stock status, and estimated potential biological removal of 0.7 for the NARW, ongoing threats such as vessel strike and fishing gear entanglement can elevate collective impacts from ongoing activities and reasonably foreseeable activities other than offshore wind to **major** levels because a measurable impact is anticipated that could have population-level effects and compromise the viability of the species. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area.

BOEM expects future offshore wind activities to affect marine mammals through the following primary IPFs.

Accidental releases: Future offshore wind activities on the OCS could result in the accidental release of trash or contaminants associated primarily as related to vessel activity during Project construction (see

Section 3.21, *Water Quality*, for quantities and details). The inadvertent releases would contribute to the existing hazard posed by chronic marine pollution and debris. Entanglement in or ingestion of marine debris is a significant source of human-caused mortality in marine mammals. For example, ingested debris was documented in up to 22 percent of beached marine mammal carcasses. Autopsies identified blockage of the digestive tract, injury, and malnutrition caused by ingested debris as the likely cause of mortality (Baulch and Perry 2014). Approximately 50 percent of marine mammal species worldwide have been documented ingesting marine litter (Werner et al. 2016). However, it is difficult to link physiological effects on individuals to population-level impacts (Browne et al. 2015).

Vessels associated with future offshore activities could generate exhaust and could be a source of potential accidental spills of petroleum-based toxics. Marine mammals that occur in the analysis area could be exposed to these contaminants. Inhalation of fumes from oil spills can result in mortality or sublethal effects on individual fitness, including adrenal effects, hematological effects, liver effects, lung disease, poor body condition, skin lesions, and several other health effects (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species. However, the likely number of additional releases associated with future offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities. Although these effects are acknowledged, the likelihood of adverse population-level impacts on marine mammals from accidental releases of debris or contaminants from future activities on the OCS is low.

Current regulations and requirements imposed on federally approved activities prohibit vessels from dumping potentially harmful debris, require measures to avoid and minimize spills of toxic materials, and provide mechanisms for spill reporting and response. Based on these factors, accidental releases and discharges from federally approved activities on the OCS are not expected to appreciably contribute to adverse marine mammal impacts.

Electromagnetic fields: Marine mammals appear to detect EMF intensity as low as 50 milligauss (Kirschvink 1990; Normandeau et al. 2011); however, scientific evidence is limited. As such, marine mammals may be sensitive to minor changes in EMFs (Walker et al. 2003). There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs, including a temporary change in swim direction following exposure to EMFs (Gill et al. 2005). These effects are more likely with exposure to high-voltage direct-current (HVDC) cables versus HVAC cables (Normandeau et al. 2011). Submarine power cables, which produce EMFs in the immediate vicinity of each cable during operations, would be installed with appropriate shielding and burial depth to reduce potential EMFs at the surface. Submarine cables typically maintain a minimum separation of at least 330 feet (101 meters) to avoid inadvertent damage to existing infrastructure during installation. This separation distance ensures that there are no additive EMF effects from adjacent cables. Additionally, exposure to submarine cable EMFs would be limited to extremely small portions of the areas used by migrating marine mammals. Therefore, EMF exposure is anticipated to be low, and impacts such as changes in swimming direction and altered migration routes would not be biologically notable.

New cable emplacement/maintenance: Future offshore wind projects could disturb over 177,718[1] acres (719 square kilometers) of seabed while installing associated undersea cables, causing an increase in suspended sediment (Appendix F, Table F2-2). Typical activities associated with cable installation that

[1] Kitty Hawk South has 3 export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Carolina) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-mile-wide corridor to Virginia and 1,000-mile-wide corridors to North Carolina to allow for optimal routing of the cables.

have variable potential to increase suspended sediment in the water column include jet trenching, cable ploughs, and dredging operations, including use of a trailing hopper suction dredge. Local site conditions, including seabed type and local currents and wave conditions, can also affect the volume of seabed sediment disturbed and brought into suspension (BEER 2008). These disturbances would be localized in extent, limited in magnitude, and short term. Data describing behavioral responses of marine mammals to localized turbidity plumes are limited, but available information suggests that most species would be insensitive to the associated changes in visibility. For example, visual impairment does not appear to negatively affect the ability of gray and harbor seals to forage and move effectively (McConnell et al. 1999; Newby et al. 1970; Todd et al. 2015). Behavioral responses and impacts related to increased turbidity are expected to be temporary and short term.

Research on the total suspended solids (TSS) sensitivity of other marine mammal species such as dolphins and large whales is generally lacking. However, these species have developed echolocation for communicating, foraging, and navigating by evolving in an environment with variable and predominantly low visibility (Tyack and Miller 2002). This suggests that temporary reduction in visibility would not drastically impair behavior. Even if marine mammals were to alter their behavior in response to elevated TSS (e.g., by avoiding the disturbance and/or interrupting foraging), any potential exposures would be localized in extent, limited in magnitude, short term, and therefore unlikely to result in biologically notable effects. Implementation of standard mitigation measures, such as minimum separation distances, would further reduce effects on marine mammals. Although marine mammal entrainment during dredging activities is not expected, these mitigation measures would further reduce the potential risk to marine mammals. Therefore, the anticipated effects of construction-related seabed disturbance on marine mammals would be minor and no population-level effects would be expected.

Noise: Cetaceans rely heavily on acoustics for communication, foraging, mating, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007). Offshore wind activities may negatively affect marine mammals if the sound frequencies produced overlap with the functional hearing range of the animal exposed (NSF and USGS 2011). To account for differences in hearing among species, Southall et al. (2007) grouped marine mammals into five generalized hearing groups (low-frequency cetaceans [LFC], mid-frequency cetaceans [MFC], high-frequency cetaceans [HFC], phocid pinnipeds in water [PPW], and otariid pinnipeds in water [OW]) which have been adopted by NMFS for the purposes of assessing impacts from underwater noise. No species from the OW hearing group (i.e., eared seals) are expected to occur in the Project area, and these species are not discussed further. A summary of estimated hearing ranges for marine mammal hearing groups from NMFS (2018) is provided in Table 3.15-4.

Noise exposure can cause responses ranging from low-level behavioral effects and interference with communication, foraging, mating, predator avoidance, and navigation to temporary hearing impairment (Madsen et al. 2006; Weilgart 2007; Southall et al. 2019) to auditory injury such as PTS or TTS (Southall et al. 2019). The type of effect will depend on the type of noise, the noise level to which an animal is exposed, and the duration of the exposure. Sources of anthropogenic noise can generally be categorized in two ways; impulsive noise which is characterized by an instantaneous and rapid increase in sound pressure over a short period of time; and non-impulsive noise which does not have the characteristic rapid rise in sound pressure seen in impulsive sources. Noise can also be characterized as intermittent or continuous depending on how often noise is generated over time. Both types of noise may be produced by activities related to future offshore wind projects. Acoustic thresholds, which represent the minimal sound level at which the onset of a particular effect may occur, are available for both impulsive and non-impulsive noise and each marine mammal hearing group from NMFS (2018), as provided in Table 3.15-5. Animals are less likely to respond to sound levels when distant from a source, even when those levels elicit responses at closer ranges; therefore, both proximity and received levels are important factors when evaluating animal responses (Dunlop et al. 2017).

The most notable impulsive noise source associated with offshore wind development projects is impulse pile driving used during construction. A typical foundation pile installation generates 4 to 6 hours of underwater noise at intensities that may meet or exceed marine mammal acoustic thresholds for some species. Depending on their distribution in relation to construction activities, the duration of the exposure and potential for repeated exposures would be variable. An individual may be exposed anywhere from a single pile installation to intermittent noise over a period of weeks if an individual is migrating over the larger geographic analysis area. The probability and extent of potential impacts are situational and dependent on several factors which influence noise propagation in an individual project area. Neighboring projects could conduct concurrent pile driving (Appendix F, *Planned Activities Scenario*, Tables F2-1 and F2-2), but this will not necessarily result in an additive effect in which above-threshold sounds are propagated over greater distances. Non-concurrent pile driving that occurs across projects in the geographic analysis area within the same year could result in individuals being exposed to pile driving noise over multiple days, but it is likely there would be silent periods in between piling activity that would help marine mammals recover from any potential impacts. BOEM assumes that future COP approvals will include project-specific mitigation and monitoring measures developed through NEPA, ESA consultations, and ITAs that will be implemented by each future project designed to avoid exposure of individuals to injurious levels of noise and minimize and monitor impacts that would result in behavioral responses. These measures may include, but are not limited to, seasonal restrictions, specifically in avoidance of times with high NARW abundance; protected species observers (PSO) to visually monitor the vessel strike, pre-clearance, and exclusion zones; passive acoustic monitoring (PAM) to acoustically detect the presence of marine mammals; pre-clearance monitoring to ensure marine mammals are not present within an established radii prior to the startup of noise-generating equipment; and the establishment of exclusion zones in which sound sources and other noise-generating activities would be shut down when marine mammals are present. These mitigation measures are designed to ensure that activities that cause auditory injury such as PTS are not initiated or are stopped when marine mammal are present. Potential impacts, therefore, are more likely to be limited to behavioral disturbances which are not expected have permanent population-level impacts for any marine mammal species.

Both impulsive and non-impulsive intermittent sound sources are used during HRG survey activities to conduct pre-, during-, and post-construction site characterization surveys. Some HRG survey equipment (e.g., boomers, sparkers) can produce high-intensity impulsive noise, while other survey equipment (e.g., compressed high-intensity radiated pulse [CHIRP] sonar) produce lower intensity noise without the characteristic rise in pressure (Crocker and Frantantonio 2016; Crocker et al. 2019). A full list of the types of equipment and their specifications that are typically used for offshore wind development projects is provided in the *Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf* (Baker and Howsen 2021). Due to the equipment operating frequencies, deployment configuration, beam patterns, and relatively low source levels (Baker and Howsen 2021), individual marine mammals would have to be unrealistically positioned close to the sound source for extended periods of time in order to be exposed to noise of sufficient intensity to cause TTS or PTS, which is considered unlikely. BOEM requires applicants to develop mitigation plans to protect marine mammals from noise exposure during HRG surveys such as the implementation of clearance and exclusion zones, the use of PSOs, and equipment shutdown protocols, which would further minimize exposure risk. Impacts, therefore, would be limited to short-term behavioral disturbances with no population-level impacts expected.

Table 3.15-4 Estimated Hearing Ranges for Marine Mammal Hearing Groups

Marine Mammal Hearing Group	Estimated Hearing Range	Representative Species
Low-frequency cetaceans	7 hertz to 35 kilohertz	Baleen whales (e.g., fin whale, sei whale, NARW, minke whale [*B. acutorostrata*], humpback whale)
Mid-frequency cetaceans	150 hertz to 160 kilohertz	Dolphins (e.g., Atlantic spotted dolphin [*Stenella frontalis*], Atlantic white-sided dolphin [*Lagenorhynchus acutus*], common dolphin [*Delphinus delphis*], Risso's dolphin [*Grampus griseus*], common bottlenose dolphin) and toothed whales (e.g., sperm whale, long-finned pilot whale [*Globicephala melas*])
High-frequency cetaceans	275 hertz to 160 kilohertz	True porpoises (e.g., harbor porpoise [*Phocoena phocoena*])
Phocid pinnipeds in water	50 hertz to 86 kilohertz	True seals (e.g., harbor seal [*Phoca vitulina*], gray seal [*Halichoerus grypus*])

Source: NMFS 2018.

Table 3.15-5 Acoustic Thresholds for Marine Mammal Hearing Groups for Impulsive and Non-Impulsive Anthropogenic Noise Sources

Marine Mammal Hearing Group	Impulsive Noise Sources		Non-Impulsive Noise Sources	
	PTS	Behavioral Disturbance	PTS	Behavioral Disturbance
Low-frequency cetaceans	$L_{E,24hr}$: 183 dB re 1 μPa^2 s $L_{p,pk}$: 219 dB re 1 μPa	L_P: 160 dB re 1 μPa	$L_{E,24hr}$: 199 dB re 1 μPa^2 s	Intermittent Sources: L_P 160 dB re 1 μPa Continuous Sources: L_P 120 dB re 1 μPa
Mid-frequency cetaceans	$L_{E,24hr}$: 185 dB re 1 μPa^2 s $L_{p,pk}$: 230 dB re 1 μPa		$L_{E,24hr}$: 198 dB re 1 μPa^2 s	
High-frequency cetaceans	$L_{E,24hr}$: 155 dB re 1 μPa^2 s $L_{p,pk}$: 202 dB re 1 μPa		$L_{E,24hr}$: 173 dB re 1 μPa^2 s	
Phocid pinnipeds in water	$L_{E,24hr}$: 185 dB re 1 μPa^2 s $L_{p,pk}$: 218 dB re 1 μPa		$L_{E,24hr}$: 201 dB re 1 μPa^2 s	

Source: NMFS 2018.
μPa = micropascal; dB = decibel; $L_{p,pk}$ = peak sound pressure level; $L_{E,24hr}$ = sound exposure level over 24 hours; L_P = root-mean-square sound pressure level; PTS = permanent threshold shift.

Other non-impulsive sources of noise in the geographic analysis area from future offshore wind projects include helicopters and fixed-wing aircraft, construction and operations and maintenance vessels, vibratory pile driving during construction, and operational WTG noise during operations and maintenance. Aircrafts may be used during initial site surveys, protected species monitoring prior to and during construction, and facility monitoring. Noise and disturbance associated with aircraft operations may result in temporary behavioral responses such as reduced surfacing duration, abrupt dives, and alarm reactions (Patenaude et al. 2002). However, these effects have been observed when aircrafts were flying below approximately 984 feet (300 meters) above the sea surface, and all aircraft associated with offshore wind projects would be expected to operate at greater altitudes except when flying low to inspect WTGs or to take off and land on service vessels. Therefore, no biologically notable adverse effects are expected for marine mammals from aircraft operations.

Vibratory pile driving may be used for any pile (e.g., goal posts, cofferdams, foundations) prior to impact pile driving to reduce the risk of pile run for some offshore wind projects, export cable installations, and port facility construction. The precursory vibratory pile driving used for impact-driven goal posts and WTG or OSS foundations would occur between 30 and 120 minutes to set the pile prior to impact pile driving. Vibratory pile-driving noise may exceed the behavioral disturbance threshold for continuous sound sources of 120 dB referenced to 1 micropascal (Table 3.15-5) hundreds to thousands of feet from the source (Illingworth and Rodkin 2017). While vibratory pile-driving noise may exceed the behavioral threshold for marine mammals at large distances, this threshold is not frequency weighted to account for differences in hearing among marine mammal species and represents the lowest sound level at which there is a 50 percent probability of an individual responding to a noise. Vibratory piling noise will represent an increase in noise over large distances but for very short, discrete time periods. There are very few behavioral studies describing responses of marine mammals to vibratory piling noise. Observations reported by Bransetter et al. (2018) indicated that bottlenose dolphins became distracted and less interested in performing tasks during vibratory piling playback experiments. Bottlenose dolphins and harbor porpoises studied by Graham et al. (2017) showed a lower probability of occurrence during vibratory piling. Exposure to noise above a regulatory threshold alone does not necessarily elicit or equate to a behavioral response or biological consequence that would affect the viability of a population. There is no indication from available studies (Graham et al. 2017) that marine mammals will be completely displaced by vibratory piling; however, localized behavioral responses including areal avoidance can be expected. Long-term avoidance of regions where vibratory pile driving activities may occur within the marine mammal geographic analysis area is not expected to occur given the short duration of activities. Impacts would be limited to short-term behavioral disturbances with no population-level impacts expected.

Construction and operational vessels are the most broadly distributed source of non-impulsive noise associated with offshore wind projects. Marine mammal exposure to underwater vessel noise would incrementally increase as a result of future offshore wind projects, especially during construction periods (South Fork Wind 2021). Applying vessel activity estimates developed by BOEM (2019b), vessel activity could peak in 2025, with as many as 207 vessels involved in the construction of expected future wind energy projects. However, this increase must be considered relative to the baseline level of vessel traffic in the geographic analysis area (Appendix F, Table F1-14). Impacts from vessel noise on marine mammals can include behavioral responses or masking wherein the effective range over which marine mammals send out and detect acoustic signals in their environment is reduced by vessel noise (Jensen et al. 2009). The increased vessel traffic related to offshore wind projects would be expected to result in localized, intermittent, and short-term impacts on marine mammals that would dissipate once the vessels have ceased operations. Therefore, impacts on marine mammals would be limited to short-term behavioral disturbances, and no population-level impacts are expected.

No notable effects on marine mammals are anticipated from noise produced by WTG operation. Marine mammals would be able to hear the continuous underwater noise of operational WTGs. Recordings have been made of operational WTGs producing low-frequency (<500 Hz) noise with broadband SPLs ranging from 92 to 137 dB referenced to 1 micropascal at distances of 65 to 656 feet (20 to 200 meters) from the source (Tougaard et al. 2020). SPLs produced by operational WTGs vary based on the WTG type, wind speed, and location, with data showing an increase in SPLs with increasing WTG size and wind speed. Because the WTGs proposed for future offshore wind projects are larger than those previously measured, operational noise could be higher than the smaller WTG measured and would exceed ambient noise levels at greater distances from the source. Additionally, Tougaard et al. (2020) showed that the overall source level of an operational wind farm may increase with the overall number of turbines. However, the analyses conducted by Tougaard et al. (2020) showed that sound levels produced by individual WTGs were comparable to or lower than sound levels within 0.6 mile (1 kilometer) of commercial vessel noise. Additionally, this increased source level would never be realized within the wind farm because there is no point that represents 3.3 feet (1 meter) from all operating WTGs, so the noise level an animal experiences would be that produced by one or two WTGs (Tougaard et al. 2020). Along with WTG size and wind speed, Stöber and Thomsen (2021) indicate that the type of WTG also influences the noise levels produced, as measurements of WTGs using gear boxes were higher than those using direct drive technology, which are likely to be used in future offshore wind projects. Studies also suggest some marine mammal species may use the wind farm for foraging following prey species that are attracted to the foundations (Scheidat et al. 2011; Russell et al. 2014); thus, marine mammals are not expected to avoid the area while WTGs are operating. Therefore, though noise from operational WTGs may exceed ambient noise levels within a project area depending on the region, WTG noise is not expected to exceed noise levels produced by commercial vessel traffic, and no biologically notable impacts that would affect the viability of any populations are expected.

Port utilization: Global shipping traffic increased fourfold between 1992 and 2012 (Tournadre 2014). Growth worldwide is expected to continue, including on the U.S. OCS. Increases in global shipping traffic and expected increases in port activity along the East Coast will require port modifications to receive the increase in shipping traffic and increased ship size. However, future offshore wind development is expected to be a minor component of port expansion activities required to meet increased commercial, industrial, and recreational demand. Any port expansions required for reasonably foreseeable projects could increase the total amount of disturbed benthic habitat, potentially resulting in impacts on some marine mammal prey species. Increases in port utilization due to other offshore wind energy projects would also lead to increases in vessel traffic and associated risk of vessel strike (see *Traffic* IPF below). This increase would be at its peak during construction activities and would decrease during operations but would increase again during conceptual decommissioning.

Gear utilization (biological/fisheries monitoring surveys): Future offshore wind projects are likely to include plans that monitor biological resources in and nearby associated project areas throughout various stages of development. These could include acoustic, trawl, and trap surveys, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect marine mammals by entrapment or entanglement; however, it is expected that monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts. Potential impacts from gear utilization from planned offshore wind activities on marine mammals are likely to be negligible and are expected to occur at short-term, regular intervals over the lifetime of the projects and to have no perceptible consequences to individuals or the population. However, the potential extent and number of animals potentially exposed cannot be determined without project-specific information.

Presence of structures: Over 3,287 structures (WTGs, and OSSs) could be constructed in the geographic analysis area (Appendix F, Table F-3). The presence of structures can lead to impacts, both beneficial and adverse, on marine mammals through localized changes to hydrodynamic disturbance, prey aggregation, and associated increase in foraging opportunities, entanglement and gear loss/damage, migration disturbances, and displacement. These impacts may arise from buoys, met towers, foundations, scour/cable protections, and transmission cable infrastructure during any stage of a project. BOEM anticipates that structures would be added intermittently from 2023 through 2030 and that they would remain until conceptual decommissioning of each facility is complete, approximately 33 years following construction (Appendix F, Table F-3). The addition of over 3,287 new offshore structures in the geographic analysis area alter circulation and stratification down current from the structures, potentially altering oceanographic conditions such as circulation, mixing, and productivity, at the local scale. These effects on the oceanographic conditions around the offshore structures could influence the distribution, abundance, and biomass of zooplankton communities (Wang et al. 2017), which represent important prey for many baleen whale species such as NARWs. The presence of many wind turbine structures could affect oceanographic and atmospheric conditions by reducing wind-forced mixing of surface waters and increasing vertical mixing of water forced by currents flowing around foundations (Carpenter et al. 2016; Schultze et al. 2020; van Berkel et al. 2020). The presence of the wind turbines themselves could also affect wind speeds and heat fluxes above the water surface, which could affect underwater, wind-driven currents, mixing, and upwelling/downwelling events (Golbazi et al. 2022; Raghukumar et al. 2022). During times of stratification (summer), changes to atmospheric conditions could result in oceanographic conditions more similar to fall or winter conditions (Golbazi et al. 2022), and subsequent increased mixing due the presence of structures could alter marine ecosystem processes by possibly increasing pelagic primary productivity in local areas (Degraer et al. 2020; English et al. 2017; Kellison and Sedberry 1998). One influence of the presence of wind turbines that has been documented is the reduction of wind speed at the surface downstream from the windfarm, which can lead to further decreases in horizontal and vertical mixing, and may extend tens of kilometers around the windfarm affecting temperature and salinity distributions and ultimately local primary productivity (Christiansen et al. 2022; Golbazi et al. 2022). Increases in surface wind speed in the areas adjacent to the wake have also been noted in response to the presence of wind turbines (Golbazi et al. 2022; Raghukumar et al. 2022), which would affect prey species such as zooplankton that are unable to swim against strong ocean currents. Additionally, wind wakes from multiple adjacent wind farms could combine into one large wake depending on the location of the turbines and the prevailing wind patterns of the region, which would increase the size of the wake and the areas experiencing wind speed changes (Golbazi et al. 2022). However, the hub height of the turbine has been shown to influence the scale of the atmospheric changes at the sea surface, as turbines with greater hub heights are expected to have a less substantial effect on the atmospheric conditions at the sea surface (Golbazi et al. 2022).

Wang et al. (2017) determined that changes in nitrate concentrations, suspended solid concentrations, and phytoplankton abundance following construction of offshore wind farms were significantly correlated with zooplankton abundance at an established wind farm in China. Following construction, Wang et al. (2017) noted an increase in the abundance of phytoplankton likely due to the increased nutrient and suspended sediment concentrations, which would benefit zooplankton species that forage on phytoplankton, such as copepods. However, increased concentrations of suspended sediments could also negatively affect zooplankton species by reducing their food intake and diluting their intestinal contents with matter that is not food, particularly for those species that are not able to selectively graze (Wang et al. 2017). It was also hypothesized that in response to increased suspended sediments the local zooplankton community may get smaller to help enact selective grazing and avoid the negative effects of suspended sediments on foraging success (Wang et al. 2017). While this study showed no significant difference in the abundance of zooplankton within the wind farm study site versus the control sites (Wang et al. 2017), changes in the size of available zooplankton would affect marine mammal species, as smaller prey would result in lower nutritional value and more energy needed to forage to make up for caloric losses.

The presence of offshore structures could increase marine mammal prey availability through creating new hard-bottom habitat, increasing pelagic productivity in local areas, or promoting fish aggregations at foundations (Bailey et al. 2014; Degraer et al. 2020). This would benefit species which feed on fish such as humpback whales, sperm whales, and dolphin species; however, changes in primary productivity might not translate into benefits for planktivorous baleen whales if the increased productivity is consumed by filter feeders, such as mussels, that colonize the surface of the structures (Degraer et al. 2020; Slavik et al. 2019). The ultimate effects on marine mammal prey species, and therefore marine mammals, of changes to oceanographic and atmospheric conditions caused by the presence of offshore structures are not able to be quantified at this time, and they are likely to vary seasonally and regionally.

The long-term presence of WTG structures could displace marine mammals from preferred habitats or alter movement patterns, potentially changing exposure to commercial and recreational fishing activity. The evidence for long-term displacement is unclear, varies by species, and is the subject of ongoing research (Kraus et al. 2016). Some level of displacement of marine mammals out of the lease areas into areas with a higher potential for interactions with ships or fishing gear during the construction phases of future offshore wind development may occur (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing* and Section 3.16, *Navigation and Vessel Traffic*). Additionally, some marine mammals may avoid the lease areas during all phases (construction, operations, and conceptual decommissioning) of the future offshore wind development.

Current data suggest seals (Russel et al. 2014) and harbor porpoises (Schiedat et al. 2011) may be attracted to future offshore wind development infrastructure, likely because of the foraging opportunities and shelter provided. The artificial reefs created by these structures form biological hotspots that could support species range shifts and expansions and changes in biological community structure (Degraer et al. 2020; Raoux et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind facilities could potentially generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for some marine mammal species. Overall, the anticipated artificial reef effect would be expected to result in beneficial effects on several groups of marine mammals due to increased prey availability. For example, Russel et al. (2014) found clear evidence that seals were attracted to a European wind farm, apparently attracted by the abundant concentrations of prey created by the presence of structures. However, the presence of structures may also indirectly concentrate recreational fishing around foundations, potentially increasing the risk of marine mammal entanglement.

The presence of structures could result in fishing vessel displacement, thereby shifting potential vessel strike exposure risk, or a shift in fishing gear types. If a shift from mobile gear to fixed gear occurs, there would be a potential increase in the number of vertical lines, resulting in an increased risk of marine mammal interactions with fishing gear. Discarded or lost commercial fishing nets may also become entangled around WTG foundations, which could further increase the potential for marine mammal entanglement leading to injury and mortality due to infection, starvation, or drowning (Moore and van de Hoop 2012). Entanglement in commercial fishing gear has been identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species recovery, with more than 80 percent of observed individuals showing evidence of at least one and 60 percent showing evidence of multiple entanglements (Knowlton et al. 2012). Additionally, literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace et al. 2021). Entanglement may also be responsible for high mortality rates in other large whale species (Read et al. 2006). The full extent and magnitude of potential impacts on marine mammals as a result of changes in commercial and recreational fishing activities is uncertain due to the lack of available long-term data. Mitigation measures include routine inspections of Project structures and surroundings to find and remove derelict fishing gear and debris and an emergency response plan for entangled marine mammals. This would reduce entanglement risk for marine mammals foraging around the foundations. Importantly these mitigation measures would provide a new mechanism for removing derelict gear from the environment, incrementally reducing entanglement risk for all marine mammal species in the analysis area.

The combined effects of the presence of wind farm structures on marine mammals are variable, difficult to predict, and may range from minorly adverse to minorly beneficial. Broadly speaking, any effects on marine mammal prey species are expected to be localized and seasonal (NMFS 2020). The conversion of soft bottom to hard structure habitat as a result of the presence of wind farm infrastructure could alter marine mammal behavior at local scales and could indirectly expose individuals to injury, though adverse, population-level impacts would not be expected for most species and would be further minimized by imposed monitoring and mitigation measures. Potential long-term, intermittent impacts would persist until conceptual decommissioning is complete and structures are removed.

Light: The addition of over 3,287 new offshore structures in the geographic analysis area with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Vessel-related lighting impacts would be localized and temporary; this could attract potential prey species to construction zones, potentially aggregating some marine mammal species (primarily odontocetes), exposing them to greater harm from other IPFs associated with construction, including an increased risk of collision with vessels. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities to marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented.

Traffic: Vessel traffic associated with future offshore wind development poses a collision risk to marine mammals, especially NARWs, other baleen whales, and calves that spend more time at and near the ocean surface. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs. The minimum rate of human-caused mortality and serious injury to right whales between 2013 and 2017 was estimated at 6.85 per year, with vessel strikes accounting for 1.3 mortalities per year (Hayes et al. 2020). Up to 75 percent of known anthropogenic mortalities of NARWs may result from collisions with large ships along the U.S. and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel or beneath the surface and not detectable by visual observers (Vanderlaan and Taggert 2007). Weather conditions (e.g., fog, rain, wave height) and nighttime operations also reduce marine mammal detectability, thus increasing the risk for vessel strike. Larger and faster moving vessels also increase the risk for vessel strike (Pace and Silber 2005; Vanderlaan and Taggart 2007). Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007), whereas serious injury is less likely to occur at speeds below 10 knots (Laist et al. 2001).

Offshore wind development will result in only a small incremental increase in vessel traffic volume relative to ongoing and future baseline activities, and no measurable overall impacts would be expected as result. In addition, the risk of marine mammal collisions is negligible for most wind farm construction activities. CSA Ocean Sciences Inc. (CSA) has worked with BOEM to develop an assessment tool to evaluate and visualize the risks of vessel strike risk across wind energy areas on the OCS of the Atlantic (Barkaszi et al. 2021). The primary focus of this tool is to assess the general risk of vessels associated with all stages of wind development moving to/from and within wind development areas (WDAs) in encountering large whale species dependent upon species density, typical behavior, and morphology relative to vessel class and speed.

Vessels working in the WDAs either remain stationary during turbine placement or are travelling slowly (i.e., at less than 10 knots) between turbine locations. Vessel speeds may increase when travelling between the WDAs and area ports unless voluntary or mandatory speed restrictions are in effect. Timing restrictions, use of PSOs, minimum separation distances, and other ship strike reduction measures required by BOEM and NMFS, detailed in project-specific COPs and permits, would further minimize the potential for fatal vessel interactions. These measures would effectively minimize but not completely avoid collision risk. Any incremental increase in risk must be considered relative to the baseline level of risk associated with existing vessel traffic. Project operations and maintenance would involve fewer vessels that are smaller in size, and the level of vessel activity would be far lower than during construction. Smaller vessels (i.e., less than 260 feet [79 meters] in length) pose a lower risk of fatal collisions than larger vessels (Laist et al. 2001). Offshore wind development could also alter commercial and recreation fishing activity, which may lead to increased interactions with marine mammals that are also temporarily displaced out of lease areas during construction.

Climate change: Global climate change is an ongoing risk to marine mammals. However, the associated impact mechanisms are complex, not fully understood, and difficult to predict with certainty. Several sub--IPFs related to climate change have the potential to impact marine mammals, which include increased storm severity and frequency; increased erosion and sediment deposition; ocean acidification; and altered habitat, ecology, and migration patterns. Climate change could potentially affect the incidence or prevalence of infection, the frequency or magnitude of epizootics, and/or the severity or presence of clinical disease in infected individuals (Burge et al. 2014). Over time climate change and coastal development would alter existing habitats, rendering some areas unsuitable for certain species and more suitable for others. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities related to climate change (Reygondeau and Beaugrand 2011; Meyer-Gutbrod et al. 2015). These long-term, high consequence impacts could include increased energetic costs associated with altered migration routes, reduction of suitable breeding and/or foraging habitat, and reduced individual fitness, particularly juveniles. However, future offshore wind development would not be expected to contribute to climate change impacts on marine mammals, and could result in a beneficial affect for marine mammals. See Section 3.4, *Air Quality*, for more details on the expected contribution of offshore wind to climate change.

3.15.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, marine mammals would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continued impacts on marine mammals, primarily through pile-driving noise, vessel noise, presence of structures, vessel traffic, commercial and recreational fisheries gear interactions, and climate change. BOEM anticipates that the range of impacts for ongoing non-offshore wind activities and other offshore activities would be **negligible** to **moderate** for most marine mammals as impacts would be detectable and measurable, but populations would be expected to recover sufficiently, except for NARW. Due to its life history, current stock status, and potential biological removal estimate (NMFS 2021), impacts from vessel traffic and fisheries gear interactions under the No Action Alternative would be **major** for NARW. Additionally, the presence of structures could potentially result in **minor beneficial** impacts on some marine mammal species.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and marine mammals would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on marine mammals due to increased offshore construction, presence of structures, and vessel traffic.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area would result in **moderate** to **major** adverse impacts primarily due to the presence of structures, pile-driving noise, increased vessel traffic, and fisheries gear interactions. Mitigation measures would help to reduce impacts on marine mammals**.** **Moderate** impacts are expected for most marine mammal species as detectable and measurable impacts could have population-level effects, but populations would be expected to sufficiently recover, with the exception of the NARW. Due to its life history and current stock status, impacts on NARWs resulting from all IPFs combined are expected to be **major** because a measurable impact is anticipated that could have population-level effects and compromise the viability of the species. While vessel activity will increase due to the planned offshore wind projects included in the Cumulative Impacts scenario compared to the No Action Alternative, the planning, monitoring, mitigation, and enforcement of vessel activity, including speed restrictions, will minimize the effects from increased vessel numbers or transits compared to non-offshore wind activities. Additional vessel speed rules may be implemented that could result in a lowered risk from ongoing activities under the No Action Alternative (87 *Federal Register* 46921); however, until those are in place and efficacy of enforcement is established, the assessment has assumed current conditions, which further supports the equal determination for marine mammals when vessel strike and gear entanglement are the largest drivers because the risk to marine mammals will not be substantially influenced by the number of planned offshore wind projects under the Cumulative Impacts scenario.

3.15.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Total number, size, and location of WTGs.
- Total number, size, and location of offshore substations.
- The installation method of the WTG and offshore substations.
- Total number, size, and location of inter-array and offshore export cables.
- Total days of pile driving and time of year during which construction occurs.
- Number and types of vessels and ports utilized.

Variability of the proposed Project design exists as outlined in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Below is a summary of potential variances in impacts.

- **Total number, size, and location of WTGs, OSSs, and inter-array and offshore export cables:** The level of hazard is proportional to the number of offshore structures and cables installed; fewer structures/cables would present less hazard to marine mammals.
- **Number and types of vessels and ports utilized:** The level of hazard is proportional to the number, size, and speed of vessels primarily during transit to and from ports of operation; fewer vessel travelling at slower speeds would present less hazard to marine mammals.
- **Season and duration of construction activities:** Marine mammals are present year-round, with species-variable seasonality. For example, NARWs are more likely to be present in the Offshore Project area during winter and spring but can occur year-round. Implementation of a mitigation or monitoring measure could have a measurable reduction in the potential effect of an IPF.

3.15.5 Impacts of the Proposed Action on Marine Mammals

The Proposed Action in this EIS considers both Alternatives A and A-1 as described in Section 2.1.2. These two alternatives are assessed together for the following IPFs because the only difference is that under Alternative A-1 the three OSSs proposed under Alternative A would be placed within the rows of the WTGs and take the place of three of the WTGs so there is not expected to be a substantial difference between the two alternatives regarding their potential effect on marine mammals.

Accidental Releases: The incremental impacts of the Proposed Action or Alternative A-1 from accidental releases of hazardous materials and trash/debris would not increase the risk beyond that described under the No Action Alternative and is expected to have a negligible impact on marine mammals. Further, the Proposed Action or Alternative A-1 would comply with USCG requirements for the prevention and control of oil and fuel spills and would implement proposed best management practices for waste management and mitigation as well as marine debris awareness training for Project personnel, reducing the likelihood of an accidental release. Dominion Energy would have an Oil Spill Response Plan (COP, Appendix Q; Dominion Energy 2022) in place that would decrease potential impacts in the unlikely event of a spill. In context of reasonably foreseeable environmental trends, combined impacts of accidental releases on marine mammals from ongoing and planned actions are expected to be temporary and highly localized due to the likely limited extent and duration of a release, resulting in negligible impacts.

EMFs: Normandeau et al. (2011) reviewed the potential effects of EMFs from offshore wind energy projects on marine mammals and other species. They concluded that marine mammals are unlikely to detect magnetic field intensities below 50 milligauss, suggesting that these species would be insensitive to EMF effects from Project electrical cables. Project-related EMFs would be below this threshold and, therefore, indistinguishable from natural variability in the analysis area, except in a few locations where the cable lies on the bed surface (COP, Appendix AA, Table 1; Dominion Energy 2022). The areas with potentially detectable EMFs would be small, extending only a few feet from the cable. Alternative A-1 would have slightly less inter-array cabling than the Proposed Action because three fewer WTGs would be constructed; however, EMFs produced under Alternative A-1 are not anticipated to be substantively different than the Proposed Action. The likelihood of marine mammals encountering those areas is low and the EMF levels over the majority of cable length are below detectable limits, therefore EMF effects on marine mammals would be negligible.

New cable emplacement/maintenance: Construction of the Project components would physically disturb the water column and seabed. However, the area affected at any given time would be minimal relative to the size of the area of direct effects and insignificant compared to current baseline levels of disturbance. Seabed disturbance during Project construction would result in temporary plumes of suspended sediments in the immediate construction area as a result of jet trenching, plowing, pre-trenching, mechanical trenching, and dredging (including maintenance dredging) operations. Chain cutting as a method for cable installation is not anticipated, but could be required if other installation methods are not possible due to soil conditions. Pre-lay grapnel runs are expected, though other seabed preparation activities (i.e., sandwave and boulder removal) are not anticipated. COP Table 3.3-4 provides a summary of the PDE for the inter-array cable design parameters and COP Table 3.3-8 provides specifications of the maximum design scenario for the offshore export cables (Dominion Energy 2022). While Alternative A-1 would require slightly less inter-array cables than the Proposed Action, impacts from water column and seabed disturbance for cable emplacement on marine mammals are anticipated to be the same. Minimal to no risk of entrainment by trailing hopper suction dredges is anticipated given the use of this dredge is unlikely. The risk for vessel strike exists, although this is anticipated to be inherently small due to the slow-moving speeds during cable laying activities. Additional vessel strike risk is detailed below under the *Vessel traffic* IPF. Mitigation measures as detailed in COP Table 4.2-36 (Dominion Energy 2022), such as the use of PSOs to monitor for the presence of marine mammal species in the vicinity of Project operations, minimum separation distances, and vessel strike avoidance measures, would further reduce the potential impact on marine mammals that may be in the vicinity of dredging or cable laying vessels.

BOEM anticipates short-term and localized water quality impacts from inter-array cable installation and undetectable negligible impacts on marine mammals from turbidity. Suspended sediment concentrations during activities other than dredging would be within the range of natural variability for this location. Any dredging necessary prior to cable installation could also generate additional impacts, though these are expected to be negligible and further minimized with the implementation of mitigation measures. Individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased sedimentation, and only non-measurable negligible impacts, if any, on individuals would be expected given the localized and temporary nature of the potential impacts.

Noise: A short-term increase in underwater noise is the most likely IPF that could affect marine mammals, predominantly from installation of the WTG and OSS foundations, cofferdams, and nearshore structures during Project construction. The Project PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations and OSS jacket foundations, as well as vibratory pile driving, which would be used to install the cofferdams and impact pile driving of the goal post piles (COP, Appendix Z; Dominion Energy 2022). All these activities have potential to produce noise above recommended marine mammal acoustic thresholds (Table 3.15-5). Unexploded ordinance (UXO) detonation is not anticipated and, therefore, is not considered further. Underwater acoustic modeling was conducted for the Project (COP, Appendix Z; Dominion Energy 2022) for impact and vibratory pile driving activities, and the results are summarized in Table 3.15-6. For the purposes of this assessment, the deep modeling location using the maximum hammer energy with all noise attenuation is provided for each scenario Table 3.15-6.

Table 3.15-6 Summary of Underwater Acoustic Modeling Conducted at the Deep Location for the Coastal Virginia Offshore Wind Commercial Project Construction and Operations Plan

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold ($L_{p,pk}$)				Distance to PTS Threshold ($L_{E,24hr}$)				Distance to Behavioral Threshold (L_P)
		LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	All Hearing Groups
Standard Driving Installation – Impact Pile Driving	0	344	116	1,621	371	11,325	598	5,686	3,405	15,010
	6	182	67	927	213	6,020	320	2,946	1,852	8,700
	10	132	29	663	141	4,396	170	2,139	1,267	6,182
Standard Driving Installation – Vibratory Pile Driving	0	--	--	--	--	414	0	367	104	21,404
	6	--	--	--	--	199	0	193	52	12,267
	10	--	--	--	--	141	0	85	0	10,114
Hard-to-Drive Installation – Impact Pile Driving	0	344	116	1,621	371	12,423	664	6,273	3,809	15,010
	6	182	67	927	213	6,738	354	3,230	1,987	8,700
	10	132	29	663	141	4,980	187	2,304	1,358	6,182
Hard-to-Drive Installation – Vibratory Pile Driving	0	--	--	--	--	356	0	507	133	21,404
	6	--	--	--	--	150	0	258	72	12,267
	10	--	--	--	--	113	0	120	31	10,114
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	0	344	116	1,621	441	14,363	840	7,647	4,651	15,010
	6	182	67	927	228	7,997	443	3,933	2,570	8,700
	10	132	29	663	158	5,663	226	2,884	1,756	6,182
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	0	--	--	--	--	534	0	507	133	21,404
	6	--	--	--	--	256	0	258	72	12,267
	10	--	--	--	--	158	0	120	31	10,114

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold ($L_{p,pk}$)				Distance to PTS Threshold ($L_{E,24hr}$)				Distance to Behavioral Threshold (L_P)
		LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	All Hearing Groups
OSS Piled Jacket – Impact Pile Driving	0	35	0	508	55	6,807	258	3,485	3,188	5,530
	6	0	0	284	0	3,697	121	1,938	1,746	3,291
	10	0	0	197	0	2,680	48	1,435	1,283	2,172
OSS Piled Jacket – Vibratory Pile Driving	0	--	--	--	--	218	0	190	63	8,921
	6	--	--	--	--	130	0	112	35	5,272
	10	--	--	--	--	75	0	68	0	3,601
Cofferdam Installation – Vibratory Pile Driving	0	--	--	--	--	108	0	0	0	3,097
	6	--	--	--	--	16	0	0	0	2,228
	10	--	--	--	--	0	0	0	0	1,814
Goal Post Pile Installation – Impact Pile Driving	0	2	0	31	3	591	21	704	316	1,450
	6	0	0	12	1	235	8	280	126	580
	10	0	0	7	0	127	4.5	152	68	314

-- = not applicable; $L_{p,pk}$ = peak sound pressure level in units of dB referenced to 1 micropascal;; $L_{E,24hr}$ = sound exposure level over 24 hours in units of dB referenced to 1 micropascal squared second; L_P = root-mean-square sound pressure level in units of dB referenced to 1 micropascal; PPW = phocid pinniped in water PTS = permanent threshold shift.

Noise produced by both impact and vibratory pile driving during installation of WTG and OSS foundations is the noise IPF with the greatest predicted measurable acoustic impact on marine mammals. As summarized in Table 3.15-6, ranges to the PTS thresholds for impact pile driving estimated with 10 dB of noise attenuation may extend up to 3.5 miles (5.6 kilometers) for LFC; 0.1 mile (0.2 kilometer) for MFC; and 1.8 miles (2.9 kilometers) for HFC; and 1.1 miles (1.8 kilometers) PPW. However, these distances are based on the $L_{E,24hr}$ metric which assumes up to 24-hours of continuous exposure, which is unlikely to occur with proposed mitigation (COP, Section 4.2.5.3, Table 4.2-36; Dominion Energy 2022) and animal movement. Ranges to the PTS thresholds for vibratory pile driving of the WTGs were generally much smaller than those for impact pile driving, extending up to 518 feet (158 meters) for LFC, 0 feet (0 meters) for MFC, 393 feet (120 meters) for HFC, and 102 feet (31 meters) for PPW with 10-dB noise attenuation (Table 3.15-6). Behavioral disturbances may also occur during installation of the WTGs and OSSs, as ranges to the behavioral thresholds may extend up to 3.7 miles (6 kilometers) for impact pile driving and up to 6.3 miles (10.1 kilometers) for vibratory pile driving with 10-dB noise attenuation (Table 3.15-6).

The Project will implement soft-start procedures during impact pile driving of the WTG and OSS foundations as soft-start is not feasible for vibratory pile-driving operations, as well as marine mammal monitoring, which will reduce the overall time piling is conducted with the highest hammer energy. Additionally, PAM will occur during all foundation installation activities, and sound field verification measurements will be performed on a subset of foundation installation locations to monitor the underwater sound produced during pile driving (vibratory and impact) activities. Based on the ranges to the thresholds estimated with 10-dB noise attenuation, there is some risk of PTS occurring for all hearing groups except MFC as this hearing group is the only one with impact pile-driving ranges to the PTS threshold estimated at <0.6 mile (<1 kilometer). However, the use of pre-clearance protocols and shutdowns will help reduce the likelihood that individuals will be present within the ensonified areas for sufficient duration to receive sound at levels at sufficient intensity for PTS to be realized. The Project will implement a 4.0-mile (6.5-meter) clearance zone that will be monitored for at least 60 minutes prior to the start of pile driving to ensure no marine mammals are present when pile driving begins (Tetra Tech 2022). Shutdowns will also be implemented if an animal were to be detected within the shutdown zones defined in Table 40 of the LOA application. Piling would cease when practicable as determined by the lead engineer on duty (Tetra Tech 2022) until the animal had been observed moving away. It is likely behavioral disturbances will also occur for all species, but these are expected to be short term (<4 hours per pile and up to a maximum of two piles per day; Tetra Tech 2022) and will dissipate once the pile-driving activities have ceased. Additionally, pile driving will commence only during daylight hours no earlier than 1 hour after (civil) sunrise and will not be initiated later than 1.5 hours before (civil) sunset so that visual clearance can be maintained. No population-level impacts are expected to occur and impacts on marine mammals from installation of the WTGs and OSSs under the Proposed Action are expected to be moderate.

Vibratory pile driving during installation of the cofferdams is not expected to result in any acoustic injury as thresholds are not exceeded beyond 1,656 feet (504 meters) from the source (Table 3.15-6). There is a risk of behavioral disturbances based on the modeled threshold distance of 13 miles (21 kilometers), however the short duration of vibratory pile-driving activities at the nearshore location of the cofferdam installation will limit marine mammal exposure. Up to nine temporary cofferdams, if needed, would be installed via vibratory pile driving approximately 1,000 to 1,800 feet (305 to 549 meters) offshore (COP, Section 3.4.2; Appendix Z, Section Z.5.2; Dominion Energy 2022), limiting the number and species of marine mammals potentially present during operations. Additionally, the behavioral threshold for vibratory pile driving is a sound pressure level (L_P) of 120 dB referenced to 1 micropascal, which represents the lowest L_P to which a marine mammal may respond. However, behavioral responses are situationally dependent, and the type and level of disturbance will vary based on several factors such as species, development phase, and an individual's previous exposure to noise (Ellison et al. 2012;

Southall et al. 2021). Furthermore, if a behavioral response were to occur, it will not necessarily be biologically notable or result in population-level impacts. Due to the duration and location of vibratory pile driving, it is unlikely any notable adverse behavioral disturbances will occur, and impacts on marine mammals are expected to be negligible.

Impact pile driving during installation of the goal post piles used to support trenchless installation of the export cable is also not expected to result in any acoustic injury based on the modeled ranges (<33 feet [<10 meters] for all hearing groups with 10-dB noise attenuation), but there is potential for behavioral disturbances for which ranges that meet or exceed this threshold may extend to 1,030 miles (314 meters) (Table 3.15-6). However, compared to impact pile driving for the WTG and OSS foundations, noise levels produced during installation of the goal post piles will be substantially lower and this activity will occur over a relatively shorter period (24 days) so any behavioral effects would be temporary and would not affect an individual's ability to successfully obtain food to maintain their health, make seasonal migrations, or participate in breeding or calving. Additionally, the Project will implement a 4,921-foot (1,500-meter) shutdown zone for all large whales, which would fully encompass the modeled ranges and would effectively reduce the risk of exposure to above-threshold noise for any species. Therefore, due to the duration and modeled threshold ranges (Table 3.15-6), it is unlikely any notable adverse behavioral disturbances will occur, and impacts on marine mammals are expected to be negligible.

As discussed in Section 3.15.3.1, HRG survey equipment may produce both impulsive and non-impulsive noise depending on the type of equipment. The BOEM BA for data collection and site survey activities for renewable energy on the Atlantic OCS (Baker and Howsen 2021) estimated that PTS threshold distances for mysticetes for some impulsive equipment may extend up to 43 feet (13 meters), and non-impulsive equipment PTS threshold distances may extend up to 3 feet (1 meter). Distances to PTS thresholds for sperm whales were all less than 3 feet (1 meter). Behavioral disturbance threshold showed larger estimated distances, up to 1,640 feet (500 meters) for all marine mammals. However, these distances were estimated assuming the maximum operational power was used for all equipment, which is unlikely to occur. Additionally, these surveys will have relatively short durations within the overall construction period. No acoustic injury is expected to occur from operation of any HRG survey equipment, and mitigation (COP, Section 4.2.5.3, Table 4.2-36; Dominion Energy 2022) will effectively reduce the risk of biologically notable behavioral disturbances. Impacts on marine mammals are therefore expected to be negligible.

Additional sources of non-impulsive noise associated with the Proposed Action may include aircraft operations, vessel noise, and WTG operational noise. Aircraft noise may result in behavioral responses in marine mammals when flying at altitudes below 984 feet (300 meters), but as discussed in Section 3.15.3.1, *Impacts of the No Action Alternative*, all project aircraft would be expected to fly at higher altitude except when landing or taking off or inspecting WTGs. This would limit the risk of exposure for marine mammals, and impacts are expected to be negligible.

Both larger and smaller vessels may be used throughout Project construction, and smaller vessels are expected to make routine trips to the Lease Area for routine maintenance (COP, Sections 3.4.1.5 and 3.5.3; Dominion Energy 2022). Vessel noise has the potential to exceed behavioral thresholds for marine mammals, however these disturbances are not expected to be biologically notable. Larger construction vessels would be used during other construction activities such as pile driving, and it is more likely marine mammals will respond to that noise rather than noise from the vessels. BOEM anticipates that underwater noise generated by larger vessels used for Project activities would overlap the hearing range of several mysticetes (e.g., LFC) including the blue, fin, humpback, sei, minke, and NARW and would be audible to these species. However, the noise levels generated by Project vessels would be below the hearing injury threshold (e.g., PTS) of all marine mammal species; therefore, vessel noise from Project activities is not expected to result in injury-level effects. Project vessels and associated noise impacts could result in a range of behavioral responses, including the onset of avoidance behavior (e.g., heading away or increasing range from the source), changes in acoustic behavior (brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential), diving and subsurface interval behavior (increased interval between surfacing bouts), and no detectable response and brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential (Southall et al. 2021). However, these effects would be expected to dissipate once the vessel or individual has left the area, and no long-term or population-level impacts are expected. Additionally, all Project vessels will implement mitigation to prevent potential vessel strikes (COP, Section 4.2.5.3, Table 4.2-36; Dominion Energy 2022), which would also prevent any marine mammal from getting close enough to transiting vessels to be exposed to above-threshold noise levels. BOEM therefore anticipates impacts on marine mammals from vessel noise to be minor as effects would be detectable, though short term, localized, and not expected to lead to population-level effects.

While Alternative A-1 would result in a slightly reduced duration of underwater noise and vibration due to the construction of fewer WTGs compared to the Proposed Action (up to 202 WTGs under Alternative A-1), potential impacts on marine mammals are anticipated to be the same.

Operational noise from WTGs, while detectable, is not expected to result in any long-term or biologically notable impacts on marine mammals. As discussed in Section 3.15.3.2, *Cumulative Impacts of the No Action Alternative*, noise produced by WTGs is within the hearing range for marine mammals, particularly for LFC species as WTG noise is predominantly in the lower frequencies (<200 Hz) (Tougaard et al. 2020; Stöber and Thomsen 2021). Additionally, the overall number of WTGs (up to 202 under the Proposed Action) may result in a higher source level relative to previously measured WTGs, but within the wind farm itself, noise experienced by animals would predominantly be expected to result from the nearest WTG to the animal. However, though WTG noise may exceed ambient sound levels present within the Action Area, they are not expected to exceed noise produced by vessel traffic out to 0.6 mile (Tougaard et al. 2020), and impacts would therefore be similar to those described for vessel noise under Cumulative Impacts of the No Action Alternative, which would be expected to be minor.

Presence of structures: The various types of impacts on marine mammals that could result from the presence of structures are described in detail in Section 3.15.3.1. The Proposed Action would add up to 208 new structures (up to 205 new WTGs and three OSSs) on the OCS, whereas Alternative A-1 would add up to 205 new structures (202 WTGs and three OSSs) on the OCS. WTGs would be spaced in a 0.93 by 0.75 nautical mile offset grid pattern (east-west by northwest by southeast gridded layout). See COP Section 3.3 (Dominion Energy 2022) for detailed information regarding the WTG structures. Based on documented lengths (Wynne and Schwartz 1999), the largest NARW (59 feet [18 meters]), fin whale (79 feet [24 meters]), sei whale (59 feet [18 meters]), and sperm whale (59 feet [18 meters]) would fit end to end between two foundations spaced at 1 nautical mile (1.9 kilometers) 100 times over. This simple assessment of spacing relative to animal size indicates that the physical presence of the monopile foundations is unlikely to pose a barrier to the movement of large marine mammals, and even less likely to impede the movement of smaller marine mammals. On this basis, BOEM concludes that the presence of the Project's WTG foundations would pose a negligible risk of displacement effects on marine mammals. The presence of the monopile foundations over the life of the Project could affect marine mammal foraging, migratory movements, or other biologically important behaviors as a result of the Proposed Action or Alternative A-1. The potential hydrodynamic effects identified in Section 3.15.3.1 from the presence of vertical structures in the water column could affect nutrient cycling and could influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020; Golbazi et al. 2022; Raghukumar et al. 2022). However, when considered relative to the broader oceanographic factors that determine primary and secondary productivity in the region, localized impacts on zooplankton abundance and distribution are not likely to measurably affect the availability of prey resources for marine mammals. Long-term reef and hydrodynamic effects resulting from the Proposed Action could result in beneficial effects on fish-eating odontocetes and pinnipeds that benefit from increased prey abundance around the structures. Conversely, minor adverse effects due to disruption in hydrodynamics from the Proposed Action could result in impacts on mysticetes that forage on plankton and forage fish. Structures associated with the Project would be expected to provide some level of reef effect and may result in long-term, minor beneficial impacts on pinniped and small odontocete foraging and sheltering. However, the presence of structures could also result in an increased interaction with active or abandoned fishing gear. Long-term, minor to moderate impacts that would be detectable, measurable, and could lead to population-level effects for some species such as the NARW, could occur as a result of increased interaction with active or abandoned fishing gear. Requirements for annual cleanup efforts around WTG foundations would remove any identified fishing gear and reduce the potential for impacts on marine mammals to negligible to minor levels. While the abandoned fishing gear would be removed, the potential for entanglement associated with active commercial or recreational fishing gear would still exist.

Vessel traffic: Construction vessels pose a potential collision risk to marine mammals as detailed in Section 3.15.1. The construction vessels used for Project construction are described in COP Section 3.4.1 and detailed in Table 3.4-5 of the COP (Dominion Energy 2022). COP Appendix S*: Navigation Safety Risk Assessment* provides an additional comprehensive analysis of ongoing vessel traffic and risks to navigation. The Project would only have a minor impact on baseline vessel traffic in the analysis area. The relative risk of vessel strikes from vessels associated with the Proposed Action or Alternative A-1 is dependent upon the stage of development (i.e., construction, operations, or conceptual decommissioning), time of year, number of vessels, and speed of vessels during each stage. Construction vessels would either remain stationary when installing the monopiles and WTG/OSS equipment or move slowly (i.e., at less than 10 knots) when travelling between foundation locations (Dominion Energy 2022).

Vessel trips would average 46 trips per day through the duration of construction activities (January 2023 through August 2027). Daily estimated vessel trips would be dependent on the construction period and activity, and range from a minimum of 3 trips per day to a maximum of 95 trips per day. Per COP Section 3.5.1 (Dominion Energy 2022), Dominion Energy anticipates 365 operating days for the service operations vessel, with 26 annual round trips to port; and 365 operating days for each crew transfer vessel, with 26 annual round trips to port per vessel. Planned mitigation measures, including vessel strike avoidance procedures, voluntary speed restrictions, and use of PSOs, would effectively limit collision risk when travelling to and from area ports (COP, Section 4.2.5.3, Table 4.2-36; Dominion Energy 2022). With implementation of known and highly effective measures such as reduced vessel speeds and ships maintaining minimum distances from marine mammals, collision-related effects on marine mammal species from the Proposed Action or Alternative A-1 are considered negligible for pinnipeds and odontocetes and minor for non-listed mysticetes. As the death of a single NARW could lead to population-level consequences and the application of mitigation cannot rule out the potential for this effect to occur, this impact is considered major for NARW and moderate for all other listed mysticetes.

3.15.5.1 Cumulative impacts of the Proposed Action

Accidental Releases: In context of reasonably foreseeable environmental trends, combined impacts of accidental releases on marine mammals from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be temporary and highly localized due to the likely limited extent and duration of a release, resulting in negligible impacts.

EMFs: In context of reasonably foreseeable environmental trends, the combined impacts of EMFs on marine mammals from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be long-term but highly localized, resulting in overall negligible impacts.

New cable emplacement/maintenance: In context of reasonably foreseeable environmental trends, the combined cable emplacement impacts on marine mammals from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be negligible. Some non-measurable negligible impacts could occur if impacts occur in close temporal and spatial proximity, though these impacts would not be expected to be biologically notable and would be minimized due to the implementation of mitigation measures.

Noise: In context of reasonably foreseeable environmental trends, the combined impacts arising from noise on the Atlantic OCS generated by ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to range from negligible to moderate impacts on marine mammals. Impact pile driving and trenching/cable laying activities from this and all reasonably foreseeable projects would incrementally be added to existing noise levels through 2030, which is expected to result in overall minor to moderate impacts on marine mammals (Appendix F, Table F-3). Additional impacts may occur due to vessel, aircraft, and operational noise, though these impacts on marine mammals are expected to be negligible to minor. Implementation of mitigation methods would effectively limit risk to marine mammals; no population-level impacts are expected.

Presence of Structures: In context of reasonably foreseeable environmental trends, the combined impacts arising from the presence of structures on the Atlantic OCS from ongoing and planned actions, including displacement as a result of new structures on the OCS, would be expected to result in minor to moderate impacts on marine mammals; additional impacts may occur if individuals are displaced into areas with higher risk of vessel and/or fisheries interactions. Minor beneficial impacts for some marine mammal species, including delphinids and pinnipeds, is expected due to the large number of structures and associated reef effect.

Vessel Traffic: In context of reasonably foreseeable environmental trends, the combined vessel traffic impacts on marine mammals from ongoing and planned actions, including the Proposed Action or Alternative A-1 could result in minor to moderate impacts on marine mammals; however, BOEM does not expect the viability of most marine mammal stocks or populations to be affected, with the exception of the NARW, which could experience population-level effects resulting from vessel strike that would be notable and measurable.

3.15.5.2 Conclusions

Impacts of the Proposed Action. In summary, construction, installation, operation, and conceptual decommissioning of the Proposed Action or Alternative A-1 would have **negligible** to **moderate** adverse impacts and could potentially include **minor beneficial** impacts. Adverse impacts, which would be detectable and measurable, are expected to result mainly from pile-driving noise, increased vessel traffic, and the presence of structures as related to fishing gear entanglement. Populations are expected to recover fully from these individual IPFs. Beneficial impacts are expected to result from the presence of structures as related to the artificial reef effect.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, impacts resulting from individual IPFs from ongoing and planned actions, including the Proposed Action or Alternative A-1, would range from **negligible** to **moderate**, and may potentially include **minor beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would result in overall **moderate** to **major** impacts on marine mammals in the geographic analysis area. The main drivers for this impact rating are pile driving, vessel and construction noise, increased vessel traffic associated with the expanded planned action scenario, the conversion of soft bottom to hard structure habitat, and ongoing climate change. **Moderate** impacts are expected for most marine mammal species as detectable and measurable impacts could have population-level effects, but populations would be expected to sufficiently recover when IPF stressors are removed and remedial or mitigating actions are taken, with the exception of the NARW. Due to its life history and current stock status, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including the Proposed Action or Alternative A-1, are expected to be **major** because a measurable impact is anticipated that could have population-level effects and compromise the viability of the species. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through noise-related IPFs and increased vessel traffic.

3.15.6 Impacts of Alternatives B and C on Marine Mammals

Impacts of Alternatives B and C. Impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of the Alternatives B and C would be similar to those described under the Proposed Action, but associated IPFs would slightly decrease compared to the Proposed Action due to the reduction in the number and size of WTGs under Alternatives B and C; Alternative B would construct and operate 29 fewer WTGs than the Proposed Action, and Alternative C would construct and operate 33 fewer WTGs than the Proposed Action. Alternatives B and C would also avoid placement or development of infrastructure in the Fish Haven area, and Alternative C would further avoid complex habitats, including the sand ridge habitat area. However, while Alternatives B and C may be slightly less impactful than the Proposed Action, the impacts on marine mammals under these alternatives would not be appreciably different than those under the Proposed Action.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, Alternatives B and C may be slightly less impactful than the Proposed Action, the impacts on marine mammals under these alternatives would not be appreciably different than those under the Proposed Action. The main drivers for this impact rating are identical to those of all the action alternatives: pile driving, vessel and construction noise, increased vessel traffic associated with the expanded planned action scenario, entanglement risk associated with the presence of structures, and ongoing climate change.

3.15.6.1 Conclusions

Impacts of Alternatives B and C. Construction, installation, operation, and conceptual decommissioning of Alternatives B and C would have **negligible** to **moderate** adverse impacts and could include **minor beneficial** impacts. Similar to the Proposed Action, adverse impacts are expected to result mainly from pile-driving noise, increased vessel traffic, and fishing gear entanglement risk due to the presence of structures, whereas **minor beneficial** impacts are expected to result from the artificial reef effect due to the presence of structures. Population-level impacts from these individual IPFs, if experienced, are expected to be recoverable.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, impacts resulting from individual IPFs resulting from ongoing and planned actions, including Alternatives B and C, would range from **negligible** to **moderate**, and could include **minor beneficial** impacts. Considering all of the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including Alternatives B and C, would result in overall **moderate** to **major** impacts on marine mammals in the geographic analysis area. **Moderate** impacts are expected for most marine mammal species as detectable and measurable impacts could have population-level effects, but populations would be expected to sufficiently recover when IPF stressors are removed and/or remedial or mitigating actions are taken, with the exception of the NARW. Due to its life history and current stock status, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including Alternatives B and C, are expected to be **major** because a measurable impact is anticipated that could have population-level effects and compromise the viability of the species.

3.15.7 Impacts of Alternative D on Marine Mammals

Impacts of Alternative D. Impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternative D would be the same as described under the Proposed Action. Because Alternative D is specific to the Onshore Project component, individual IPFs discussed under the Proposed Action would not change. Therefore, the impacts on marine mammals under Alternative D would not be different from those for the Proposed Action. Construction, installation, operation, and conceptual decommissioning of Alternative D would have negligible to moderate adverse impacts and could include minor beneficial impacts.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, impacts resulting from individual IPFs resulting from ongoing and planned actions, including Alternative D, would range from negligible to moderate, and could include minor beneficial impacts.

3.15.7.1 Conclusions

Impacts of Alternative D. Impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternative D would be the same as described under the Proposed Action.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends and planned actions, in the geographic analysis area, impacts resulting from individual IPFs resulting from ongoing and planned actions, including Alternative D, would range from **negligible** to **moderate**, and could include **minor beneficial** impacts. Considering all of the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including Alternative D, would result in overall **moderate** to **major** impacts on marine mammals in the geographic analysis area. **Moderate** impacts are expected for most marine mammal species as detectable and measurable impacts could have population-level effects, but populations would be expected to sufficiently recover when IPF stressors are removed and remedial or mitigating actions are taken, with the exception of the NARW. Due to its life history and current stock status, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including Alternative D, are expected to be **major** because a measurable impact is anticipated that could have population-level effects and compromise the viability of the species. The main drivers for this impact rating are identical to those of all action alternatives: pile driving, vessel and construction noise, increased vessel traffic associated with the expanded planned action scenario, the conversion of soft bottom to hard structure habitat, and ongoing climate change.

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3.16. Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on the waterways and water from the proposed Project, alternatives, and ongoing and planned activities in the navigation and vessel traffic geographic analysis area. The navigation and vessel traffic geographic analysis area, as shown on Figure 3.16-1, includes coastal and marine waters within a 10-mile (16.1-kilometer) buffer of the Lease Area (OCS-A 0483) associated with the Project and OCS A0497, associated with the CVOW-Pilot Project, ensuring coverage of the nearby TSS lanes, the staging areas, and relevant routes, as well as an area within 2 nautical miles (3.7 kilometers) of the export cable corridors. Information presented in this section draws primarily upon the *Navigation Safety Risk Assessment* (NSRA)[1] (COP, Appendix S; Dominion Energy 2022) which was conducted per the guidelines in USCG Navigation and Vessel Inspection Circular (NVIC 01-19) (USCG 2019) and Commandant Instruction 16003.2B (USCG 2019).

3.16.1 Description of the Affected Environment for Navigation and Vessel Traffic

3.16.1.1 Regional Setting

Proposed Project facilities would be approximately 33 nautical miles (61 kilometers) east of the Little Creek Base–the major operating base for the Amphibious Forces in the U.S. Navy's Atlantic Fleet under a Commercial Lease for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0483). The nearest port relevant to shipping and navigation is the Port of Virginia, Virginia, located approximately 41.5 nautical miles (77 kilometers) west of the Lease Area. NSRA Figures 5.11 through 5.13 show the location of the Project area and the waterways that leading to ports that may be used by the Project. NSRA Figures 6.13 through 6.22 present regional vessel traffic in the vicinity of the Project area (COP, Appendix S; Dominion Energy 2022).

There are several routing measures that regulate vessel traffic to help ships avoid navigational hazards in the vicinity of the Project area.[2] Vessel traffic in and out of Chesapeake Bay is regulated by the Chesapeake Bay TSS consisting of a Southern Approach and an Eastern Approach converging on a Precautionary Area (33 CFR 167.200). On the Southern Approach, the inbound and outbound traffic lanes are separated by a two-way deep-water route (DWR) for deep-draft vessels or naval aircraft carriers (COP, Appendix S; Dominion Energy 2022). The Lease Area is located partially within the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway, proposed by the USCG *Atlantic Coast Port Access Route Study* (ACPARS) (Figure 4.4-43) (Dominion Energy 2022 citing USCG 2016).

[1] The NSRA (COP Appendix S, Dominion Energy 2022) analyzed vessel traffic within a Marine Traffic Study Area, which is inclusive of the Project area, the remainder of the Lease Area plus a 10-nautical mile (18.5-kilometer) buffer, the offshore export cable corridor, and a 2-nautical mile (3.7-kilometer) buffer. The study area considers current traffic patterns, density, and vessel numbers, as well as anticipated changes in traffic from the Project within the areas between the ports, to and from the Offshore Project area, and inclusive of the Offshore Project area. Where this EIS references vessel data and risk analysis from the NSRA, they are specific to the geographic scope of the Marine Traffic Study Area.

[2] The term *routing measure* originates from the International Maritime Organization. The International Convention for the Safety of Life at Sea, Chapter V, recognized the International Maritime Organization as the only international body for establishing routing measures (https://www.imo.org/en/OurWorkSafety/Pages/ShipsRouteing.aspx). USCG submits and obtains approval for routing measures within U.S. navigable waters to the International Maritime Organization. Areas to Be Avoided, Inshore Traffic Zones, No Anchoring, Area, Precautionary Areas, and Traffic Separation Schemes are all routing measures (USCG 2020, Appendix B).

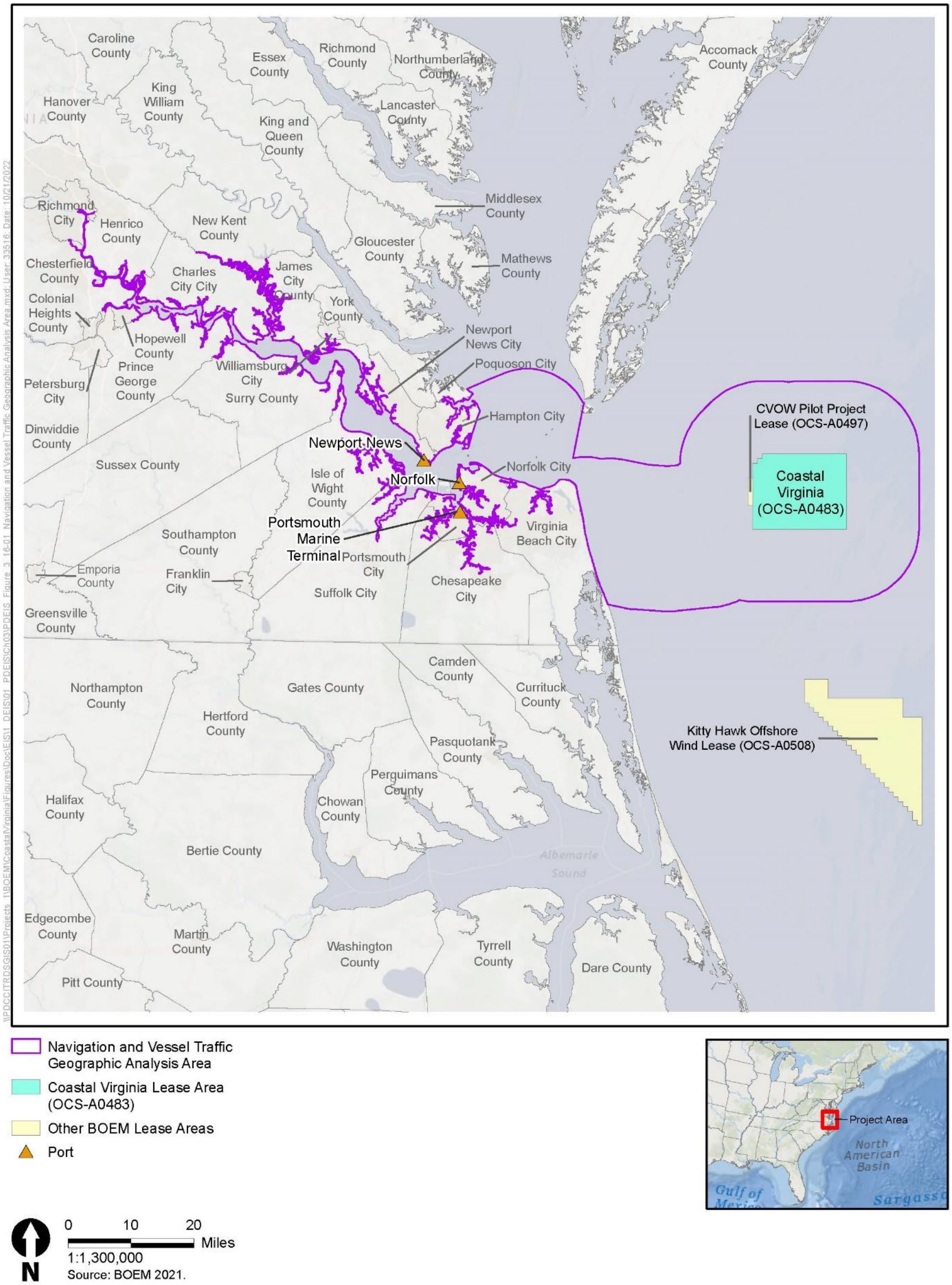

Figure 3.16-1 Navigation and Vessel Traffic Geographic Analysis Area

The potential fairway is about 200 miles (322 kilometers) long, approximately 10 nautical miles (18.5 kilometers) wide; however, the width narrows to approximately 4 nautical miles (7.4 kilometers) wide adjacent to the Lease Area and includes the customary route taken by vessels transiting between the Port of Virginia; the Port of Baltimore, Maryland; the Port of Philadelphia, Pennsylvania; and the Port of Wilmington, Delaware (USCG 2020). The proposed Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway occupies a small portion of three of the northwesternmost Lease Area aliquots. The intersection of the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway and the Lease Area is approximately 135 acres (0.5 square kilometer), which is approximately 0.1 percent of the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2022). The offshore export cable corridor is located south of a Precautionary Area (COP, Appendix S, Section 5.1, Figure 5.1; Dominion Energy 2022).

Traffic patterns, traffic density, and statistics were developed from 1 year of Automatic Identification System (AIS) data collected during the entirety of 2019 (COP, Appendix S, Section 6.1; Dominion Energy 2022). Figure 6.8 in the NSRA shows vessel traffic in the vicinity of the Project area based on Automatic Identification System (AIS) data and nearby routing measures (traffic separation zones, precautionary areas); data from NOAA Vessel Monitoring System (VMS) data recorded during 2015–16; the Northeast Ocean Data Portal (Dominion Energy 2022). This data and information were analyzed in the NSRA for the Proposed Action. The highest density area was in the approach to Chesapeake Bay, where large volumes of commercial traffic converged in the Southern Approach of the Chesapeake Bay TSS from the northeast, east and southeast.

3.16.1.2 Project Area

3.16.1.2.1 Vessel Traffic

NSRA used AIS vessel traffic data, VMS data for fishing vessels, USCG maritime incident data, NOAA nautical charts, and other publicly available data. The AIS data, which are only required on commercial vessels with a length of 65 feet (19.8 meters) or longer, was collected for the entirety of 2019 from both satellite and terrestrial receivers (NSRA 1.5, page 24). It used a 10 nautical miles radius around the Project area to determine the vessel types and density transiting in the area during this time period and to evaluate incidents (NSRA 2.3, page 31). Some smaller recreational and fishing vessels carry and AIS; however, the NSRA likely exclude most vessels less than 65 feet (19.8 meters) long that traverse the Project area, and it is recognized that this category of vessels is likely to be underreported (COP, Section 4.4.6; Dominion Energy 2022; COP Section 4.4.5; Dominion Energy 2022). COP Section 4.4.6 discusses commercial fisheries and for-hire recreational fishing, and Section 4.4.5 discusses recreation and tourism. “Other/undefined” vessel types include offshore supply vessels and research/survey vessels (COP, Appendix S, Section 6.3.4.1; Dominion Energy 2022).

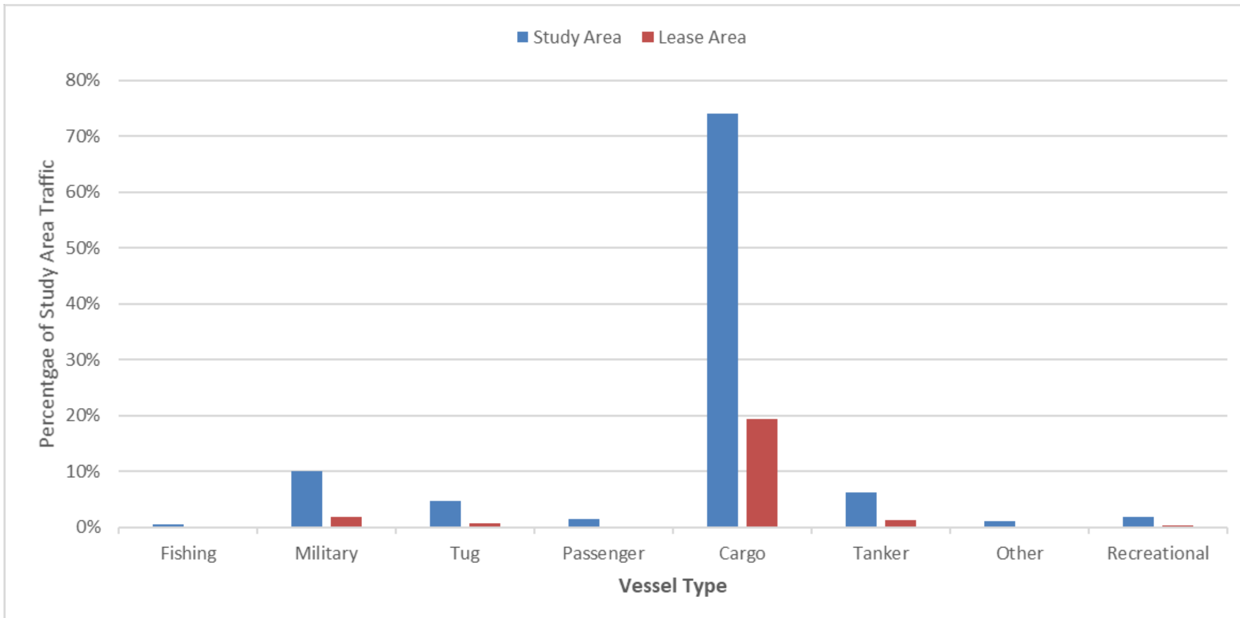

Figure 3.16-2 Main Vessel Type Distribution

During the study period, an average of approximately 22 to 23 unique vessel transits/day were recorded within the geographic analysis area. The busiest months were May and September and the quietest was December. The Lease Area was transited an average of six times/day. Overall, approximately 25 percent of vessel tracks recorded within the geographic analysis area intersected the Lease Area. The average draft recorded in the geographic analysis area was 31 feet (8.8 meters) and was only slightly deeper at 33.1 feet (10.1 meters) in the Lease Area. The average vessel speed in the geographic analysis area, excluding anchored vessels was 10.2 knots, which remained the same in the Lease Area.

3.16.1.2.1.1 Military Vessels

Military vessels, such as carriers, destroyers, cruisers, and others, accounted for approximately 9 percent of traffic within the geographic analysis area and were the second most prolific vessel type in the geographic analysis area. They were primarily inbound or outbound from Naval Station Norfolk and the Joint Expeditionary Base–Little Creek within Chesapeake Bay conducting training within the Virginia Capes Range Complex and Operating Area and Range Complex, not within the Lease Area. More information on military vessels in the geographic study area can be found in COP Section 4.4.8 (Dominion Energy 2022).

AIS data from 2019 on pleasure craft/sailing vessel density show very low recreational activity within and directly adjacent to the Lease Area (COP, Figure 4.4-51; Dominion Energy 2022). Figure 3.16-4 shows 2019 AIS recreational vessel density in the geographic analysis area. Recreational vessels accounted for approximately 4 percent of AIS traffic in the geographic analysis area. An average of one unique recreational vessel every 2 to 3 days was recorded in the geographic analysis area and twice a month in the Lease Area. Most of the recreational fishing activity occurs directly adjacent to shore in proximity to the export cable corridor, and the density decreases as vessels proceed offshore.

AIS, VMS, and vessel trip report data reveals that there are commercial fishing vessel transits and fishing efforts through the Offshore Project area without concentration in a specific area (COP, Figure 4.4-50; Dominion Energy 2022). However, most commercial fishing vessels are not required to carry AIS;

therefore, data may under-represent existing vessel traffic. Figure 3.16-5 shows AIS CMCL fishing vessel density in the geographic analysis area.

As seen on Figure 3.16-6, AIS data demonstrate that there is relatively light cargo vessel traffic through the Lease Area, with higher vessel traffic traversing the offshore export cable route. Most of the cargo vessel activity in the Lease Area consists of transits to and from the Chesapeake Bay through the middle and the southern portion of the Lease Area, as well as additional transits just outside of the northwestern corner of the Lease Area. Traffic that traverses the middle of the Lease Area moves north, while traffic along the southern boundary continues east. During 2019, an average of 17 unique cargo vessels per day were recorded within the geographic analysis area and four vessels per day within the Lease Area (see COP Appendix S, *Navigation Safety Risk Assessment*) (Dominion Energy 2022). Container vessels were the most frequently recorded cargo vessel type within the geographic analysis area (43 percent) followed by bulk carriers (33 percent) and vehicle carriers (14 percent), as shown in COP Figure 4.4-46 (Dominion Energy 2022). The highest concentration of cargo vessels in the survey period was southwest of and through the Lease Area.

Figure 3.16-7 shows towing vessel (also referred to as tug/tow or push/tow vessels) density was light in 2019; a maximum of 10 vessel transits throughout the Lease Area (COP, Figure 4.4-47; Dominion Energy 2022). The density of towing vessels is relatively uniform throughout the Lease Area. The highest vessel density is closer to shore and within Chesapeake Bay outside the Lease Area where these vessels are transiting to and from the Port of Virginia. Throughout the survey period, an average of one unique towing vessel per day was recorded within the geographic analysis area and one unique towing vessel in 6 to 7 days within the Lease Area.

AIS 2019 data demonstrates that tankers transit the space within the southwest portion of the Lease Area. Figure 3.16-8 shows the clear pattern of tankers transiting to and from Chesapeake Bay with a light amount of vessel traffic in 2019. Tanker traffic through the offshore export cable corridor is consistent with the higher density closer to shore. Throughout the survey period an average of one unique tanker per day was recorded within the geographic analysis area and one in 3 days within the Lease Area. Liquified natural gas carriers were the most frequently recorded tanker type within the geographic analysis area (33 percent), followed by combined chemical/oil tankers (25 percent) and chemical tankers (15 percent).

Although there is not a high presence of passenger vessels that travel through the Lease Area, there is a heavy cruise line presence out of the Norfolk Terminal, with those vessels crossing the offshore export cable route. Carnival Cruise Lines, one of the world’s largest cruise ship operators, uses Norfolk as a central hub for many of their Caribbean cruises. Approximately 12 cruise ships leave their Norfolk hub a year. Passenger vessels accounted for approximately 2 percent of traffic within the geographic analysis area. Throughout the survey period, an average of one unique passenger vessel every 3 days was recorded within the geographic analysis area, although the presence of passenger vessel within the Lease Area was limited.

3.16.1.2.1.2 Aids to Navigation

The only aids to navigation within 10 nautical miles (18.9 kilometers) of the Lease Area are a lit navigation buoy approximately 6.7 nautical miles (12.4 kilometers) to the west of the two existing CVOW-Pilot Project turbines (COP, Appendix S, Section 5.1.5; Dominion Energy 2022) adjacent to the western side of the Lease Area. The closest federal aid to navigation to the offshore export cable corridor is a lighted buoy equipped with AIS and Racon marking the southern extent of the Southern Approach to the Chesapeake Bay TSS, which is 0.6 nautical miles (1.1 kilometers) north of the cable alignment. USCG and the USACE administer the permits for Private Aids to Navigation on structures positioned in or near navigable waters of the United States.

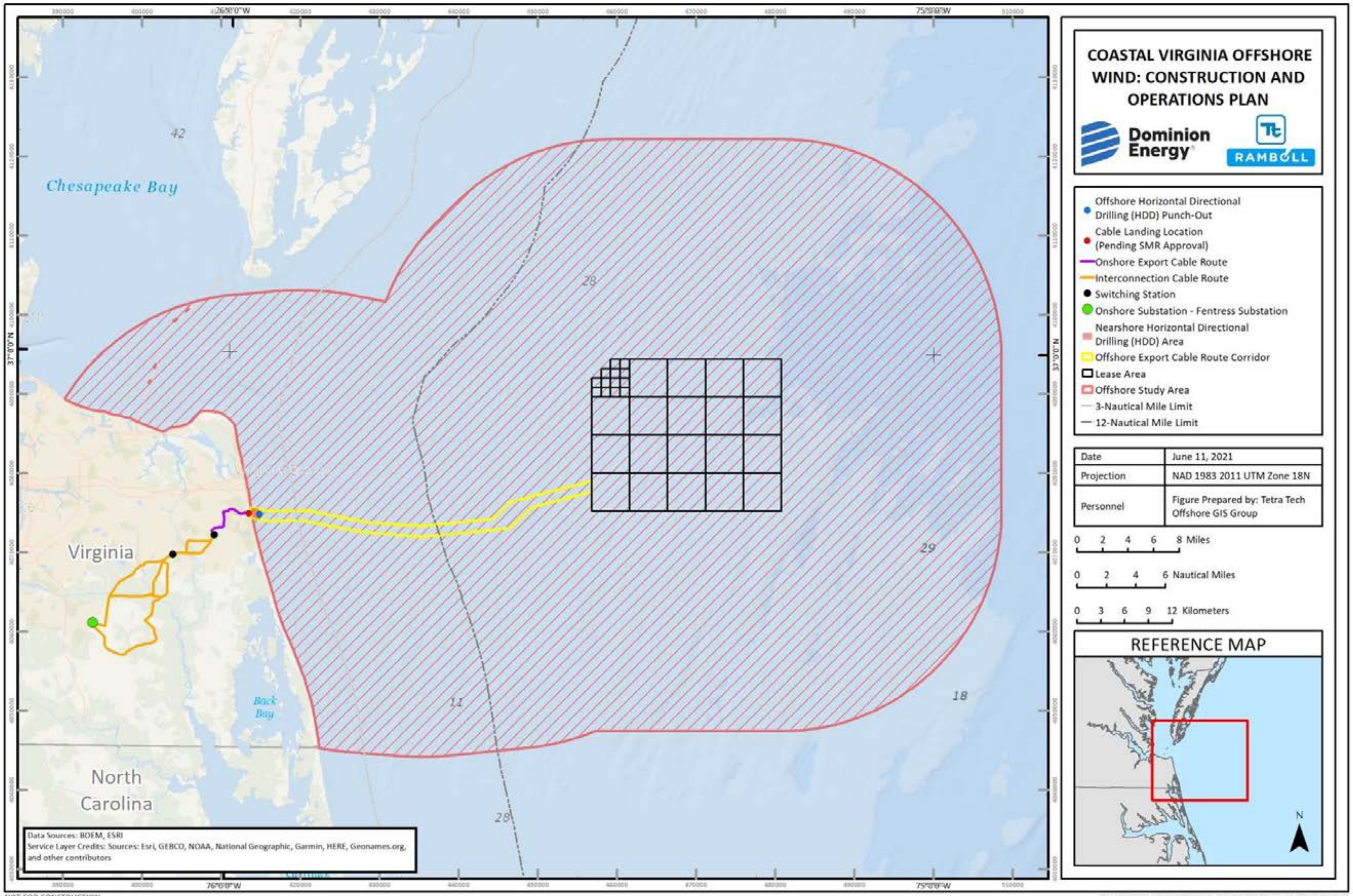

Figure 3.16-3 Offshore Study Area

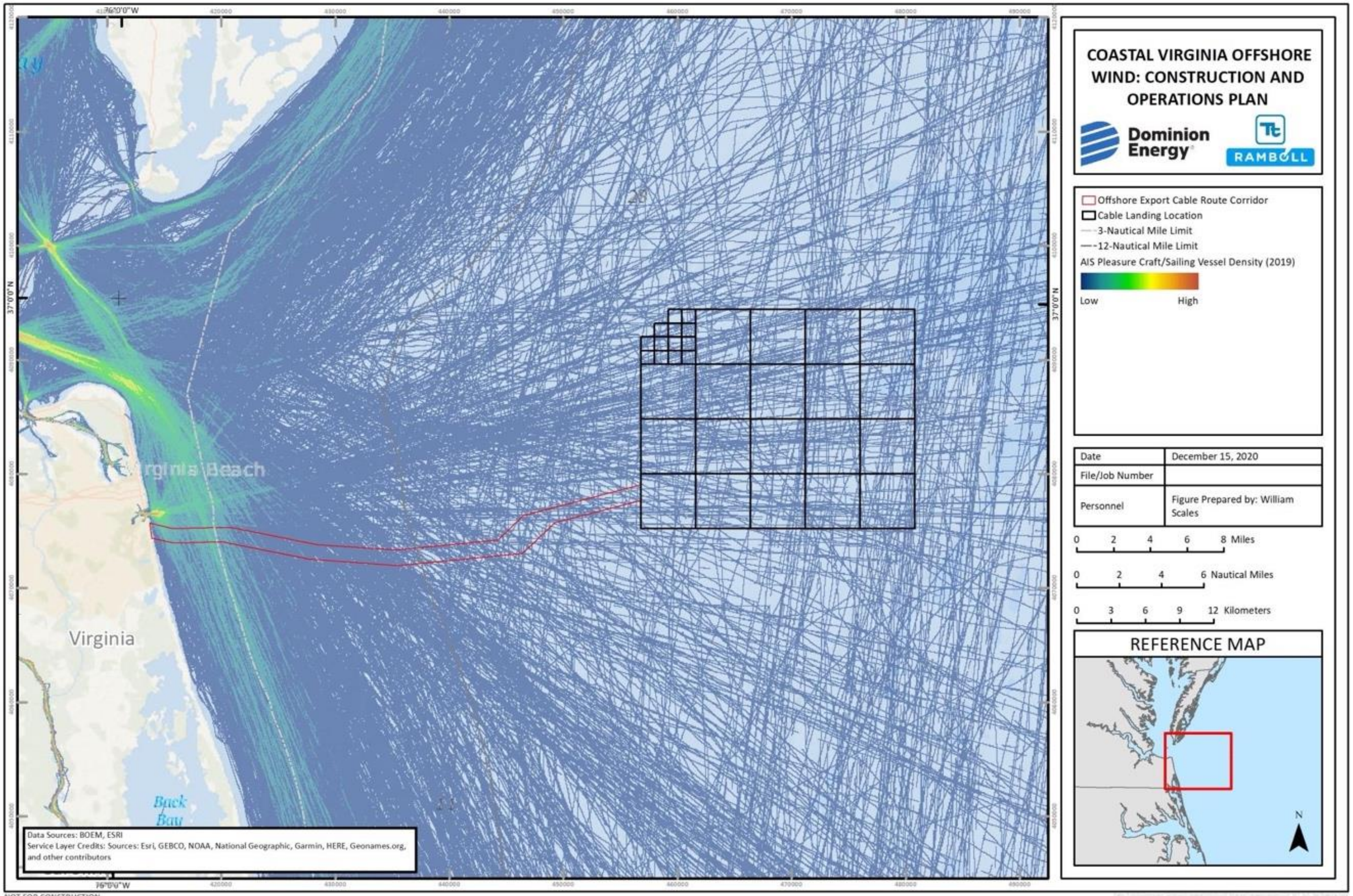

Figure 3.16-4 AIS Recreational Vessel Density (12 Months – January to December 2019)

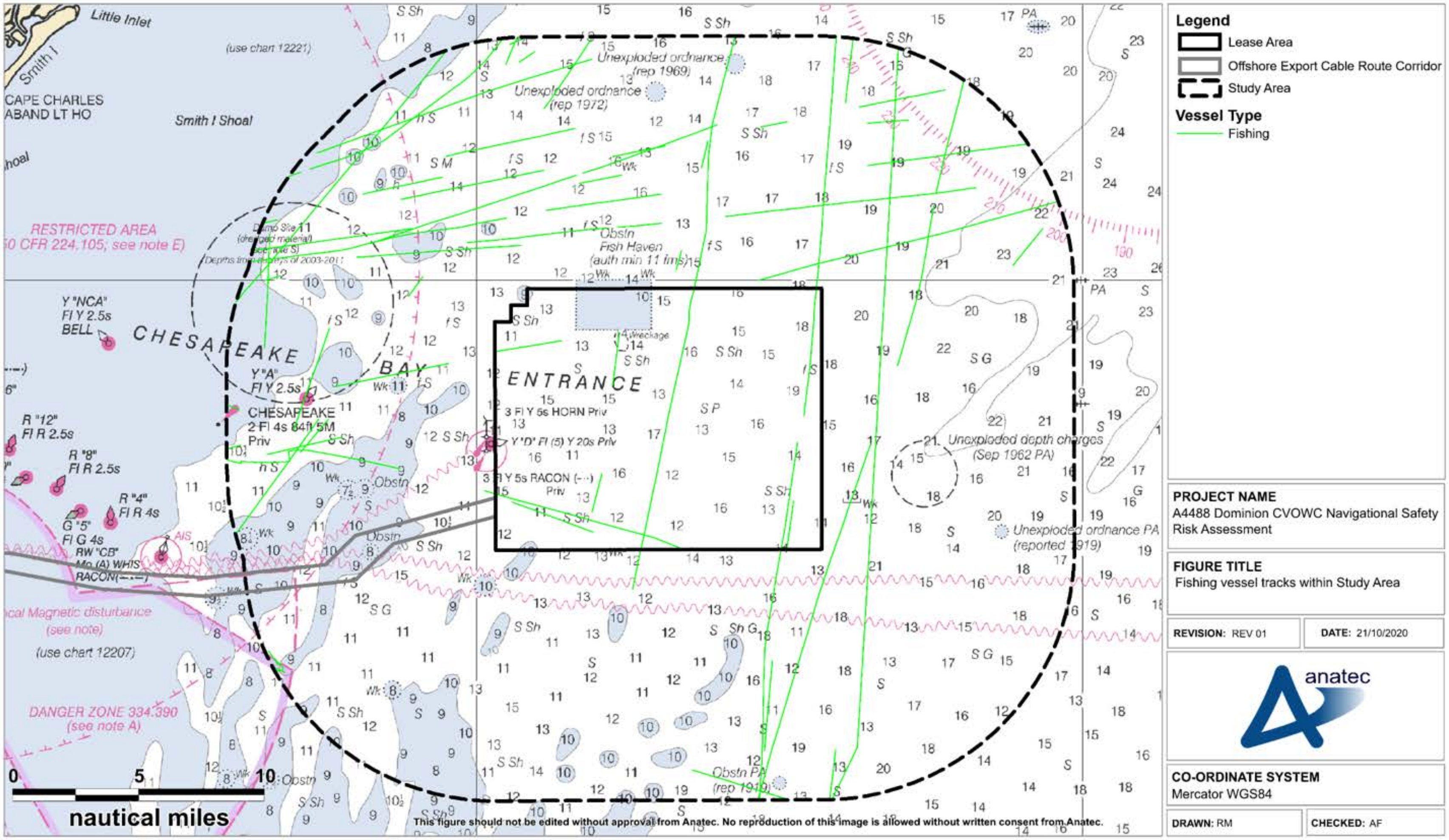

Figure 3.16-5 AIS CMCL Fishing Vessel Density (12 Months – January to December 2019)

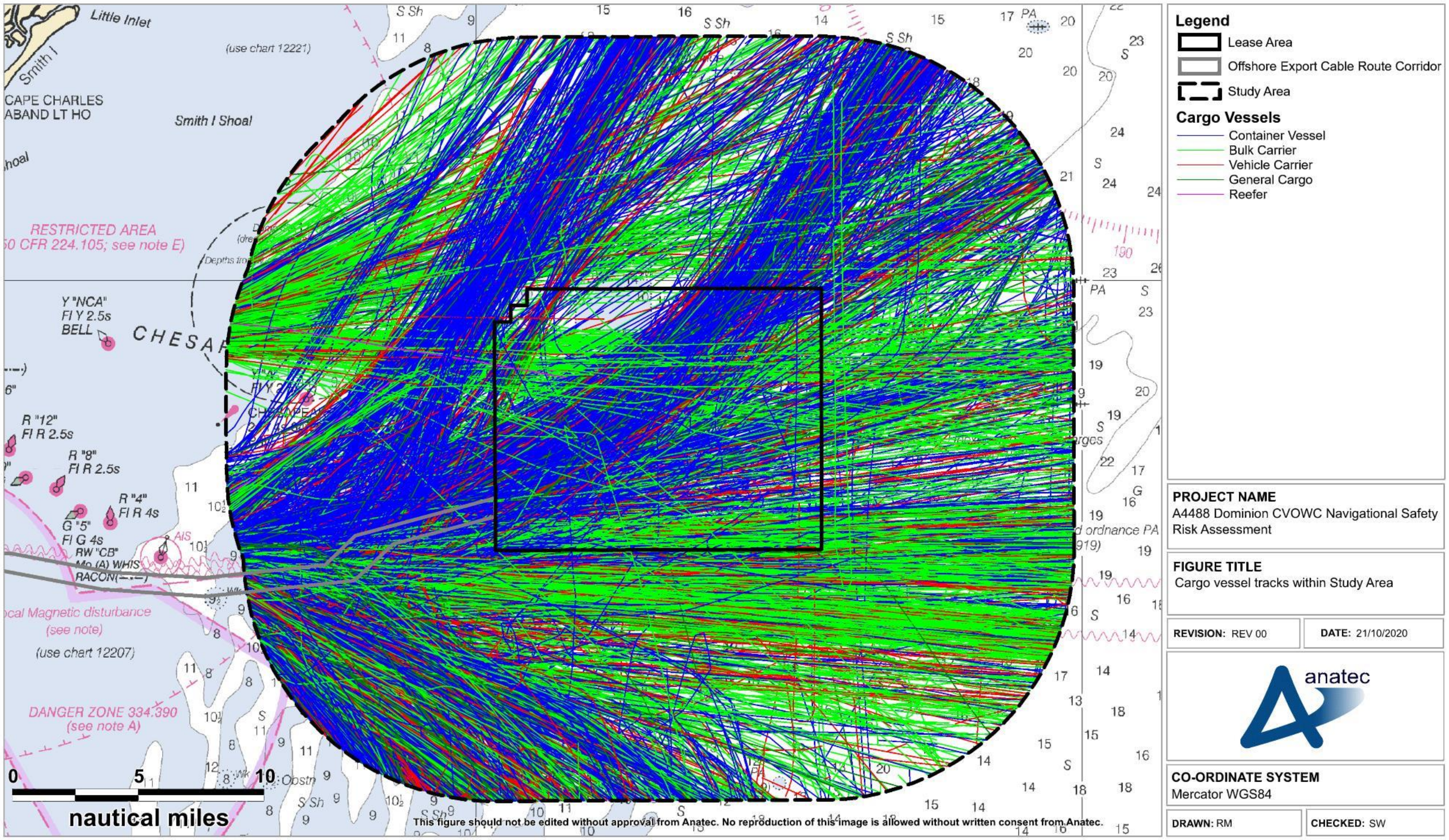

Figure 3.16-6 AIS Cargo Vessel Density (12 Months – January to December 2019)

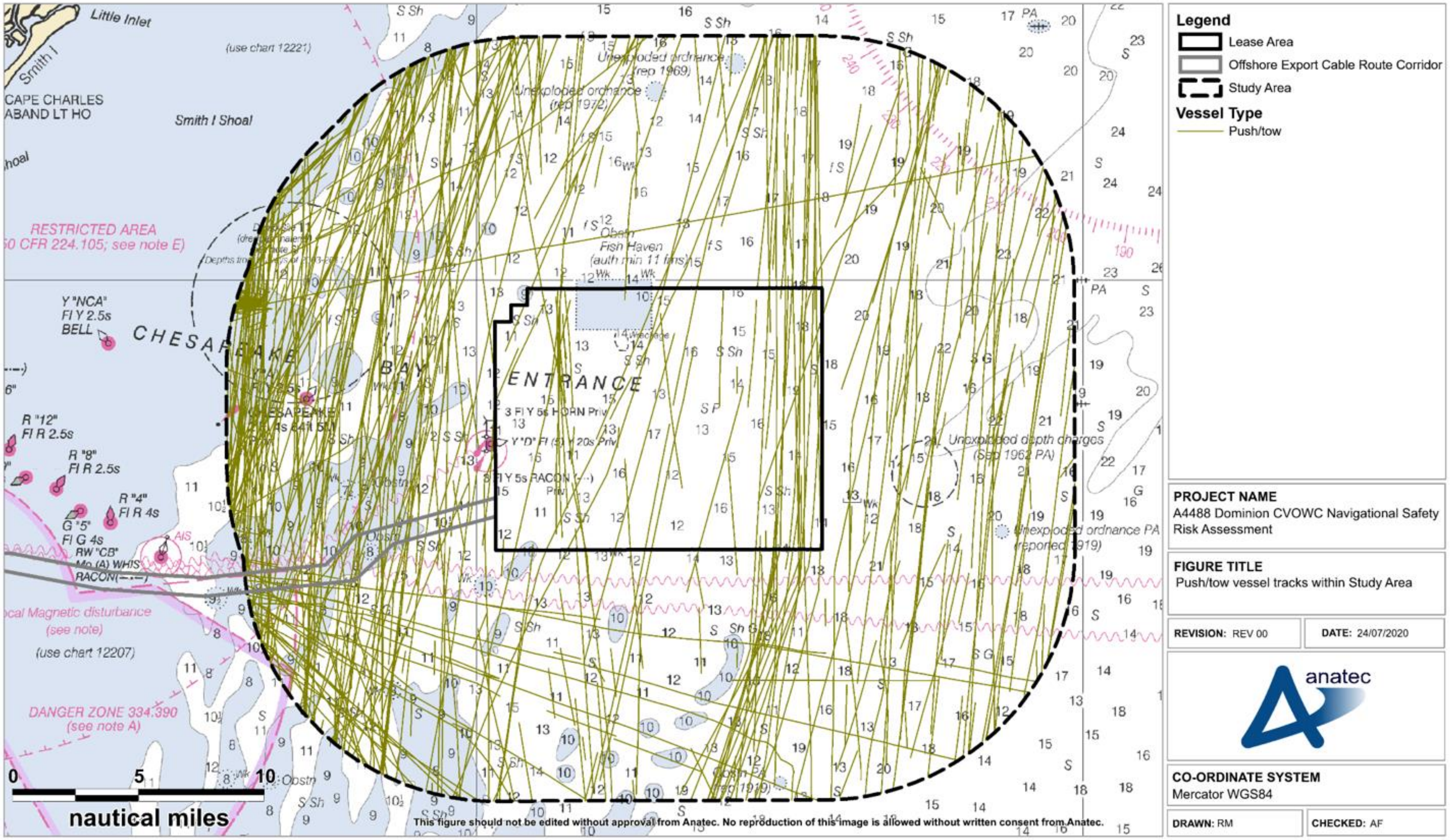

Figure 3.16-7 AIS Towing Vessel Density (12 Months – January to December 2019)

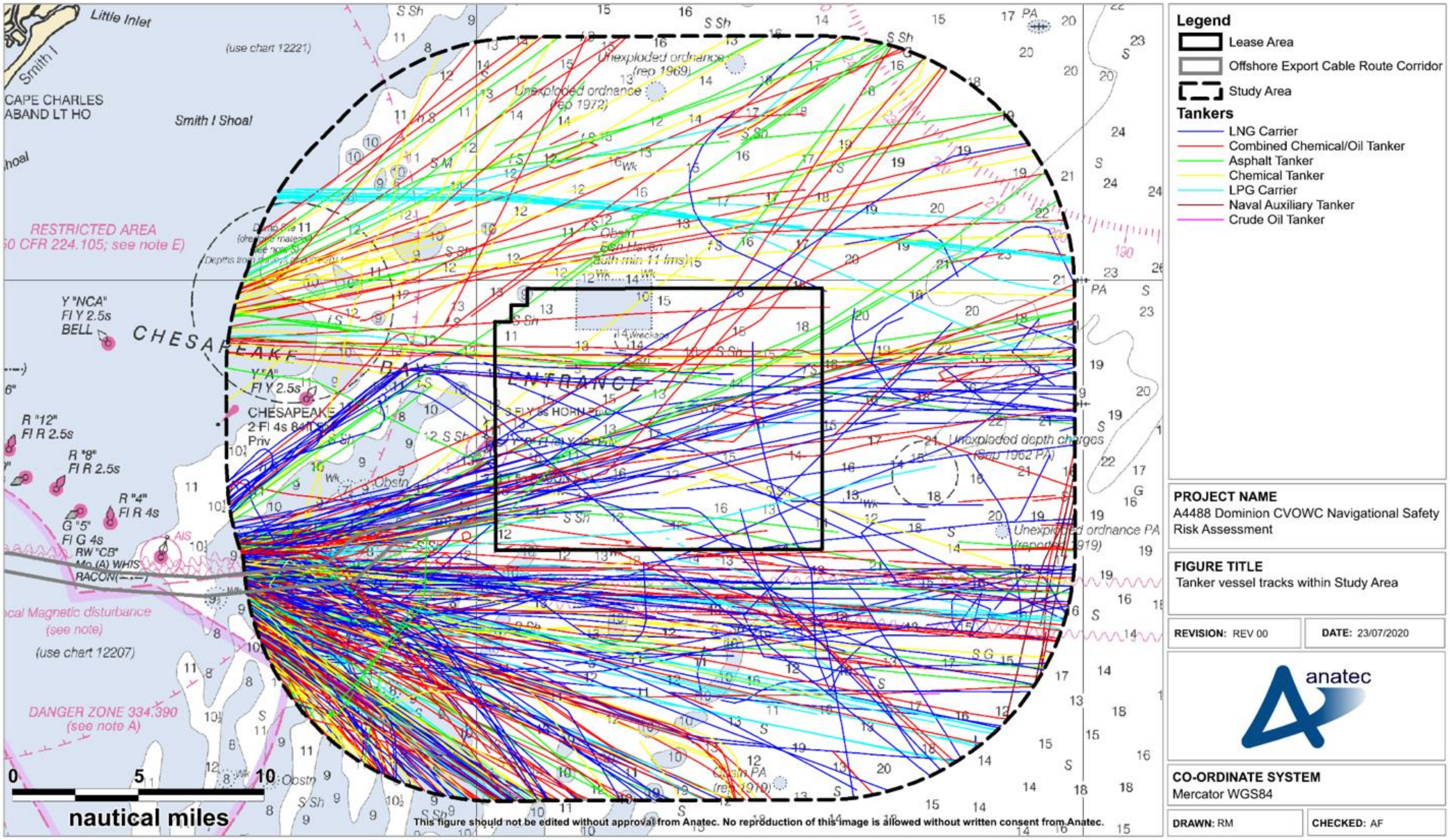

Figure 3.16-8 AIS Tanker Vessel Density (12 Months – January to December 2019)

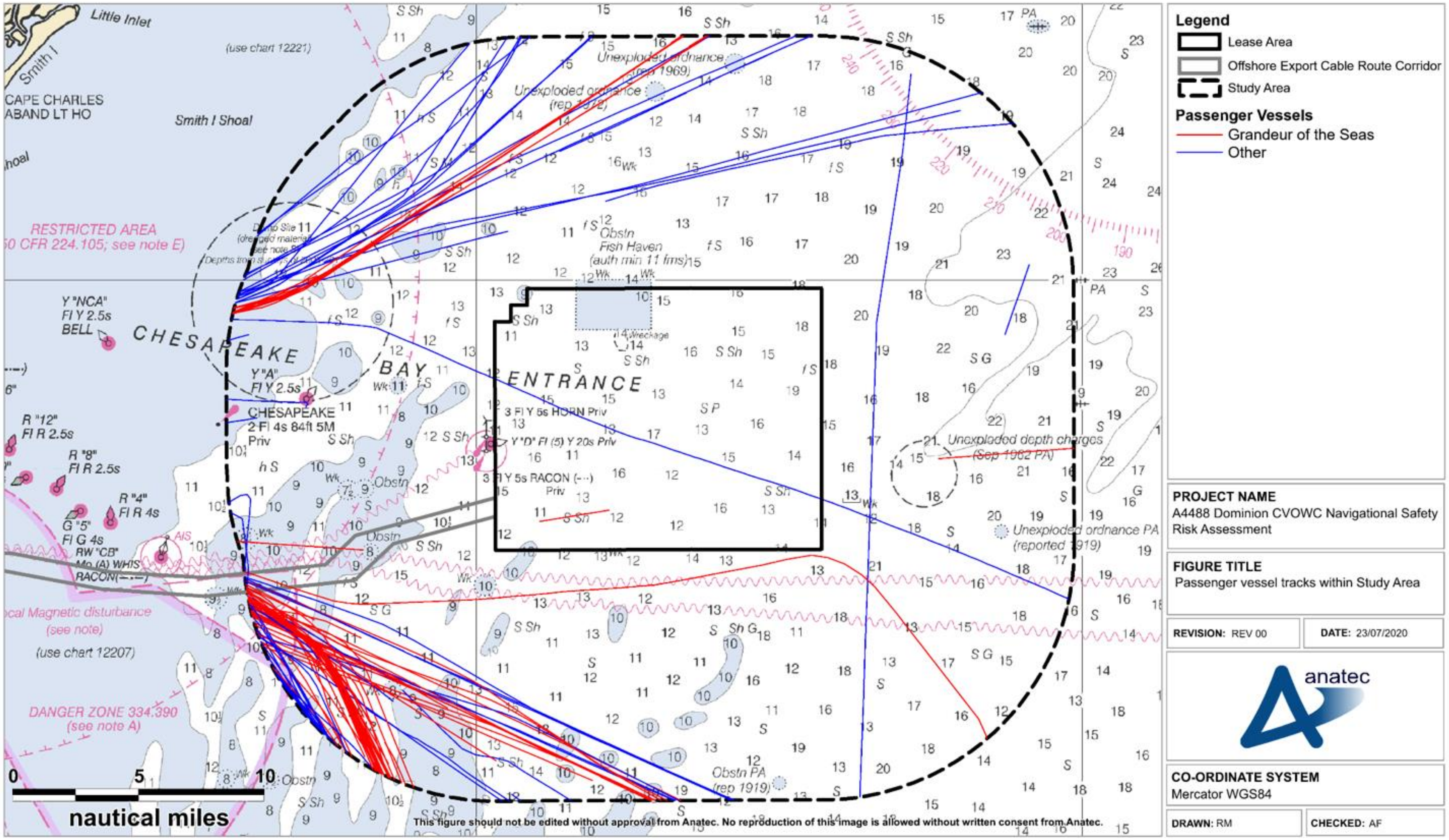

Figure 3.16-9 AIS Passenger Vessel Density (12 Months – January to December 2019)

3.16.1.2.1.3 Ports, Harbors, and Navigation Channels

The closest ports to the geographic analysis area and the Cable Landing Locations are Norfolk and Newport News, Virginia (Figure 3.16-1). Both ports are located inside of Chesapeake Bay on the western side of the entrance. USACE is responsible for documenting vessel and trip information of major American ports. Dry cargo vessels, tankers, and towing vessels are each typical components of vessels that traverse in and out of Norfolk Harbor and Newport News Virginia annually (USACE 2018). The NSRA considers commercial cargo vessels, military (a notable user of the area) vessels, towing, fishing and recreation (COP, Section 4.4.7; Dominion Energy 2022). Of particular relevance to the Project is the Port of Virginia within Chesapeake Bay, which is a busy cargo port comprised of six marine terminals that are capable of handling various commercial vessel types, including deep-draft vessels (COP, Appendix S, Section 5.1.12; Dominion Energy 2022).

During the study period, an average of six unique vessels per day passed through the Lease Area. The busiest month was September, and the busiest days were August 29th and September 21st with 15 vessel transits. Overall, approximately 255 of vessel track recorded withing the geographic analysis area intersected the Lease Area. The most frequently recorded vessel types within the geographic analysis area were cargo vessels at 73 percent, with 19 percent intersecting the Lease Area.

During construction, Dominion Energy has stated that they anticipate that the base construction port would be the Portsmouth Marine Terminal, Virginia, and that Project vessels would be transiting between this port and the Lease Area (COP, Appendix S, Section 18.1; Dominion Energy 2022).

The NSRA analyzed vessel incidents using AIS data collected during 2019 in its entirety. Allision, collision and grounding incidents were observed to be limited over the period studied, with no such incidents recorded within the geographic analysis area. One collision and one allision were recorded within the Export Cable Study Area, however these were both within inshore waters (COP, Appendix S, Section 9.1.4; Dominion Energy 2022). The accident frequency for collisions in the Project area is one accident in 93 years.

Over a 9-year period (2010 through 2019), the USCG conducted 18 missions within the geographic analysis area. Of these incidents, 14 involved material failure or malfunction, while three incidents involved injury to personnel. One incident occurred within the Lease Area, which was considered a serious incident, in which an injured person was medivacked to a Norfolk hospital from a vessel located 23 nautical miles (43 kilometers) off Cape Henry. A total of 26 SAR incidents were recorded within the Export Cable Study Area between 2010 and 2019, of which 10 involved material failure or malfunction. Five incidences of personnel injury occurred, four of which were considered serious incidents. (COP, Appendix S, Section 9.1.2; Dominion Energy 2022)

3.16.2 Environmental Consequences

3.16.2.1 Impact Level Definitions for Navigation and Vessel Traffic

Definitions of impact levels are provided in Table 3.16-1. There are no beneficial impacts on navigation and vessel traffic.

Table 3.16-1 Impact Level Definitions for Navigation and Vessel Traffic

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Impacts would be avoided. Normal or routine functions associated with vessel navigation would not be disrupted.
Moderate	Adverse	Impacts would be unavoidable. Vessel traffic would have to adjust somewhat to account for disruptions due to impacts of the Project.
Major	Adverse	Vessel traffic would experience unavoidable disruptions to a degree beyond what is normally acceptable, including potential loss of vessels and life.

3.16.3 Impacts of the No Action Alternative on Navigation and Vessel Traffic

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

3.16.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for navigation and vessel traffic described in Section 3.16.1, *Description of the Affected Environment for Navigation and Vessel Traffic*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic are generally associated with onshore construction and operations.

Marine transportation in the region is diverse and sourced from many ports and private harbors. Commercial vessel traffic in the region includes research, tug/barge, liquid tankers (such as those used for liquid petroleum), cargo, military and search and rescue vessels, and commercial fishing vessels. Recreational vessel traffic includes cruise ships, sailboats, and charter boats. A number of federal agencies, state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing research offshore including oceanographic, biological, geophysical, and archaeological surveys. The Mid-Atlantic Regional Council on the Ocean (comprising Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, and federally recognized tribes) anticipates that regional commercial shipping may increase, and navigation routes may change in response to increasing demand for larger ships to transport goods (MARCO 2016). The Port of Virginia recently completed land-side projects to expand cargo and rail capacity and a dredging project to increase depth of Norfolk Harbor to 55 feet is scheduled for completion in 2024 (Appendix F, Section F.2.8).

Under the No Action Alternative, baseline conditions for navigation and vessel traffic would continue to follow regional current trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic are generally associated with dredging and port improvement projects, military use, marine transportation, and fisheries use and management. These activities may result in a moderate increase in port maintenance activities, port upgrades to accommodate larger deep-draft vessels, and temporary increases in vessel traffic for offshore cable emplacement and maintenance. Impacts associated with global climate change have the potential to require modifications to existing port infrastructure and aids to navigation, with the former adding to port congestion and limited berths during construction activities.

There is one ongoing offshore wind activity within the geographic analysis area that contributes to impacts on navigation and vessel traffic: Continued O&M of the CVOW-Pilot project (2 WTGs) installed in OCS-A 0497.

3.16.3.1 Cumulative Impacts of the No Action Alternative

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

Planned non-offshore wind activities that may affect navigation and vessel traffic in the geographic analysis area include port improvement projects, dredging projects, and installation of new structures on the OCS (see Section F.2 in Appendix F for a description of ongoing and planned activities). These activities may result in a moderate increase in port maintenance activities, port upgrades to accommodate larger deep-draft vessels, and temporary increases in vessel traffic for offshore cable emplacement and maintenance. See Table F1-14 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for navigation and vessel traffic.

BOEM expects future offshore wind activities to affect navigation and vessel traffic through the following primary IPFs.

Anchoring: Future offshore wind developers are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk for deep-draft vessels would come from anchoring in an emergency scenario. Generally, larger vessels accidently dropping anchor on top of an export cable (buried or mattress protected) to prevent drifting in the event of vessel power failure would result in damage to the export cable; risks associated with an anchor contacting an electrified cable; and impacts on the vessel operator’s liability and insurance. Impacts on navigation and vessel traffic would be temporary and localized, and navigation and vessel traffic would be expected to fully recover following the disturbance.

Smaller commercial or recreational vessels anchoring in the offshore wind lease areas may have issues with anchors failing to hold near foundations and any scour protection. Considering the small size of the geographic analysis area compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario, it is unlikely that offshore wind activities would affect vessel-anchoring activities.

Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep-draft visits to major port visits are expected to increase as well, increasing the potential for an emergency need to anchor, creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.

Port utilization: As described in Appendix F, future offshore wind development would support planned expansions and modifications at ports in the geographic analysis area for navigation and vessel traffic, including the Portsmouth Marine Terminal and the Port of Norfolk, Virginia. Simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for both this Project and the Kitty Hawk Wind North and South projects in the geographic analysis area could stress port capacity and resources and could concentrate vessel traffic in port areas. Such concentrated activities could lead to increased risk of allision, collision, and vessel delay.

Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, which could lead to increased risk of allision, collision, and vessel delay. A channel deepening project at the Port of Virginia is currently underway with USACE and a private contractor engaged in dredging approximately 1.1 million cubic yards of sediment from the federal channel in Norfolk Harbor and Newport News, Virginia (USACE 2019). The project is anticipated to be completed in 2024, resulting in a channel depth of over beyond 50 feet in the harbor, which would allow it to accommodate two ultra-large container vessels simultaneously (Virginia Port Authority 2021).

Under the Cumulative No Action Alternative, three offshore wind projects in the geographic analysis area, the CVOW-Pilot Project and Kitty Hawk Wind North and South, would generate vessel traffic. The CVOW-Pilot Project is currently in operation and is the pilot project for the proposed Project. During peak activity for the Kitty Hawk Wind North project in 2024, impacts on port utilization would be short term, continuous, and localized to the ports and their maritime approaches. Construction of Kitty Hawk Wind South is not anticipated to start until 2027.

Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Impacts would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.

Future activities with the potential to result in port expansion impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects) (Appendix F, Attachment 2).

Presence of structures: Under the Cumulative No Action Alternative, approximately 190 WTGs (Appendix F, Table F2-1) would be constructed in the geographic analysis area. Structures in this area would pose navigational hazards to vessels transiting within and around areas leased for offshore wind projects. Offshore wind projects would increase navigational complexity and ocean space use conflicts, including the presence of WTG and OSS structures in areas where no such structures currently exist, potential compression of vessel traffic both outside and within offshore wind lease areas, and potential difficulty seeing other vessels due to a cluttered view field. Another potential impact of offshore wind structures is interference with marine vessel radars. USCG noted in its final *Areas Offshore of Massachusetts and Rhode Island Port Access Route Study* (USCG 2020) that various factors play a role in potential marine radar interference by offshore wind infrastructure, stating that "the potential for interference with marine radar is site specific and depends on many factors including, but not limited to, turbine size, array layouts, number of turbines, construction material(s), and the vessel types." In the event of radar interference, other navigational tools are available to ship captains.

Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 37 years. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion (Appendix F, Attachment 2).

The fish aggregation and reef effects of offshore wind structures would also provide new opportunities for recreational fishing. The additional recreational vessel activity focused on aggregation and reef effects would incrementally increase vessel congestion and the risk of allision, collision, and spills near WTGs. If marine mammals choose to avoid WTGs and OSSs, this could potentially increase the risk of cetacean interaction with vessels, marginally increasing the likelihood of a vessel strike outside the offshore wind lease areas. Fishing near artificial reefs is not expected to change meaningfully over the next 37 years. Overall, the impacts of this IPF on navigation and vessel traffic would be long term (as long as structures remain), regional (throughout the entire geographic analysis area for navigation and vessel traffic), and constant (COP, Section 4.4.7; Dominion Energy 2022).

New cable emplacement/maintenance: Based on the assumptions in Appendix F, Table F2-1, the 190 WTGs associated with planned projects (Appendix F, Table F-3) would require about 453 miles (729 kilometers) of offshore export cables plus 349 miles (562 kilometers) of inter-array cables (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022). Emplacement and maintenance of cables for these planned offshore wind projects would generate vessel traffic and would specifically add slower-moving vessel traffic above cable routes. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes during installation and maintenance activities. BOEM anticipates that there would likely be simultaneous cable-laying activities from multiple projects based on the estimated construction timeline. While simultaneous cable-laying activities may disrupt vessel traffic over a larger area than if activities occurred sequentially, the total time of disruption would be less than if each project were to conduct cable-laying activities sequentially. The impacts of this IPF on vessel traffic and navigation under the No Action Alternative would be short term, localized, and most disruptive during peak construction activity of the offshore wind projects starting in 2024 (Appendix F, Table F-3).

Additionally, the FCC has two pending submarine tele-communication cable applications in the North Atlantic. Future new cables would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 37 years. Care would need to be taken by vessels that are crossing the cable routes during these activities (Appendix F, Table F-3).

Traffic: Any offshore wind projects in the navigation and vessel traffic geographic analysis area would generate vessel traffic during construction, operation, and decommissioning. Other vessel traffic in the region (e.g., from commercial fishing, for-hire and individual recreational use, shipping activities, military uses) would overlap with offshore wind-related vessel activity in the open ocean and near ports supporting the offshore wind projects.

As shown in Table F-3 in Appendix F, the increase in vessel traffic and navigation risk due to offshore wind projects in the Project area would increase beginning in 2024 when 190 WTGs associated with an offshore wind projects other than the Proposed Action (Kitty Hawk Wind North and South) would be under construction. During this construction period for Kitty Hawk Wind North, a maximum of 41 vessels could be operating simultaneously in the geographic analysis area at any given time (Kitty Hawk Wind North 2021: Section 3.2.7, Table 3.2-10). The presence of offshore wind project vessels would add to the overall Atlantic Coast vessel traffic levels as new offshore wind farm areas are developed, leading to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, engagement of USCG Search and Rescue, and vessel fuel spills. Increased offshore wind-related vessel traffic during construction would have short-term, constant, localized impacts on overall (wind and non-wind) vessel traffic and navigation.

After the remaining scheduled wind project is constructed, related vessel activity would decrease. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. During operations, project-related vessel traffic would have long-term, intermittent, localized impacts on overall vessel traffic and navigation. Vessel activity would increase again during decommissioning at the end of the assumed 35-year operating period of each project, with magnitudes and impacts similar to those described for construction. As stated under the *Presence of structures* IPF, absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 37 years. Even with increased port visits by deep-draft vessels, this is still a relatively small adjustment when considering the whole of Norfolk-area vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.

3.16.3.2 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, navigation and vessel traffic would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on navigation and vessel traffic. Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on navigation and vessel traffic.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and navigation and vessel traffic would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on navigation and vessel traffic due to increased offshore construction and operations.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing short- and long-term impacts on navigation and vessel traffic, primarily through the presence of structures, port utilization, and vessel traffic. BOEM anticipates that the impacts of ongoing activities, especially port utilization and vessel traffic, would be **moderate**. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on navigation and vessel traffic. Planned activities other than offshore wind include port expansion, new cable emplacement and maintenance, and search and rescue operations. BOEM anticipates that the impacts of planned activities other than offshore wind would be **minor** because while impacts would be measurable, they would not disrupt navigation and vessel traffic. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** to **moderate** impacts on navigation and vessel traffic.

Future offshore wind projects would increase vessel activity, which could lead to congestion at affected ports, the possible need for port upgrades beyond those currently envisioned, and an increased likelihood of collisions and allisions, with resultant increased risk of accidental releases. In addition, the future offshore wind projects other than the Proposed Action would lead to the construction of approximately 190 WTGs in areas where no such structures currently exist, also increasing the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with ongoing and planned activities other than offshore wind and future offshore wind activities in the geographic analysis area would result in **moderate** impacts. (BOEM 2019)

3.16.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario (NSRA Table 4-4); any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. Variability of the proposed Project design within the PDE that could affect navigation and vessel traffic includes the number of vessels that would be used during construction; the ports used to support Project construction, installation, and decommissioning; the exact placement and number of WTGs; and the construction schedule, as outlined in COP Section 1, Table 1.1-3 (Dominion Energy 2022). Variances in these factors could affect vessel traffic and navigation choices. This section has assessed the maximum-case scenario, so variances from this scenario should lead to similar or reduced impacts.

3.16.5 Impacts of the Proposed Action on Navigation and Vessel Traffic

Impacts from the Proposed Action alone would include increased vessel traffic in and near the Wind Farm Area and on the approach to ports used by the Proposed Action, as well as obstructions to navigation caused by Proposed Action activity. During construction, the potential impact-producing factors to marine transportation and navigation may include short-term increase in Project-related construction vessel traffic, short-term presence of partially installed structures, and short-term safety zone implementation. Dominion Energy would implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. COP Section 3.4.1.5, Table 3.4-5 (Dominion Energy 2022) summarizes the anticipated Project-related vessel traffic during Proposed Action construction. Construction vessel trips would likely originate or terminate at Portsmouth, Virginia.

Anticipated changes in traffic from the Project were estimated to include the following.

1. Project-related vessel traffic related to construction, O&M, and decommissioning activities.
2. Additional non-Project traffic that might be generated by the presence of the wind farm, for example, pleasure vessel trips for sight-seeing or recreational fishing.
3. The modification of usual traffic routes for some ship types due to the presence of wind farm structures.

Impacts on navigation and vessel traffic would also include changes to navigational patterns and the effectiveness of marine radar and other navigation tools. This could result in delays within or approaching ports, increased navigational complexity, detours to offshore travel or port approaches, or increased risk of incidents such as collision and allision, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. NSRA Section 14 addresses the Proposed Action's impacts on recreation, while NSRA Section 15 addresses the Proposed Action's impacts on commercial fisheries and for-hire recreational fishing.

The NSRA marine risk analysis modeled the frequency of non-Project vessel accidents that could result from installation of the Proposed Action wind farm structures. The future case assessments for marine accidents accounting for Project- and location-specific environmental, traffic and operational parameters (COP, Appendix S, Section 6.5, Section 10, Section 11; Dominion Energy 2022). Baseline vessel traffic data used in the model are described in the NSRA (COP, Appendix S, Section 4.4.7; Dominion Energy 2022.) Detailed information about the risk analysis is included in COP Appendix S (Dominion Energy 2022).

The risk analysis calculated the frequency of hazards due to the following navigation hazards (COP, Appendix S, Section 10; Dominion Energy 2022).

- Increased vessel to vessel collision risk.
- Powered vessel to structure allision risk.
- Drifting vessel to structure allision risk.
- Internal fishing vessel to structure allision risk.
- Grounding vessel risk.

Anchoring: The closest official anchorages to the Offshore Project area are within or at the opening of Chesapeake Bay; however, these anchorages are for naval vessels only, not for commercial use except in cases of emergency. Vessel traffic in and out of Chesapeake Bay is regulated by the Chesapeake Bay TSS consisting of a Southern Approach and an Eastern Approach converging on a Precautionary Area (33 CFR 167.200). On the Southern Approach, the inbound and outbound traffic lanes are separated by a two-way DWR for deep-draft vessels or naval aircraft carriers (COP, Appendix S, Section 5.1.1; Dominion Energy 2022). The Lease Area is located partially within the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway, proposed by the USCG ACPARS (COP, Section 4.4.7.1, Figure 4.4-44; Dominion Energy 2022). The potential fairway is about 200 miles (322 kilometers) long, approximately 10 nautical miles (18.5 kilometers) wide; however, the width narrows to approximately 4 nautical miles (7.4 kilometers) wide adjacent to the Lease Area and includes the customary route taken by vessels transiting between the Port of Virginia; the Port of Baltimore, Maryland; the Port of Philadelphia, Pennsylvania; and the Port of Wilmington, Delaware (USCG 2020). The proposed Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway occupies a small portion of three of the northwesternmost Lease Area aliquots. The intersection of the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway and the Lease Area is approximately 135 acres (0.5 square kilometer), which is approximately 0.1 percent of the Lease Area. (COP, Section 4.4.7; Dominion Energy 2022)

It is not expected that anchorage areas would have an impact on the Project (COP, Appendix S, Section 16.2; Dominion Energy 2022). There would be no restrictions on anchoring in the Lease Area; it is considered unlikely that commercial vessels would seek to do so once the Offshore Project Components were installed, and as such, the existing activity is likely to be displaced. Based on the study data, the level of activity which may be displaced is low, and there is established anchoring space inshore of the Lease Area.

The presence of the Offshore Project Components may create an underwater snapping or contact risk to vessel anchoring in proximity, such as the following.

- A vessel deliberately drops anchor over a subsea cable in an emergency.
- The deployed anchor of a vessel fails to imbed causing the anchor to drag over a subsea cable.
- A departing vessel neglects to raise anchor and drags it over a subsea cable.
- The anchor is negligently or accidently deployed over a subsea cable.

During the study period, approximately one vessel per day was recorded at anchor within 2 nautical miles (3.7 kilometers) of the Export Cable Corridor Study Area. Dominion Energy states that they would conduct a Cable Burial Risk Assessment to further mitigate these risks (Dominion Energy 2022).

Under Alternative A-1, impacts on anchoring would generally be the same as or slightly lower than those of the Proposed Action, as there would be slightly more area available for anchoring within the Lease Area because the OSS would be placed in the WTG gridded layout instead of offset.

Port utilization: The Proposed Action would generate vessel traffic at the Port of Portsmouth, Virginia. The construction, maintenance and decommissioning activities associated with the Project may result in restricted access at local ports, including those used as base port by the Project. The Proposed Action would generate trips by support vessels, such as crew transports vessels, hotel vessels, tugs and miscellaneous vessels (COP, Appendix S, Section 18.1; Dominion Energy 2022). Project vessels are not anticipated to cause access issues in these areas, with the potential exception of larger vessels such as jack-up barges when in transit to/from the Lease Area, including a pilotage boarding area within the Precautionary Area. The onshore O&M facility is anticipated to be based in Hampton Roads–Lynnhaven, Virginia and any Project vessel activity would be taking a similar route to/from the Lease Area. On average, the Proposed Action would generate approximately 26 annual roundtrips from the Port of Portsmouth, Virginia during regular operations (COP, Section 3.5.1; Dominion Energy 2022). Project traffic would decrease during the operation phase, and no significant impact is anticipated. The presence of these vessels could cause delays for non-Proposed Action vessels and could cause some fishing or recreational vessel operators to change routes or use an alternative port. Under Alternative A-1, port utilization would generally be the same as under the Proposed Action, although there would be slightly less ship traffic at the ports because three fewer WTGs would be constructed, operated, maintained, and decommissioned. The Proposed Action or Alternative A-1's impacts on vessel traffic due to port utilizations would be intermittent and continuous through construction and installation O&M, and decommissioning with greater impacts during construction, installation, and decommissioning compared to O&M.

Presence of structures: The Proposed Action would include up to 205 WTGs and 3 OSSs, operating for 33 years (COP, Section 3.5; Dominion Energy 2022), within the Wind Farm Area where no such structures currently exist. Presently there are no approved routing measures within the proposed Project area that would be altered by the presence of structures. Additionally, from the Chesapeake Bay to Delaware Bay, many vessels already utilize (Figure 4.4-44) the Eastern Approach Cutoff Fairway (COP, Section 4.4.7.1, Figure 4.4-44; Dominion Energy 2022) that provides a separation of the northwest corner of the Lease Area to the majority of vessel traffic. Vessel traffic would potentially be further diverted from within the Lease Area to the ACPARS safety fairways (COP, Appendix S, Section 6.5.4; Dominion Energy 2022), if approved.

The WTG layout was designed to have a 397-foot (121-meter) buffer to the edges of the Lease Area to ensure that no structures would be outside of the Lease Area including the blades (COP, Section 3.3, Dominion Energy 2022). Vessels that exceed a height of 108 feet (33 meters) would be at risk of allision with WTG blades at mean high water should they navigate through the Wind Farm Area due to negligence, accident or emergency, and would need to navigate around the Wind Farm Area or navigate with caution through the Wind Farm Area to avoid the WTGs.

Proposed Action structures would increase the risk of allision as well as collision with other vessels navigating through WTGs and could interfere with marine radars (although other navigation tools are available to ship captains). The increased risk of allisions and collisions could, in turn, increase the risk of spills (refer to COP Section 4.1.2, for a discussion of the likelihood of spills). Nearly all vessels that travel through the Wind Farm Area where no structures currently exist would need to navigate with greater caution under the Proposed Action to avoid WTGs and OSSs; however, there would be no restrictions on use or navigation in the Wind Farm Area. WTGs with lighting and marking could serve as additional aids to navigation. Many vessels that currently navigate that area would continue to be able to navigate through the Wind Farm Area between the WTGs and OSSs.

While some non-Project vessel traffic may navigate through the Wind Farm Area, many vessels would most likely choose not to pass through the area during construction (due to the presence of construction-related activities and the emergence of fixed structures), during the life of the Project (due to the presence of fixed structures) and during decommissioning. The NSRA modeled the frequency of marine accidents under the Proposed Action assuming there would be a rerouting of common vessel traffic routes around the Wind Farm Area for the larger commercial traffic utilizing the proposed ACPARS safety fairways (COP, Appendix S, Section 6.5.4; Dominion Energy 2022). The NSRA assumed other vessel types, including fishing, pleasure and other vessels, would not reroute around the Wind Farm Area.

The primary increased risk in terms of allision with structures arises from the cumulative impact from the Proposed Action and the nearby Kitty Hawk Wind North and South projects near the southern and northwestern surface Offshore Project Components, and there is not anticipated to be a notable increase of traffic. A moderate risk with further mitigation needed for power vessel allisions and moderate to high risk with further mitigation needed for drifting vessel allisions (COP, Appendix S, Section 10.2.4; Dominion Energy 2022).

O&M of the Proposed Action would likely affect marine radar on vessels near or within the Wind Farm Area. As noted in the NSRA, the potential impacts on marine radar are variable, with the most likely effect being signal degradation. Proximity to the WTGs is the primary factor that determines the degree of radar signal degradation. Due primarily to the quality of radars and the proficiency of professionally licensed crew, radar operations on commercial ships are not anticipated to be affected. Smaller vessels operating in the vicinity of the Project may experience radar cluttering and shadowing (COP, Appendix S, Section 8.8, Section 8.9; Dominion Energy 2022) While radar is one of several navigational tools available to vessel captains, including navigational charts, global positioning system, and navigation lights mounted on the WTGs (COP, Appendix S, Section 7.1; Dominion Energy 2022) radar is the main tool used to help locate other nearby vessels that are not otherwise visible. The navigational complexity of transiting through the Wind Farm Area, including the potential effects of WTGs and OSSs on marine radars, would increase risk of collision with other vessels (including non-Project vessels and Proposed Action vessels). Furthermore, the presence of the WTGs could complicate offshore search and rescue operations or surveillance missions within the Wind Farm Area and lead to abandoned search and rescue missions and resultant increased fatalities. This would have localized, long-term, continuous, major impacts on navigation and vessel traffic.

Under Alternative A-1, there would be three fewer WTGs compared to the Proposed Action’s 205 WTGs to accommodate alignment of the three OSSs within the gridded layout of WTGs. Therefore, the potential risk of allision with structures, collisions with other vessels, and impacts on offshore search and rescue operations or surveillance missions would be reduced when compared to the Proposed Action. However, because Alternative A-1 would still introduce up to 202 WTGs and three OSSs where no such structures currently exist, impacts on navigation and vessel traffic would remain localized, long term, continuous, and major.

New cable emplacement/maintenance: The Proposed Action or Alternative A-1 would require the installation of offshore export cables and inter-array and substation interconnector cables. The presence of slow-moving (or stationary) installation or maintenance vessels would increase the risk of collisions and spills. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes or avoid installation or maintenance areas entirely during installation and maintenance activities. The presence of installation or maintenance vessels would have localized, short-term, intermittent impacts on navigation and vessel traffic.

Traffic: Construction of the Proposed Action would generate an average of 46 vessel per day throughout the duration of construction operating in the Wind Farm Area or over the offshore export cable route at any given time from 2023 through 2027, with a minimum of three and a maximum of 95 vessel trips (COP, Table 3.4-5; Dominion Energy 2022). Alternative A-1 would require similar but slightly less vessel traffic due to three fewer WTGs that would be constructed compared to the Proposed Action. Various vessel types (scour protection, installation, cable-laying, support, transport/feeder, and crew vessels) would be deployed throughout the Offshore Project area during the construction and installation phase. The presence of these vessels would increase the risk of allision, collision, and spills (refer to COP Section 4.1.2 for a discussion of the likelihood of spill. The vessels would typically be transiting to the Offshore Project area from staging and support areas throughout the Hampton Roads area of Virginia (Section 3, *Description of Proposed Activity*). However, construction activities within the Offshore Project area would be compatible with existing marine transportation uses and would not represent a substantial increase in existing vessel traffic in the region.

Project-related vessel traffic would not interfere with existing marine and navigation traffic patterns as shown in COP Appendix S. Project-related vessel traffic would follow existing transit routes to the extent practicable. During offshore export cable route construction, non-Project vessels required to travel a more restricted (narrow) lane could potentially experience greater delays waiting for cable-laying vessels to pass. Proposed Action vessel traffic in ports could result in vessel traffic congestion, limited maneuvering space in navigation channels, and delays in ports and could also increase the risk of collision, allision, and resultant spills, in or near ports. Non-Project vessels transiting between the Proposed Action ports and the

Wind Farm Area would be able to avoid Proposed Action vessels, components, and any restricted safety zones (where USCG is authorized and elects to establish such zones)[3] through routine adjustments to navigation. Although fishing vessels may experience increased transit times in some situations, these situations would be spatially and temporarily limited. An increase in avoidance measures could lead to over-avoiding and alluding with fixed structures or non-moving vessels. The Proposed Action or Alternative A-1's construction and installation vessel traffic would have localized, short-term, continuous impacts on overall navigation and vessel traffic in opens waters and near ports.

Vessel traffic generated by the Proposed Action or Alternative A-1 could restrict maneuvering room and cause delays accessing the port. Although vessel traffic within the Lease Area is expected to decrease once the WTGs and OSSs are in place, O&M of the Proposed Action would result in the same types of vessel traffic and navigation impacts as those described during construction (COP, Table 3.4-6; Dominion Energy 2022). During O&M, approximately 52 annual vessel round trips are anticipated to port. Activities related to the operation of the Proposed Action or Alternative A-1 would be localized, temporary, and infrequent relative to the life of the Project.

There is a potential for additional navigation risk where crossings are proposed on inland waters, specifically the Atlantic Intracoastal Waterway (AIWW) Albemarle-Chesapeake Canal (ACC). The Portsmouth Marine Terminal, which will be the construction port for this project is at the entrance of Elizabeth River, which is the beginning of the ACC. CVOW anticipates that there will be localized, short-term impacts on vessel traffic during construction and decommissioning activities at these crossings.

The NSRA risk modeling suggests that under the Proposed Action, accident frequency would increase negligibly at 1 in 1,447 years (COP, Appendix S, Table 10.2; Dominion Energy 2022). The Final Safety Assessment lists the As Low As Reasonably Practicable cumulative Risk Level associated with the Proposed Action as within either the Tolerable level, or the Broadly Acceptable level. The Final Safety Assessment table is included in EIS Appendix I along with the Risk Results Summary table from the NSRA.

Chapter 2, *Proposed Action and Alternatives,* of the EIS describes the non-routine activities associated with the Proposed Action. Examples of such activities or events that could affect navigation and vessel traffic include non-routine corrective maintenance activities, collisions or allisions between vessels or vessels and WTGs or OSSs, cable displacement or damage by anchors or fishing gear, chemical spills or releases, severe weather and other natural events, and terrorist attacks (this is listed as unlikely and not analyzed further). These activities, if they were to occur, would generally require intense, temporary activity to address emergency conditions. The occasional increased vessel activity in offshore locations near the offshore export cable route or within the Wind Farm Area working on individual WTGs or OSSs could temporarily prevent or deter navigation and vessel traffic near the site of a given non-routine event. In addition, severe weather could temporarily prevent or deter vessel operators from approaching or crossing the Wind Farm Area. Impacts on navigation and vessel traffic would be temporary, lasting only as long as severe storms or repair or remediation activities necessary to address these non-routine events.

[3] Under the current captain of the Port authority, USCG does not regulate the safety and security risks associated with the construction and operation of Offshore Renewable Energy Installations beyond 12 nautical miles (22 kilometers); however, the 2021 National Defense Authorization Act Section 8343 includes a pilot program for the U.S. Coast Guard to begin to develop a process to establish safety zones in the EEZ for "Special Activities," which includes offshore energy development. (USCG 2021).

3.16.5.1 Cumulative Impacts of the Proposed Action

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

Anchoring: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to anchoring impacts from ongoing and planned activities would be short term and minor due to the small size of the offshore wind lease areas in the geographic analysis area compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario. In addition, the designated official anchoring area nearby would limit the potential impacts on routine anchorage operations across the geographic analysis area.

Port Utilization: Other offshore wind projects would generate comparable types and volumes of vessel traffic in ports and would require similar types of port facilities as the Proposed Action. The Proposed Action would be under construction in 2025, after construction to the other potential offshore wind project in the geographic analysis area has begun. Therefore, the increase in port utilization due to other offshore wind project vessel activity would be limited during construction and installation of the Proposed Action. It is unlikely that all projects would use the same ports; therefore, the total increase in vessel traffic would likely be distributed across multiple ports in the region. However, there could be delays for vessels using those ports if two or more projects are under construction at the same time. Accordingly, in context of reasonably foreseeable environmental rends, combined port utilization impacts on navigation and vessel traffic from ongoing and planned activities, including the Proposed Action and Alternative A-1, would be continuous and moderate.

Presence of Structures: In context of reasonably foreseeable environmental trends, the Proposed Action or Alternative A-1 would contribute an appreciable increment to the combined impacts from ongoing and planned activities including offshore wind. Structures from other offshore wind activities would generate comparable types of impacts as under the Proposed Action across the entire geographic analysis area. A total of 395 WTGs and six OSSs would be constructed under the Proposed Action and the other offshore wind projects in the geographic analysis area (or 392 WTGs and six OSSs under Alternative A-1). The presence of structures from all offshore wind projects in the geographic analysis area would further increase the navigational complexity in the region, resulting in an increased risk of collisions and allisions, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The presence of neighboring offshore wind projects could also affect demand for resources associated with USCG search and rescue operations by changing vessel traffic patterns and densities.

New cable emplacement/maintenance: In context of reasonably foreseeable environmental trends and planned activities, cable installation and maintenance for other offshore wind activities would generate comparable types of impacts to those of the Proposed Action for each offshore export cable route and inter-array and interconnector cable system. As shown in Table F-3 in Appendix F, offshore export cable and inter-array/ interconnector cables for one other offshore wind project could be operating simultaneously while the Proposed Action is under construction. Simultaneous construction of inter-array and interconnector cables for the adjacent project could have a combined effect of temporary increases in construction traffic, although it is assumed that installation vessels would only be present above a portion of a project’s inter-array/interconnector system at any given time and the cables themselves would not conflict with the project layout. Substantial areas of open ocean are likely to separate simultaneous offshore export cable and inter-array/interconnector installation activities for other offshore wind projects. As a result, the contribution of the Proposed Action to the impacts on navigation and vessel traffic from cable installation from ongoing and planned activities would be localized, short term, intermittent, and minor. The impacts of cable maintenance during operation of the Proposed Action or Alternative A-1 and other ongoing and planned activities would be localized, long term, and intermittent.

Traffic: The other offshore wind project in the geographic analysis area would generate amounts of vessel traffic comparable to that of the Proposed Action or Alternative A-1. While construction of the Proposed Action or Alternative A-1 is expected to be completed in 2027 (COP, Appendix S, Table 4.3; Dominion Energy 2022) should any overlap in construction occur vessel traffic impacts could be increased. Following construction, 26 annual vessel roundtrips are anticipated to support O&M activities. Traffic from these projects could be spread among multiple ports within and outside the geographic analysis area for navigation and vessel traffic, thus potentially moderating the effect of offshore wind-related vessel traffic at any single location. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to vessel traffic impacts from ongoing and planned activities would be localized, short term, and intermittent. The NSRA (COP, Appendix S; Dominion Energy 2022) was completed with consultation from key marine and navigation stakeholders as well as a comprehensive list of "regular operators" in the region identified via assessment of vessel traffic data and all comments and concerns were addressed.

3.16.5.2 Conclusions

Impacts of the Proposed Action. In summary, construction and installation, O&M, and decommissioning of the Proposed Action or Alternative A-1 would have adverse impacts on navigation and vessel traffic. The impacts of the Proposed Action alone on navigation and vessel traffic would range from **minor** to **moderate**. Impacts on non-Project vessels would include changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore search and rescue or surveillance missions within the Wind Farm Area, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would choose to avoid the Wind Farm Area altogether, leading to some potential funneling of vessel traffic along the Wind Farm Area borders. In addition, the increase in potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users in the geographic analysis area. Because Alternative A-1 would develop three fewer WTGs compared to the Proposed Action's 205 WTGs to accommodate alignment of the three OSSs within the gridded layout of WTGs, the potential risk of allision with structures, collisions with other vessels, and impacts on offshore search and rescue operations or surveillance missions would be slightly reduced. However, because Alternative A-1 would still introduce up to 202 WTGs and three OSSs where no such structures currently exist, impacts on navigation and vessel traffic would remain localized, long term, continuous, and major. For more information regarding navigation and vessel traffic, refer to Appendix I, *Environmental and Physical Setting*, Table I-7 and Table I-8 for navigation-related mitigation measures.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **minor** to **major**. The main IPF is the presence of structures, which increase the risk of collision/allision and navigational complexity, particularly if OSSs are not positioned in alignment within the rows of WTGs as under the Proposed Action. Considering all the IPFs together, BOEM anticipates the overall impacts on navigation and vessel traffic from ongoing and planned activities, including the Proposed Action and Alternative A-1, would be **minor** to **major** and short and long term, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.16.6 Impacts of Alternatives B and C on Navigation and Vessel Traffic

Impacts of Alternatives B and C. The impacts on navigation and vessel traffic from Alternatives B and C would be similar to but slightly less than the impacts from the Proposed Action. Alternatives B and C include 29 fewer WTGs and 33 fewer WTGs than the Proposed Action, respectively. However, unlike the Proposed Action but as with Alternative A-1, Alternatives B and C would site the three OSSs in alignment with the rows of WTGs, thus reducing impacts on navigation and vessel traffic.

When compared to the Proposed Action, Alternatives B and C would exclude a diagonal row of three WTGs in the northwestern portion of the Lease Area, which would otherwise slightly overlap a portion of the proposed Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway. As discussed in COP Section 4.4.7, *Marine Transportation and Navigation*, regulations governing fairways in 33 CFR Part 166 provide that fixed offshore structures are not permitted within fairways because these structures would jeopardize safe navigation. USCG may establish, modify, or relocate existing fairways to improve navigation safety or accommodate offshore activities such as mineral exploitation and exploration. While the proposed Eastern Approach Cutoff Fairway has not yet been established, Alternatives B and C would deconflict any interference with the exclusion of three WTGs in the northwestern portion of the Lease Area when compared to the Proposed Action.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, incremental impacts contributed by Alternatives B and C to the combined impacts from ongoing and planned activities including offshore wind would be similar to but slightly less than those of the Proposed Action.

3.16.6.1 Conclusions

Impacts of Alternatives B and C. Construction of Alternatives B and C alone would have the same **minor** to **major**, short- and long-term impacts on navigation and vessel traffic as described under the Proposed Action. While Alternatives B and C may slightly reduce impacts due to the reduction in WTG positions and alignment of OSSs, including exclusion of three WTGs within a small portion of the proposed Eastern Approach Cutoff Fairway, the magnitude of impacts would not be materially different from that of the Proposed Action.

Cumulative Impacts of Alternatives B and C. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B and C to the overall impacts on navigation and vessel traffic would be appreciable. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternatives B and C when combined with the impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action: **minor** to **major**.

3.16.7 Impacts of Alternative D on Navigation and Vessel Traffic

Impacts of Alternative D. The impacts on navigation and vessel traffic from Alternative D would be the same as under the Proposed Action because Alternative D would use the same offshore layout as the Proposed Action (205 WTGs and three OSSs in offset positions).

Cumulative Impacts of Alternative D. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the overall impacts on navigation and vessel traffic would be appreciable. As under the Proposed Action, the main IPF from which impacts are contributed is the presence of structures, which increases the risk of collision/allision and navigational complexity, particularly because the OSSs would not be positioned within the rows of the gridded WTG layout. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative D, when combined with impacts from ongoing and planned activities including offshore wind, would be **minor** to **major**, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.16.7.1 Conclusions

Impacts of Alternative D. The impacts of Alternative D alone on navigation and vessel traffic would be the same as those of the Proposed Action and would range from **minor** to **moderate** and short and long term.

Cumulative Impacts of Alternative D. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the overall impacts on navigation and vessel traffic would be appreciable and the same as under the Proposed Action. Considering all of the IPFs together, BOEM anticipates the overall impacts associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be the same as those of the Proposed Action and range from **minor** to **major**.

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3.17. Other Uses (Marine Minerals, Military Use, Aviation)

This section discusses potential impacts on other uses not addressed in other portions of the EIS, including marine minerals, military use, aviation, cables and pipelines, radar systems, and scientific research and surveys, that would result from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis areas for these topics are described in Appendix F, *Planned Activities Scenario*, and shown on Figure 3.17-1.

- **Aviation and air traffic, military and national security, and radar systems:** Areas within 10 miles (16.1 kilometers) of the offshore export cable route corridor, interconnection cable route corridor, onshore export cable route corridor, and Wind Farm Area and Lease Area, as well as Norfolk International Airport; Newport News/Williamsburg International Airport; Naval Station Norfolk; Naval Air Station Oceana; Naval Auxiliary Landing Field Fentress; and Dam Neck Annex, Virginia Beach (Figure 3.17-1).
- **Cables and pipelines:** Areas within 1 mile (1.6 kilometers) of the offshore export cable route corridor, interconnection cable route corridor, onshore cable route corridor, Wind Farm Area, and the Lease Area that could affect future siting or operation of cables and pipelines (Figure 3.17-1).
- **Scientific research and surveys:** Same geographic analysis area as finfish, invertebrates, and EFH (Figure 3.17-1).
- **Marine minerals:** Areas within 0.25 mile (0.4 kilometer) of the export cable route corridor and Wind Farm Area that could affect marine minerals extraction (Figure 3.17-1).

These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction, O&M, and conceptual decommissioning.

3.17.1 Description of the Affected Environment for Other Uses

3.17.1.1 Marine Minerals

BOEM's Marine Mineral Program manages non-energy minerals (primarily sand and gravel) in federal waters of the OCS and leases access to these resources to target shoreline erosion, beach renourishment, and restoration projects. The geographic analysis area includes one active OCS lease area, and the offshore export cable route corridor would cross portions (23 aliquots) of sand resource areas but not cross the active sand borrow areas.

There are two ocean dredge disposal sites within the geographic analysis area. The Dam Neck Ocean Disposal Site (DNODS) is located approximately 2.4 nautical miles (4.4 kilometers) off the coast of Virginia Beach, Virginia, and would be crossed by the Offshore Cable Export Route. The DNODS was designated by USEPA for the ocean placement of suitable dredged material on March 31, 1988, and is active today. The DNODS receives approximately 1.2 million cubic yards of dredged material every 2 years to support the maintenance dredging of federal navigation channels (COP, Section 2.1.1.2; Dominion Energy 2022a). The Norfolk Ocean Disposal Site is located approximately 14.91 miles (24 kilometers) off the coast of Cape Henry, Virginia, at the mouth of the Chesapeake Bay, north of the Project area. The Norfolk Ocean Disposal Site was designated by USEPA for placement of suitable dredged material at this ocean site on July 2, 1993, and is active today. Ocean dredge disposal sites and the Project area are shown in COP Figure 4.4-59 (Dominion Energy 2022a). The DNODS is jointly managed by the USEPA and USACE and is specifically utilized by the USACE Norfolk District and Baltimore District.

USACE requires that buried cables be located only within DNODS Cells 2 and 5 and those cables be buried at depths greater than 6 feet below the native bottom sediment. USACE will authorize the use of cable protection measures, in order to maintain the use of the entire dredge material placement site and to allow the USEPA to conduct necessary sediment testing throughout the site.

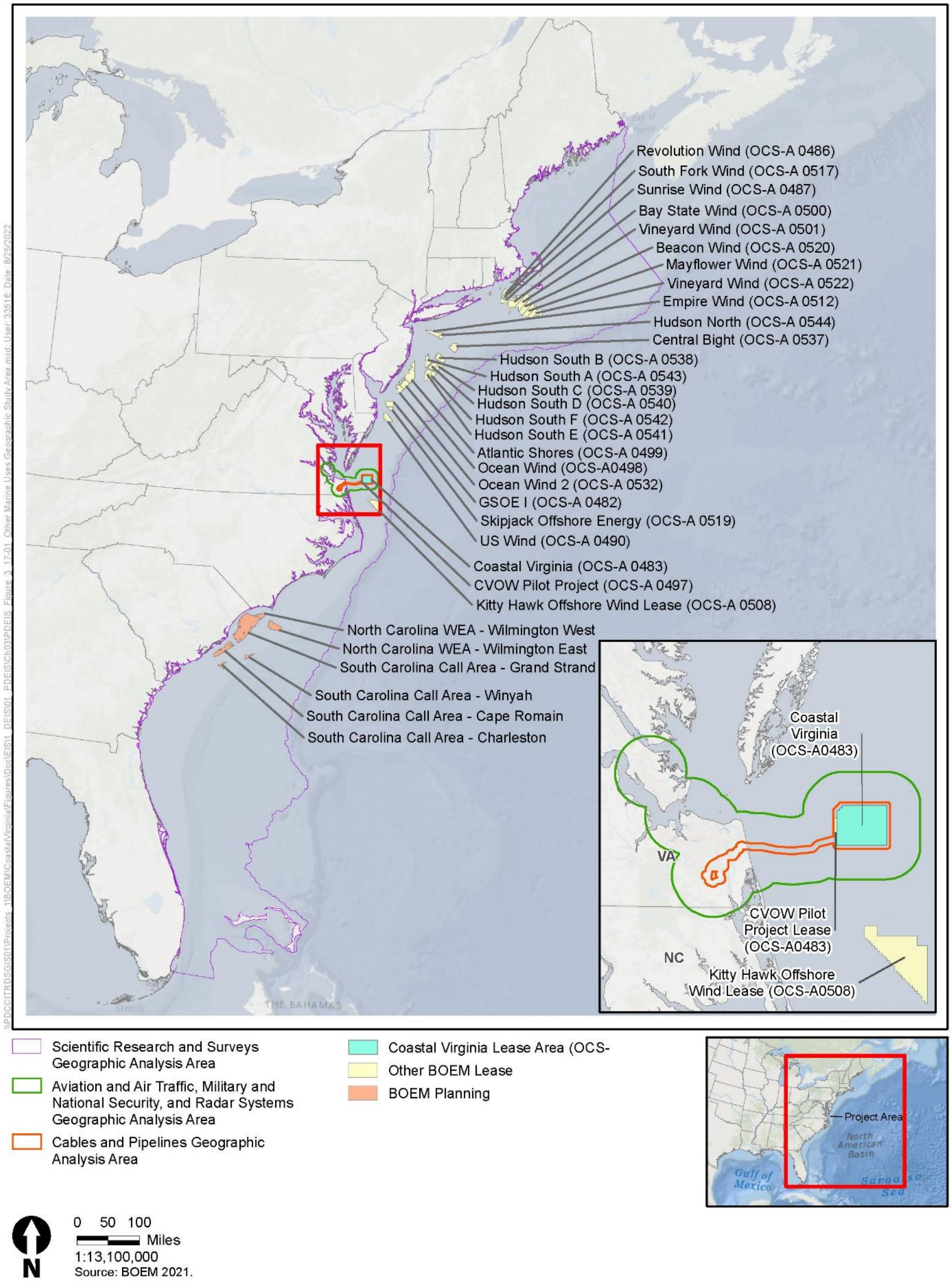

Figure 3.17-1 Other Marine Uses Geographic Analysis Area

3.17.1.2 National Security and Military Uses

3.17.1.2.1 Virginia Capes Operating and Warning Areas and State Military Reservation Areas

The Wind Farm Area is located near VACAPES (COP, Figure 4.4-52; Dominion Energy 2022a). The closest distance from the Wind Farm Area to VACAPES is 1,805 feet (550 meters). Operations throughout VACAPES occur intermittently, with durations ranging from a few hours to several weeks, and are dispersed off the coasts of Virginia and North Carolina but largely concentrated within VACAPES (COP, Figure 4.4-53; Dominion Energy 2022a). The U.S. Navy uses VACAPES for various exercises and training, with areas within the geographic analysis area designated as: Danger Zones (defined by 33 CFR 334.2 as "a defined water area (or areas) used for target practice, bombing, rocket firing or other especially hazardous operations, normally for the armed forces"), Danger Areas (defined by 33 CFR 334.2 as "airspace of defined dimensions within which activities dangerous to the flight of an aircraft may exist at specified times"), and Restricted Areas (defined by 33 CFR 334.2 as areas where public access is prohibited or limited due to general use by the U.S. Government). Danger Zones and Restricted Areas are shown in COP Figure 4.4-54 (Dominion Energy 2022a). The offshore export cable route corridor intersects VACAPES Danger Zone 334.380(a) and VACAPES Danger Zone 334.390(A), and also intersects the SMR Danger Zone (the SMR is formerly known as Camp Pendleton). The offshore export cable route corridor is also adjacent to one Danger Area and to Naval Restricted Area 334.320(a) (COP, Section 4.4.8.1; Dominion Energy 2022a).

Military activities are anticipated to continue to use onshore and offshore areas in the vicinity of the Project area into the future and may involve routine and non-routine activities. Dominion Energy has been coordinating with DoD throughout Project development, and previously coordinated with DoD on the CVOW-Pilot Project. All CVOW-C survey, construction, and O&M activities would be coordinated closely with the DoD. If Project activities encounter military operations in the Project area, VACAPES Fleet Area Control and Surveillance Facility (Giant Killer) would be contacted. This VACAPES facility is dedicated to supporting homeland defense and advancing the combat readiness of U.S. Atlantic Fleet and Joint Forces by providing control, surveillance, management, sustainment, and ready access to assigned airspace, operating areas, training ranges, and resources.

3.17.1.2.2 Special-Use Airspace

As shown on COP Figure 4.4-55 (Dominion Energy 2022a), the Offshore Project area would be located between VACAPES AIR-K and W-72 special use airspace areas. The closest regulated military airspace is 0.36 mile (0.58 kilometer) from the Lease Area.

3.17.1.2.3 Naval Air Station Oceana

Naval Air Station Oceana (NAS Oceana) is located in Virginia Beach, Virginia, approximately 1.6 linear miles (2.6 kilometers) from the cable landing location. NAS Oceana contains approximately 7 miles (11 kilometers) of runways, with more than 4,000 acres (1,619 hectares) of facilities to serve military air traffic on the East Coast. The mission of NAS Oceana is to support the Navy's Atlantic and Pacific Fleet Force of Strike Fighter Aircraft and Joint/Inter-Agency Operations and to ensure readiness of the 16 homebased F/A-18 Hornet Strike Fighter Squadrons. NAS Oceana's Apollo Soucek Field has four runways, three measuring 8,000 feet (2,438 meters) in length and one measuring 12,000 feet (3,658 meters). NAS Oceana is also home to numerous Fleet Support units, commands, and departments.

A portion of the onshore export cable route runs underground through property owned by the Navy, as part of NAS Oceana, in an area that is currently managed as part of the agricultural out lease program. Dominion Energy is in the process of coordinating with NAS Oceana for the appropriate real estate leasing necessary to utilize this parcel to route the onshore export cable, pending Navy approval, at this location (COP, Section 4.4.8.1; Dominion Energy 2022a).

3.17.1.2.4 State Military Reservation

The SMR, formerly known as Camp Pendleton, is located in Virginia Beach, Virginia, and is used primarily for Virginia Army National Guard training activities. The SMR covers 365 acres (148 hectares) and includes the following facilities: a firing range in the eastern portion of the base, a reserve center along the western border, various training areas in the beaches and dunes areas, and an explosives test facility. The SMR is primarily used for training in special warfare, ordnance, overland assault, beach assault, and tactical air operations radar. The offshore export cable route corridor would intersect the SMR Danger Zone/Pendleton Danger Zone as shown in COP Figure 4.4-54 (Dominion Energy 2022a). The cable landing location would utilize the proposed Parking Lot west of the Firing Range at the SMR, located east of Regulus Avenue and north of Rifle Range Road. Additionally, the onshore export cable route would run underground through the SMR. Dominion Energy is in the process of coordinating with the SMR for the appropriate real estate leasing necessary to use this parcel to route the onshore export cable at this location (COP, Section 4.4.8.1, Dominion Energy 2022a); the easement agreement will be finalized after the Virginia State Corporation Commission (SCC) review of the project is complete.

3.17.1.2.5 Dam Neck Annex

Dam Neck Annex, which is part of NAS Oceana, is located directly south of the SMR in Virginia Beach, Virginia, covering approximately 1,900 acres (769 hectares). The mission of Dam Neck Annex is to provide training in specified combat systems operation and maintenance, specialized skills training, and training systems support to operational and systems commands. Major tenants of Dam Neck Annex include Naval Special Warfare Development Group; Tactical Training Group, Atlantic; and Atlantic Targets & Marine Operations. Facilities include firing ranges, weapons gunline, helicopter pad, weapons compound, and beach/dune training areas. Danger Zones associated with the installation’s offshore ranges are shown in COP Figure 4.4-54 (Dominion Energy 2022a).

3.17.1.2.6 Naval Auxiliary Landing Field Fentress

The Naval Auxiliary Landing Field Fentress (NALFF) is located in Chesapeake, Virginia, within 1.4 linear miles (2.3 kilometers) from the onshore substation (at the closest point). Strike Fighter Squadron 106 NALFF serves as a major carrier landing training facility for aircraft stationed at NAS Oceana and Chambers Field. The 329-acre (133-hectare) installation includes one 8,000-foot (2,438-meter) runway equipped to simulate an aircraft carrier flight deck. Operations are intended to familiarize pilots with aircraft carrier landings and are primarily conducted at nighttime. The interconnection cable route options overlap with NALFF property and are 0.75 mile (1.2 kilometer) from the airfield location.

3.17.1.2.7 U.S. Coast Guard

The geographic analysis area includes the USCG Fifth District in the Atlantic area, which is based in Portsmouth, Virginia, and is responsible for all USCG missions between New Jersey and the southern border of North Carolina. The closest USCG station to the Lease Area and offshore export cable route is located as a tenant at the Naval Amphibious Base Little Creek (for a list of additional nearby USCG stations, see COP Appendix S, *Navigation Safety Risk Assessment*, Figure 9.1; Dominion Energy 2022a). During a recent 10-year time period (2010–2019), 18 USCG Search and Rescue (SAR) incidents were recorded within 10 miles of the Lease Area, and an additional 21 SAR incidents were recorded within a few miles of the offshore export cable route (COP, Appendix S, Section 9.1.2; Dominion Energy 2022a). No allision, collision, or grounding incidents were recorded during the same time period within 10 miles of the Lease Area; one collision and one allision were recorded within a few miles of the offshore export cable route (COP, Appendix S, Section 9.1.4; Dominion Energy 2022a).

3.17.1.3 Aviation and Air Traffic

Multiple public, private-use, and military airports and heliports serve the region surrounding the Project area, including Norfolk International Airport (ORF), Newport News/Williamsburg International Airport, Hampton Roads Executive Airport, Chesapeake Regional Airport, and NAS Ocean/Apollo Soucek Field. Air traffic is expected to increase in and around the geographic analysis area; for example, the ORF 2021 Master Plan anticipates a 34 percent increase in total operations from 2018 to 2038 (Norfolk Airport Authority 2021).

The Wind Farm Area is outside of U.S. territorial waters; therefore, the FAA does not have a mandate to conduct aeronautical studies for WTGs associated with the proposed Project. Engineering details for the Onshore Project components have not yet been finalized. Once line engineering details are more complete, each proposed transmission line structure will be entered into the FAA's Obstruction Evaluation Notice Criteria Tool to identify potential hazards to air navigation that would require additional FAA Evaluation/Part 2 Notification (Notice of Proposed Construction or Alteration).

The proposed Project lies within the Atlantic Test Range Geographical Area of Concern, with the potential to impact test capabilities of the Advanced Dynamic Aircraft Measurement System at Patuxent River Naval Air Station. Dominion Energy is coordinating with the Department of the Navy on the undersea cable route and cable landing location and whether there are plans to put monitoring equipment on the undersea cables—and coordinating on the use of foreign-owned or controlled vendors in the Project—and anticipates providing updates to BOEM in late 2022. Discussions with DoD are ongoing based on the findings of this informal review.

3.17.1.4 Cables and Pipelines

The offshore export cable route corridor crosses three submarine telecommunication cables, the MAREA, DUNANT, and BRUSA submarine cables. All three cables make landfall at the Croatan Beach Parking Lot in Virginia Beach, Virginia. The offshore export cable route corridor would likely also cross the easement for the CVOW-Pilot Project Offshore Export Cable Route Corridor, which lands at the SMR Beach Parking Lot.

There are no pipelines identified in the offshore portion of the geographic analysis area. The Commonwealth of Virginia Legislature passed a bill in 2020 that is intended to discourage future oil and gas development off the coast of Virginia by prohibiting the issuance of leases or easements in Virginia state territorial waters for the purpose of oil and gas infrastructure, including pipelines, gathering systems, storage, and processing (Virginia HB1016) (COP, Section 4.4.9.1; Dominion Energy 2022a).

In the onshore portion of the geographic analysis area, there are multiple existing Dominion Energy transmission lines, existing natural gas pipelines operated by Virginia Natural Gas (VNG), and an existing pipeline that transports jet fuel and is operated by NuStar Energy, L.P. T (Dominion Energy 2022b).

3.17.1.5 Radar Systems

There are several radar systems in the general vicinity of Project, including DoD, FAA, and NOAA radar sites, as well as high-frequency (HF) Coastal Radar sites. Relevant radar operations may include those associated with the Advanced Dynamic Aircraft Measurement System at Naval Air Station Patuxent River and the Re-locatable Over the Horizon Radar system located at Naval Support Activity Hampton Roads, Northwest Annex in Chesapeake, Virginia, and the North American Aerospace Defense

Command homeland defense radar. In addition, the following HF radar systems may experience impacts: Duck HF Radar, Little Island Park HF Radar, Island HF Radar, and Cedar Island HF Radar. WTGs that are near to or in the direct line of sight of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal.

Existing radar systems will continue to provide weather, navigational, and national security support to the region. The number of radars and their coverage area are anticipated to remain at current levels for the foreseeable future (COP, Section 4.4.10; Dominion Energy 2022a).

3.17.1.6 Scientific and Research Surveys

Various federal, state, and educational organizations regularly conduct scientific research, including aerial- and ship-based scientific surveys, within the geographic analysis area. This includes long-term and seasonal scientific surveys conducted by NOAA and Virginia Institute of Marine Science (VIMS) for several regional programs. Some survey programs of note included the following.

- NOAA's NEFSC:
  - Atlantic Bottom Trawl Survey (NOAA 2020a)
  - Marine Recreational Information Program (NOAA 2020b)
  - Fisheries Large Pelagics Survey (NOAA Fisheries 2020c)
- VIMS:
  - Longline shark survey (VIMS 2020a)
  - Northeast Area Monitoring and Assessment Program survey (VIMS 2020b)
  - Real-time Opportunity for Development Environmental Observations (BOEM 2020)

Fisheries-independent data are collected during these surveys to inform stock assessments, set harvest quotas, and support other fisheries management goals (COP, Section 4.4.11.1; Dominion Energy 2022a).

Very few geophysical and geotechnical activities for oil and gas exploration in the mid-Atlantic have been conducted due to a moratoria on Atlantic oil and gas leasing activities during most of the past 30 years. Previous surveys from the 1970s employed older technologies that are considered to be less precise than those used today. No other ongoing long-term surveys were identified within the Offshore Project area. In addition, there is no overlap between the Offshore Project area and oil and gas/geological and geophysical testing areas (COP, Section 4.4.11.1; Dominion Energy 2022a).

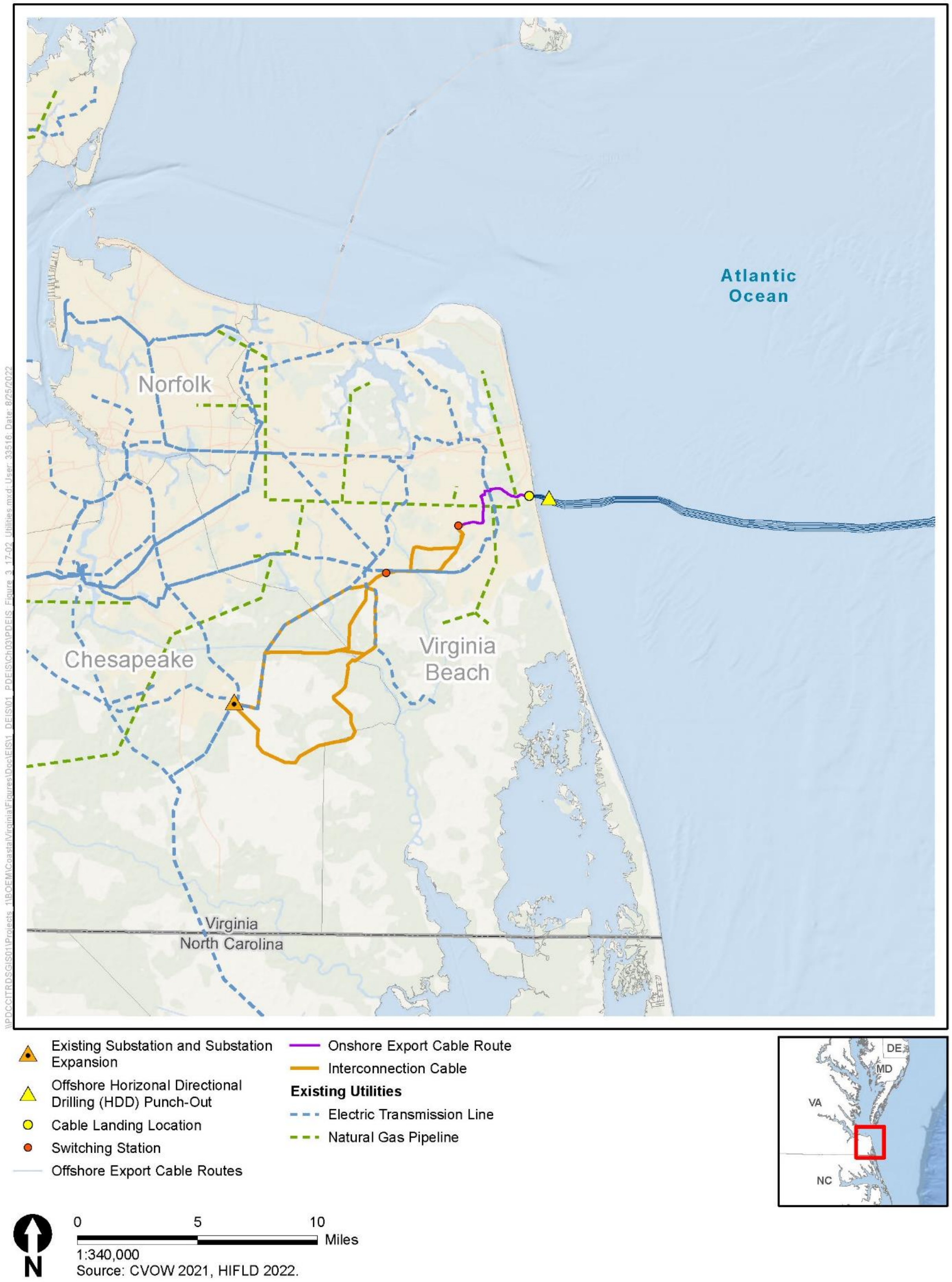

Figure 3.17-2 Cables and Pipelines in the Other Uses Geographic Analysis Area

3.17.2 Environmental Consequences

3.17.2.1 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation)

Definitions of impact levels are provided in Table 3.17-1. There would be no beneficial impacts on other uses.

Table 3.17-1 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation)

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Impacts on the affected activity would be avoided, and impacts would not disrupt the normal or routine functions of the affected activity. Once the Project is decommissioned, the affected activity would return to a condition with no measurable effects.
Moderate	Adverse	Impacts on the affected activity would be unavoidable. The affected activity would have to adjust to account for disruptions due to impacts of the Project, or, once the Project is decommissioned, the affected activity could return to a condition with no measurable effects if proper remedial action is taken.
Major	Adverse	The affected activity would experience unavoidable disruptions to a degree beyond what is normally acceptable, and, once the Project is decommissioned, the affected activity could retain measurable effects indefinitely, even if remedial action is taken.

3.17.3 Impacts of the No Action Alternative on Other Uses (Marine Minerals, Military Use, Aviation)

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

3.17.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys described in Section 3.17.1, *Description of the Affected Environment for Other Uses*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that would contribute to impacts on other uses would generally be associated with offshore developments and climate change. No offshore developments, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). Impacts on the marine environment associated with climate change and commercial fishing have the potential to affect ongoing research and surveys within the geographic analysis area.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on other uses include:

- Continued O&M of the Block Island Project (5 WTGs) installed in state waters,

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

Ongoing O&M of the Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect other uses through the primary IPFs of traffic and presence of structures. Ongoing offshore wind activities would have the same types of impacts from traffic and presence of structures that are described in detail in Section 3.17.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

3.17.3.2 Cumulative Impacts of the No Action Alternative

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

BOEM expects future offshore wind development to affect other uses through the following IPFs.

3.17.3.2.1 Marine Mineral Extraction

Presence of structures: There are two other planned future offshore wind project with offshore project components in the active OCS sand borrow area within the geographic analysis area: the Kitty Hawk Wind North and South Offshore Export Cable Routes would be located near the active sand borrow area and crosses the adjacent potential sand resource area. During operations and maintenance, users would be restricted from collecting sand resource areas within the vicinity of the offshore export cables to avoid uncovering the buried cable or to avoid disturbing remedial surface cable protection. Future projects would identify borrow areas through consultation with the BOEM Marine Minerals Program and USACE before approving offshore wind cable routes. There is one existing offshore wind project in the geographic analysis area: the CVOW-Pilot Project's offshore export cable route is located 1.6 nautical miles north of the sand resource area (BOEM 2015).

There are no other planned offshore wind projects in the geographic analysis area that would create space use conflicts with ocean dredge disposal sites. There is one existing offshore wind project in the geographic analysis area: the CVOW-Pilot Project intersects the DNODS with its offshore export cable route, which was sited based on recommendations made by USACE (BOEM 2015; Dominion Energy 2018).

The adverse impacts associated with the presence of structures on sand and marine mineral extraction of future offshore wind activities are anticipated to be long term and minor.

Traffic: The Kitty Hawk Wind North and South Export Cable Routes would be near the existing active sand borrow area and crosses the adjacent potential sand resource area. During construction and maintenance, vessel traffic associated with the sand borrow area could be temporarily disrupted due to vessels associated with cable construction and maintenance. Impacts would be greatest during construction during overlapping periods of construction with CVOW-C (the construction period of Kitty Hawk North would overlap with CVOW-C's construction period from 2024-2027 while Kitty Hawk South's construction period would overlap in 2027) (Appendix F, Table F-3). There may also be infrequent low levels of vessel traffic associated with maintenance of the existing CVOW-Pilot Project offshore export cable route.

The Kitty Hawk Wind North and South Export Cable Routes would be near, but would not intersect with, the DNODS. During construction and operation, there would be vessel traffic associated with offshore export cables. During such events, there may be a need to divert ocean dredge disposal traffic near dredge disposal sites due to the operations of the export cable maintenance vessels. There may also be maintenance vessels associated with operations of the CVOW-Pilot Project offshore export cable route.

The adverse impacts on vessel traffic associated with sand and marine mineral extraction of future offshore wind activities are anticipated to be temporary and minor.

3.17.3.2.2 National Security and Military Uses

Presence of structures: Existing stationary facilities within the geographic analysis area are limited to meteorological buoys operated for offshore wind farm site assessment. Dock facilities and other structures are concentrated along the coastline. Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for USCG SAR operations or other non-typical activities. Smaller-draft vessels moving within or near the wind installation have a higher risk of allision with offshore wind structures.

The CVOW-Pilot Project (construction completed and currently in operation) is located in the geographic analysis area, adjacent to the CVOW-C Lease Area (BOEM 2015). A small portion of the offshore export cable is located within the VACAPES Operations Area and parts of a special-use airspace area, and crosses live-fire danger zones operated by the Dam Neck Fleet Combat Center. The two project WTGs are located between sections of the VACAPES Operations Area. No other planned offshore wind stationary facilities are located in the geographic analysis area. The overall impacts from the presence of structures on military and national security uses from future offshore wind energy activities are anticipated to be minor.

Traffic: Impacts on military operations from vessel traffic related to the construction and operation of future and ongoing offshore wind activities (Kitty Hawk Wind North and South, and CVOW-Pilot Project) on the OCS are expected to be short term and localized. Vessel traffic is expected to increase during construction. Military and national security vessels may experience minor impacts due to congestion and delays in ports due to the increase in offshore wind facility vessels. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success.

3.17.3.2.3 Aviation and Air Traffic

Presence of structures: One existing offshore wind project was identified with WTGs in the geographic analysis area: the CVOW-Pilot Project has two 12-MW WTGs adjacent to the CVOW-C Lease Area. No additional offshore wind projects were identified with WTGs in the geographic analysis area. Two nearby future offshore wind project (Kitty Hawk Wind North and South) was identified that may have construction equipment located onshore and in ports within the geographic analysis area, as well as the presence of construction equipment (cranes and barges) offshore within the geographic analysis area. As a result, there may be short-term interference with airspace and aviation radar system. It is expected that the presence of structures on navigation risks and space use conflicts would be negligible with the implementation of mitigation measures.

3.17.3.2.4 Cables and Pipelines

Presence of structures: Three submarine telecommunication cables are located within the geographic analysis area. In addition, the existing CVOW-Pilot Project Offshore Export Cable Route Corridor is located within the geographic analysis area and makes landfall in the SMR Beach Parking Lot.

There are no pipelines identified in the offshore portion of the geographic analysis area. Further, the existing CVOW-Pilot Project cable landing location and onshore export cable do not intersect any cables or pipelines.

Up to 453 miles (729 kilometers) of export cables and up to 349 miles (562 kilometers) of inter-array cables are expected to be installed in the geographic analysis area as part of future offshore wind energy project infrastructure (Kitty Hawk Wind North and South). One existing offshore wind project (CVOW-Pilot Project) has approximately 24 miles (44.5 kilometers) of offshore export cable installed. The installation of WTGs and OSSs could preclude future submarine cable placement within the foundation footprint, which would cause future cables to route around these areas. However, the presence of existing submarine cables would not prohibit the placement of additional cables and pipelines. Following standard industry procedures, cables and pipelines can be crossed without adverse impact. Impacts on submarine cables would be eliminated during decommissioning of offshore wind farms when foundations are removed and if the export and inter-array cables associated with those projects are removed. Impacts on existing cables and pipelines due to anticipated future offshore wind projects are expected to be negligible.

3.17.3.2.5 Radar Systems

Presence of structures: WTGs that are near to or in the direct line of sight of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal. The location of WTGs in the proposed Kitty Hawk Wind North and South Projects could also impact the same military radar systems as the Proposed Action: the Advanced Dynamic Aircraft Measurement System at Naval Air Station Patuxent River and the Re-locatable Over the Horizon Radar system located at Naval Support Activity Hampton Roads, Northwest Annex in Chesapeake, Virginia, and the North American Aerospace Defense Command homeland defense radar. There are two WTGs associated with the existing CVOW-Pilot Project in the geographic analysis area that could also affect the HF radar systems.

BOEM assumes that project proponents would conduct an independent radar analysis and coordinate with FAA to identify potential impacts and any mitigation measures specific to aeronautical, military, and weather radar systems. BOEM would continue to coordinate with the Military Aviation and Installation Assurance Siting Clearinghouse to review each proposed offshore wind project on a project-by-project basis, and would attempt to resolve project concerns identified through such consultation related to military and national security radar systems with COP approval conditions. Refer to Section 3.16, *Navigation and Vessel Traffic*, for a discussion of impacts on marine vessel radar. As a result, impacts are expected to be negligible.

3.17.3.2.6 Scientific Research and Surveys

Presence of structures: Construction of other wind energy projects between 2023 and 2030 in the geographic analysis area would add up to 3,226 WTGs, associated cable systems, and associated vessel activity that would present additional navigational obstructions for sea- and air-based scientific studies. Collectively, these developments would prevent NOAA from continuing scientific research surveys or protected species surveys under current vessel capacities, would affect monitoring protocols in the geographic analysis area, could conflict with state and nearshore surveys, and may reduce opportunities for other NOAA scientific research studies in the area. This EIS incorporates by reference the detailed summary of and potential impacts on NOAA's scientific research provided in the Vineyard Wind Final EIS in Section 3.12.2.5, *Scientific Research and Surveys* (BOEM 2021). In summary, offshore wind facilities actuate impacts on scientific surveys and advice by preclusion of NOAA survey vessels and aircraft from sampling in survey strata and impacts on the random-stratified statistical design that is the basis for assessments, advice, and analyses. NOAA has determined that survey activities within offshore wind facilities are outside of safety and operational limits. Survey vessels would be required to navigate around offshore wind projects to access survey locations, leading to a decrease in survey precision and operational efficiency. The height of turbines would affect aerial survey design and protocols, requiring flight altitudes and transects to change. Scientific survey and protected species survey operations would therefore be reduced or eliminated as offshore wind facilities are constructed. Similarly, changes to existing survey methodologies or disruption of long-term surveys of fish and shellfish would create uncertainties in understanding stock or population change, biomass estimates, or other parameters used in projecting fishery quotas. Offshore wind facilities would disrupt survey sampling statistical designs, such as random-stratified sampling. Impacts on the statistical design of region-wide surveys would violate the assumptions of probabilistic sampling methods. Development of new survey technologies, changes in survey methodologies, and required calibrations could help to mitigate losses in accuracy and precision of current practices caused by the impacts of wind development on survey strata.

Other offshore wind projects could also require implementation of mitigation and monitoring measures identified in records of decision. Identification and analysis of specific measures are speculative at this time; however, these measures could further affect NOAA's ongoing scientific research surveys or protected-species surveys because of increased vessel activity or in-water structures from these other projects. BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies as a result of offshore wind farms.

Overall, reasonably foreseeable offshore wind energy projects in the area would have major effects on NOAA's scientific research and protected-species surveys, potentially leading to impacts on fishery participants and communities; as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

3.17.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, other uses would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on other uses. These effects are primarily driven by offshore construction impacts, the presence of structures, and traffic.

BOEM expects ongoing activities and future offshore wind activities to have continuing impacts on military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys primarily through presence of structures that introduce navigational complexities and vessel traffic.

BOEM anticipates that the impacts of ongoing activities other than offshore wind on other uses would be **negligible** for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Military and national security use, aviation and air traffic, vessel traffic, commercial fishing, and scientific research and surveys are expected to continue in the geographic analysis area. Impacts of ongoing activities on scientific research and surveys are anticipated to be long-term and **moderate** due to the impacts from climate change and fishing on the marine environment.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and other uses would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on other uses due to increased offshore construction, presence of structures, and traffic.

In addition to ongoing activities, BOEM anticipates that the impacts of planned non-offshore wind activities would also contribute to impacts on other uses. Planned activities expected to occur in the geographic analysis area other than offshore wind include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; and continued development of

FAA-regulated structures including cell towers and onshore wind turbines. BOEM anticipates that any issues with aviation routes or radar systems would be resolved through coordination with DoD or FAA, as well as through implementation of navigational marking of structures according to FAA, USCG, and BOEM requirements and guidelines. BOEM anticipates that the impacts of planned activities other than offshore wind would be **negligible** for aviation and air traffic, and cables and pipelines. Impacts of planned activities other than offshore wind are anticipated to be **minor** for marine minerals, for military and national security uses, radar systems, and scientific research and surveys due to the lack of proposed development in the offshore area.

Considering all the IPFs collectively, it is anticipated that ongoing and planned offshore wind activities in the geographic analysis area would result in **negligible** to **major** impacts. BOEM anticipates that the overall impacts associated with offshore wind in the geographic analysis area combined with ongoing activities and planned activities would be **negligible** for aviation and air traffic, cables and pipelines, and radar systems; **minor** for marine mineral extraction and national security and military uses, and **major** for scientific research and surveys.

3.17.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The number, size, location, and spacing of WTGs.
- Timing of offshore construction and installation activities.

Variability of the proposed Project design exists as outlined in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Below is a summary of potential variances in impacts.

- **WTG size and location:** larger (16 MW compared to 14 MW) turbines located closer to shore within the Wind Farm Area could increase impacts on land-based radar systems, movements of civilian and military aircraft, and military vessels.
- **WTG spacing:** Removal of groups of WTGs, creating spacing of greater than 1 nautical miles, could allow for scientific research and surveys in those areas, decreasing the impact.
- **Timing of construction:** Construction could affect submarine or surface military vessel activity during typical operations and training exercises.
- **Offshore cable route options:** The route chosen (including variants within the general route) could conflict with marine mineral extraction or cables and pipelines.

3.17.5 Impacts of the Proposed Action on Other Uses (Marine Minerals, Military Use, Aviation)

3.17.5.1 Marine Mineral Extraction

Space use conflicts: During operations and maintenance, users would be restricted from collecting sand resource in areas within the vicinity of the offshore export cables to avoid uncovering the buried cable or due to the presence of remedial surface cable protection. Three fewer WTGs and repositioning of OSSs under Alternative A-1 would not result in a substantive change in restrictions to sand resource areas compared to the Proposed Action. In the event that existing sand resource areas are considered for designation as sand borrow areas, Dominion Energy would work with the appropriate federal and state agencies to safeguard the export cable assets under the Proposed Action and Alternative A-1.

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action and Alternative A-1 to space use impacts on marine mineral extraction from ongoing and planned activities would be long-term, localized, and minor.

Traffic: The construction and maintenance of offshore export cables and corresponding increased construction and maintenance vessel traffic may impact vessel traffic associated with sand borrow and dredge disposal activity through temporary restrictions to the sand borrow areas in the geographic analysis area. Dominion Energy has proactively sited the offshore export cables to avoid active sand borrow sites and disposal sites to the extent practicable in an effort to avoid impacts. In the event that existing sand resource areas are considered for designation as sand borrow areas, Dominion Energy would work with the appropriate federal and state agencies to safeguard the export cable assets.

Construction and maintenance and repair of offshore export cables could also temporarily affect access to the DNODS. Dominion Energy would provide advance notice of construction and maintenance activities through local notices to mariners (LNTMs) and broadcast LNTMs, as well as on the Project website. Dominion Energy would also monitor and control Project vessel movements to minimize impacts on sand-borrowing and dredge spoil dumping activities. Three fewer WTGs and repositioning of OSSs under Alternative A-1 would not result in a substantive change in construction and maintenance of offshore export cables, and impacts on vessel traffic associated with sand borrow and dredge disposal activities would be the same as the Proposed Action.

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to vessel traffic impacts on marine mineral extraction from ongoing and planned activities would be long-term, localized, and minor.

3.17.5.2 National Security and Military Uses

Presence of structures: The addition of up to 205 WTGs and up to three OSSs would increase the risk of allisions for military vessels during Project operations, particularly in bad weather or low visibility. The presence of structures could also change navigational patterns and add to the navigational complexity for military vessels and aircraft operating in the Project area during construction and operation of the Proposed Action. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG guidelines, and WTGs would be visible on military and national security vessel and aircraft radar, minimizing the potential for allision and increased navigational complexity. Under Alternative A-1, there would be three fewer WTGs compared to the Proposed Action to accommodate alignment of the three OSSs within the gridded layout of WTGs. Therefore, the potential risk of allision with structures and impacts on military vessels and aircraft operating in the Project area would be reduced when compared to the Proposed Action. Dominion Energy would work with the DoD and USCG to facilitate training exercises within the Lease Area. Additional navigational complexity would increase the risk of collision and allisions for military and national security vessels or aircraft within the Project area.

The construction of the cable landing location in the SMR and the onshore export cable through the SMR would be the same for the Proposed Action and Alternative A-1 and could temporarily disturb some DoD activities. The construction of the onshore export cable through NAS Oceana would result in disturbance of agricultural land (open space). Once construction is complete, the lands, roads, and parking lots would be restored to previous conditions. To minimize potential construction effects on DoD activities, the DoD would be provided timely information regarding the planned construction activities and schedule.

Overall, presence of stationary structures from the Proposed Action or Alternative A-1 in the Wind Farm Area would cause localized, long-term, minor impacts from increased space use conflicts.

Traffic: Increased vessel traffic in the Wind Farm Area, offshore export cable route, and cable landing location in Virginia Beach during construction, operations, and decommissioning could result in an increased risk of vessel collisions with military and national security vessels, cause military and national security vessels to change routes, and result in congestion and delays in ports. Impacts would be greatest during construction when vessel traffic is highest and would be reduced during operations. Alternative A-1 would require similar but slightly less vessel traffic due to three fewer WTGs that would be constructed compared to the Proposed Action. Dominion Energy would schedule and track Project-related vessels to best manage congestion and traffic flow in coordination with USCG, DoD, and other national security stakeholders. Where practical, Project vessels would utilize transit lanes, fairways, and predetermined passage plans consistent with existing waterway uses and would send and receive AIS signals for awareness and collision avoidance. USCG would publish LNTMs and broadcast LNTMs to inform mariners and aviators of Project activities in the area. Additionally, Dominion Energy would publish an operations plan on the Project website to inform mariners and other interested parties on what work is being done in the Offshore Project area.

In context of reasonably foreseeable environmental trends, combined impacts, most likely to occur during construction and decommissioning timeframes, associated with the Proposed Action or Alternative A-1 and ongoing and planned activities would be localized, temporary, and minor.

3.17.5.3 Aviation and Air Traffic

Presence of structures: The Proposed Action or Alternative A-1 would install up to 205 WTGs or 202 WTGs, respectively, with maximum blade tip heights of 869 feet (265 meters) AMSL in the Wind Farm Area. Based on an Obstruction Evaluation Analysis and an Air Traffic Flow Analysis conducted by Capitol Airspace Group (COP, Appendix T; Dominion Energy 2022a), there are no anticipated adverse impacts on published instrument departure or approach procedures or 14 CFR 77.19 imaginary surfaces. The height of the WTGs should not require an increase to the minimum enroute altitudes in the area; however, the height of 48 WTGs would exceed the obstacle clearance surface and require an increase to the ORF TRACON Minimum Vectoring Altitude (MVA) Sector B or create an isolation area with a higher segment altitude. Historical air traffic data indicates that the required changes to ORF TRACON MVA Sector B should not affect a significant volume of radar vectoring operations. As a result, it is possible that Norfolk (ORF) TRACON would be willing to increase the affected MVAs to accommodate wind development up to 869 feet (265 meters) tall. This mitigation option is subject to FAA approval.

Dominion Energy will continue to consult with the DoD Clearinghouse for an informal review of onshore and offshore Project Components. Dominion Energy solicited comments directly from the FAA and Virginia Department of Aviation on September 23, 2021, as part of the SCC filing and during BOEM’s review of the COP. As several portions of the proposed route would be within 20,000 linear feet (6,096 meters) of either the Fentress Airfield or NAS Oceana, Dominion Energy will submit Form 7460-1 to the FAA for each segment of the proposed Project that would be within 20,000 linear feet (6,096 meters) of the airfield and/or for any structure that would meet or exceed 200 feet (61 meters) above ground level. Twenty-four of Dominion Energy’s potential interconnection cable route and switching station/substation structures, and associated temporary construction cranes, would require submission of Form 7460-1 (Dominion Energy 2022b). As of September 2022, the FAA has not provided a response to Dominion Energy’s VAA SCC filing.

In the context of reasonably foreseeable environmental trends and planned activities, the Proposed Action or Alternative A-1 and other offshore wind projects would contribute to impacts on aviation and air traffic. BOEM assumes that offshore wind project operators would coordinate with aviation interests throughout the planning, construction, operations, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic. Navigational hazards and space use conflicts would exist during construction, operations, and maintenance, and would be gradually eliminated during decommissioning as offshore WTGs are removed. Adverse impacts on air traffic are anticipated to be negligible if mitigation measures are approved by the FAA and implemented.

3.17.5.4 Cables and Pipelines

Presence of structures: Three submarine telecommunication cables and one active offshore wind export cable are present in the geographic analysis area. These cables would be crossed by the offshore export cable route corridor under the Proposed Action or Alternative A-1. Installation of the offshore export cables would cross four active submarine cables. Dominion Energy would coordinate with cable owners and would follow standard industry procedures for crossing utility lines and avoid adverse impacts on these existing lines.

The presence of future offshore wind energy structures could preclude future submarine cable placement within any given development footprint, requiring future cables to route around these areas. However, the placement and presence of the offshore export cables for the Proposed Action or Alternative A-1 would not prohibit the placement of additional cables and pipelines because these could be crossed following standard industry protection techniques. Impacts on submarine cables and pipelines would be eliminated during decommissioning of the Project as the export and inter-array cables are removed.

Project structures including WTGs and OSSs, and the stationary lift vessels used during Project construction and installation, may pose allision risks and navigational hazards to vessels conducting maintenance activities on existing submarine telecommunication cables. Because Alternative A-1 would construct three fewer WTGs and align the three OSSs within the gridded layout of the WTGs, the potential risk of allision with structures and navigational risks in the Project area would be reduced when compared to the Proposed Action. However, FAA, USCG, and BOEM navigational hazard marking as well as the relative infrequency of maintenance activities would minimize the risk of allision under both the Proposed Action and Alternative A-1. Risk of vessel collision between cable maintenance vessels and vessels associated with the Project would be limited to the construction and installation phase and during planned maintenance activities in the operational phase.

Interconnection Cable Route Option 1 would overlap with Dominion Energy–owned transmission lines: 1.8 miles (2.9 kilometers) for Line #2118/147, 6.1 miles (9.8 kilometers) for Line #271/I74, and 1.9 miles (3.1 kilometers) for Line #2240/I74 (Dominion Energy 2022b). The maximum construction and operational corridor for Interconnection Cable Route Option 1 would be 250 feet (76.2 meters). Final heights of overhead interconnection cable infrastructure would be determined by Dominion Energy following site-specific surveys and detailed engineering. Impacts on onshore transmission lines in the geographic analysis area resulting from the Proposed Action or Alternative A-1 would be minimal and temporary, as they are owned by Dominion Energy and within existing rights-of-way. Therefore, installation of onshore interconnection cables would be coordinated to minimize disruption to services. By considering using existing corridors to the maximum to the extent practicable when planning new transmission lines, Dominion Energy is complying with Virginia SCC requirements (COP, Section 2.1.2.4; Dominion Energy 2022a).

Impacts on natural gas and jet fuel pipelines in the geographic analysis area resulting from the Proposed Action or Alternative A-1 would be minimal. The onshore export cable route would cross a VNG pipeline at one location, while Interconnection Cable Route Option 1 would cross a VNG pipeline in two locations (Dominion Energy 2022b). Dominion Energy would use a combination of open trench, microtunneling, and HDD for installing the onshore export cables (COP, Section 2.1.2.2; Dominion Energy 2022a) to avoid impacts on the two natural gas pipeline crossings. Interconnection Cable Route Option 1 would also cross the NuStar Energy L.P. jet fuel pipeline in location using an overhead crossing (Dominion Energy 2022b).

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the impacts on cables and pipelines from ongoing and planned activities could result in some localized and long-term impacts. However, these impacts would be negligible because they can be avoided by standard protection techniques.

3.17.5.5 Radar Systems

Presence of structures: There are several radar systems in the general vicinity of Project, including DoD, FAA, and NOAA radar sites, as well as HF Coastal Radar sites. DoD issued a response to Dominion Energy's request for an informal review (COP, Appendix T, *Obstruction Evaluation and Additional Analysis*; Dominion Energy 2022a) on June 2, 2021, which indicated that impacts from the Proposed Action on military operations in the area would be likely. Impacts could include radar operations associated with the Advanced Dynamic Aircraft Measurement System at Naval Air Station Patuxent River, the Re-locatable Over the Horizon Radar system located at Naval Support Activity Hampton Roads, Northwest Annex in Chesapeake, Virginia, the U.S. Navy's underwater cable office, and the North American Aerospace Defense Command homeland defense radar. Dominion Energy is continuing to engage and coordinate with applicable military contacts to assess and address potential impacts as needed.

In addition, the following HF radar systems would be within the line of sight of all or some WTGs, which would likely present interference: Duck HF Radar and Little Island Park HF Radar. Two additional HF radar effects may experience radar effects such as clutter beyond line of sight: Assateague Island HF Radar and Cedar Island HF Radar. Dominion Energy would continue to engage and coordinate with applicable owners and operators of these HF radar systems to assess and address potential impacts as needed.

Equipment (cranes and barges) used during construction of offshore project components would not exceed the height of the WTGs. Dominion Energy would be in direct communication with relevant agencies and personnel to alert the appropriate parties to planned construction movements and actions. All WTG Components and construction equipment would be properly lighted and marked in accordance with FAA's Advisory Circular 70/7460-1M within FAA jurisdiction and beyond, or other methods as deemed required during consultation and as applicable. Cranes would also be used during construction of the onshore substation and for loading/unloading materials in ports. If the introduction of new cranes is required, an FAA Notice Criteria check (14 CFR 77.9) and additional airspace and aviation radar system assessment would be performed to determine whether there are potential airspace impacts and FAA filing is required during the storage or transit of Project materials and Offshore Project components. Impacts for the Proposed Action or Alternative A-1 are anticipated to be the same.

In context of reasonably foreseeable environmental trends, the Proposed Action or Alternative A-1 would contribute to the impacts on radar systems from ongoing and planned activities, primarily due to the presence of WTGs within the line of sight causing interference with radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars.

3.17.5.6 Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs, could be affected during the construction and operations of the Proposed Action or Alternative A-1; however, research activities may continue within the proposed Project area, as permissible by survey operators. The Proposed Action or Alternative A-1 would affect survey operations by excluding certain portions of the Lease Area occupied by Project components from sampling. Additionally, NOAA's Office of Marine and Aviation Operations has determined that the NOAA Ship Fleet will not conduct survey operations in wind facilities with 1 nautical miles or less separation between turbine foundations. The Proposed Action or Alternative A-1 WTGs would have a spacing of 0.75 by 0.93 nautical mile between WTGs, which would mean survey operations in the Wind Farm Area would likely be curtailed.

This Draft EIS incorporates by reference the detailed analysis of potential impacts on scientific research and surveys provided in the Vineyard Wind Final EIS (BOEM 2021). The analysis in the Vineyard Wind Final EIS is summarized under the discussion of the No Action Alternative in Section 3.17.3.1, *Impacts of the No Action Alternative*.

The Proposed Action or Alternative A-1 would install up to 205 WTGs or 202 WTGs, respectively, with a maximum blade tip of 869 feet (265 meters) AMSL. Aerial survey track lines for cetacean and sea turtle abundance surveys could not continue at the current altitude (600 feet AMSL) within the Project area because the planned maximum-case scenario for WTG blade tip height would exceed the survey altitude. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially smaller species. Agencies would need to expend resources to update scientific survey methodologies due to construction and operation of the Proposed Action or Alternative A-1, as well as to evaluate these changes on stock assessments and fisheries management, resulting in moderate impacts for scientific research and surveys.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the impacts on scientific research and surveys from ongoing and planned activities would be long term and major, particularly for NOAA surveys that support commercial fisheries and protected-species research programs. The entities conducting scientific research and surveys would have to make significant investments to change methodologies to account for areas occupied by offshore energy components, such as WTGs and cable routes, that are no longer able to be sampled.

3.17.5.7 Conclusions

Impacts of the Proposed Action. Under the Proposed Action or Alternative A-1, up to 205 WTGs or 202 WTGs, respectively, with a maximum blade tip of 869 feet (265 meters) AMSL would be installed, operate, and eventually be decommissioned within the Project area. The presence of these structures would introduce navigational complexity and increased vessel traffic in the area that would continue to have temporary to long-term impacts that range from negligible to major on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

- **Marine mineral extraction:** The offshore export cable routes would intersect sand borrow areas and ocean dredge disposal areas, resulting in potential long-term, **minor** impacts.
- **Military and national security uses:** The installation of WTGs in the Project area would result in increased navigational complexity, allision risk, and vessel traffic, creating potential long-term, **moderate** adverse impacts on USCG SAR operations and military and national security uses.
- **Aviation and air traffic:** Potential impacts on aviation and air traffic would be **negligible** with the implementation of mitigation measures, if approved by the FAA.
- **Cables and pipelines:** Potential impacts on cables and pipelines would be **negligible** due to the use of standard protection techniques to avoid impacts.
- **Radar:** Potential **minor** adverse impacts on radar systems would primarily be caused by the presence

of WTGs within the line of sight causing interference with radar systems. Options are available to minimize or mitigate impacts and Dominion Energy would continue to coordinate with the FAA, DoD, and NOAA on impacts.

- **Scientific research and surveys:** Potential impacts on scientific research and surveys would generally be **moderate**, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs. The presence of structures would exclude certain areas within the Project area occupied by Project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action or Alternative A-1 to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **major**. Considering all IPFs collectively, BOEM anticipates that the overall impacts associated with the Proposed Action or Alternative A-1when combined with ongoing and planned activities would range from **negligible** to **minor** marine mineral extraction, aviation and air traffic, cables and pipelines, and radar systems; and **moderate** for most military and national security uses and scientific research and surveys. The presence of structures associated with the Proposed Action or Alternative A-1is the primary driver for impacts on other marine uses. Impacts on NOAA scientific research and surveys would qualify as **major** because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas, with potential long-term and irreversible impacts on fisheries and protected-species research as a whole, as well as on the commercial fisheries community.

3.17.6 Impacts of Alternatives B and C on Other Uses (Marine Minerals, Military Use, Aviation)

Impacts of Alternatives B and C. Construction of Alternative B would reduce the number of WTGs to up to 176 (inclusive of three spare WTG positions) and locate the three OSSs, in the gridded alignment with the WTGs. WTGs would have a 14.7-MW capacity with power boost technology and be 836 feet (255 meters) AMSL in the Wind Farm Area. All other offshore design parameters and potential variability in the design would be the same as under the Proposed Action. However, under Alternative B, the Fish Haven area located along the northern boundary of the Lease Area would be an exclusion zone; eight WTGs and associated infrastructure would not be developed or placed in the Fish Haven area. Additionally, three WTGs and associated inter-array cables would be excluded from the northwest corner of the Lease Area to avoid vessel traffic. Onshore components would be the same as the Proposed Action.

Alternative C would use a similar layout as Alternative B but would further avoid sand ridge habitat and shipwrecks through a combination of micrositing WTGs, inter-array cables and/or OSSs, the removal of four WTGs within priority sand ridge habitat, and the relocation of one WTG, totaling up to 172 WTGs (inclusive of two spare WTG positions). This configuration would minimize linear seafloor impacts on priority sand ridge habitat. Onshore components would be the same as the Proposed Action.

Impacts of Alternatives B and C would be similar to those of the Proposed Action for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys. Alternatives B and C could decrease impacts on radar systems by removing some WTGs (though not those located closest to shore) and slightly decreasing the size of the WTGs from 16 MW to 14 MW. Alternatives B and C could reduce localized impacts on scientific research and surveys by avoiding placing structures in sand ridges and troughs; however, the structures present throughout the remainder of the Lease Area would exclude certain portions of the Project area from potential vessel and aerial sampling.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternatives B and C to the cumulative impacts on other uses would be the same as described under the Proposed Action.

3.17.6.1 Conclusions

Impacts of Alternatives B and C. Implementation of Alternatives B or C would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The overall level of impact would remain similar to that of the Proposed Action, and the impacts of each alternative resulting from individual IPFs associated with these alternatives would be **negligible** for cables and pipelines and aviation and air traffic; **minor** for marine mineral extraction and radar systems; **moderate** for marine mineral extraction and scientific research and surveys.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends in the area, the contribution of the Alternatives B or C to the impacts of individual IPFs resulting from ongoing and planned activities would range from temporary to long-term and **negligible** to **major**. Considering all IPFs collectively, BOEM anticipates that the overall impacts associated with Alternatives B or C when combined with ongoing and planned activities would range from **negligible** to **minor** for marine mineral extraction, aviation and air traffic, cables and pipelines, and radar systems; and **moderate** for most military and national security uses, and **major** for scientific research and surveys.

3.17.7 Impacts of Alternative D on Other Uses (Marine Minerals, Military Use, Aviation)

Impacts of Alternative D. Under Alternative D, BOEM would approve either Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2) to reduce impacts of the proposed Project on onshore sensitive habitats. Interconnection Cable Route Option 1 would be an entirely overhead route, while Hybrid Interconnection Cable Route Option 6, would involve installation of the interconnection cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores.

Interconnection Cable Route Option 6 would have an equal degree of overlap with existing Dominion Energy–owned transmission lines as Interconnection Cable Route Option 1, and therefore impacts would be the same between Alternative D-1 and Alternative D-2 (minimal). The maximum construction and operational corridor for the underground portion of Interconnection Cable Route Option 6 would be 86.5 feet (26 meters); the overhead portion would be 250 feet (76.2 meters), which is equivalent to the corridor width for Interconnection Cable Route Option 1. Interconnection Cable Route Option 6 would also have an equivalent number of natural gas and jet fuel pipeline crossings as Interconnection Cable Route Option 1, and therefore impacts would be the same between Alternative D-1 and Alternative D-2 (minimal).

While Interconnection Cable Route Option 6 (Alternative D-2) would be partially underground, thus reducing the number of structures with potential aviation and air traffic impacts, impacts from Interconnection Cable Route Option 1 (Alternative D-1) are already expected to be negligible with appropriate mitigation measures, so there would be no difference. Impacts of Alternatives D-1 or D-2 would be the same as those of the Proposed Action for military and national security uses because onshore impacts would be related to the cable landing location and onshore export cable route and not the switching station or interconnection cable routes. Additionally, because the Offshore Project components of Alternatives D-1 and D-2 are the same as the Proposed Action, impacts of Alternative D on marine mineral extraction, radar systems, and scientific research and surveys would be the same.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the cumulative impacts on other uses would be the same as described under the Proposed Action.

3.17.7.1 Conclusions

Impacts of Alternative D. Implementation of Alternatives D-1 or D-2 would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The overall level of impact would remain similar to that of the Proposed Action, and the impacts of each alternative resulting from individual IPFs associated with these alternatives would be **negligible** for cables and pipelines and aviation and air traffic; **minor** for marine mineral extraction and radar systems; **moderate** for marine mineral extraction and scientific research and surveys.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action and would range from temporary to long-term and **negligible** to **major**. Considering all IPFs collectively, BOEM anticipates that the overall impacts associated with Alternative D when combined with ongoing and planned activities would range from **negligible** to **minor** for marine mineral extraction, aviation and air traffic, cables and pipelines, and radar systems; and **moderate** for most military and national security uses, and **major** for scientific research and surveys.

3.18. Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources from the proposed Project, alternatives, and ongoing and planned activities in the recreation and tourism geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.18-1, includes the 40-mile (64.4-kilometer) visual analysis area measured from the borders of the Wind Farm Area. The geographic analysis area encompasses parts of Accomack County, Northampton County, the City of Norfolk, the City of Virginia Beach, and Chesapeake City, Virginia, and Currituck and Dare Counties, North Carolina. Section 3.11, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the Project area.

3.18.1 Description of the Affected Environment for Recreation and Tourism

3.18.1.1 Regional Setting

Proposed Project facilities would be within and off the coast of Virginia and North Carolina. The coastal areas support ocean-based recreation and tourist activities that include boating, swimming, surfing, scuba diving, sailing, and paddle sports. As indicated in Section 3.11, *Demographics, Employment, and Economics*, recreation and tourism contribute substantially to the economies of Virginia and North Carolina's coastal counties. Tourism in Virginia's coastal communities is a multibillion-dollar industry. More than 19 million people visited Virginia Beach in 2017, generating about $1.7 billion annually in total expenditures (City of Virginia Beach 2017; COP Section 4.4.5.1; Dominion Energy 2022).

Coastal Virginia and North Carolina have a wide range of visual characteristics, with communities and landscapes ranging from large cities to small towns, suburbs, rural areas, and wildlife preserves. As a result of the proximity of the Atlantic Ocean, as well as the views associated with the shoreline, the Virginia and North Carolina shore has been extensively developed for water-based recreation and tourism.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Additionally, the visual qualities of these historic coastal towns, which include marine activities within small-scale harbors, and the ability to view birds and marine life are important community characteristics.

3.18.1.2 Project Area

Recreational and tourist-oriented activities are concentrated in the coastal communities in the City of Virginia Beach and the City of Chesapeake. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year. Although many of the coastal and ocean amenities, such as beaches, that attract visitors to these regions are accessible to the public for free and, thus, do not directly generate employment, these nonmarket features function as key drivers for recreation and tourism businesses.

Water-oriented recreational activities in the Project area include boating, visiting beaches, diving, fishing tournaments, and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding.

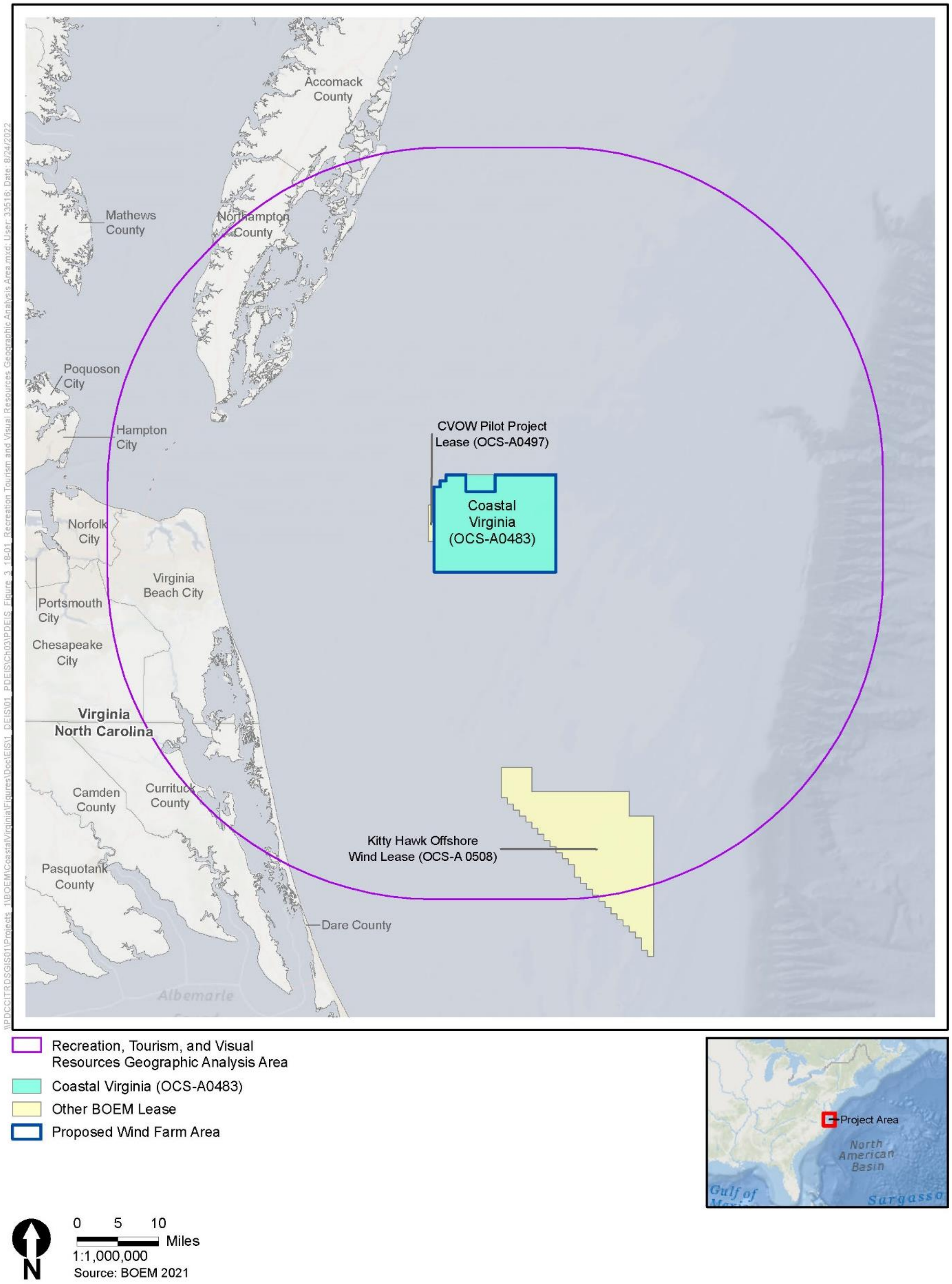

Figure 3.18-1 Recreation, Tourism, and Visual Resources Geographic Analysis Area

Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks. As discussed in Section 3.11, *Demographics, Employment, and Economics*, recreation and hospitality are major sectors of the economy in the City of Virginia Beach and the City of Chesapeake, supported by ocean-based recreation uses.

Inland recreational facilities are also popular but have less of a relationship to possible impacts of the Project; this section does not address these facilities in detail, except where Project components would intersect with these facilities. These include inland waters such as ponds and rivers, wildlife sanctuaries, golf courses, athletic facilities, parks, and picnic grounds.

3.18.1.2.1 Coastal and Offshore Recreation

Many marine recreational activities, such as swimming, surfing, kayaking, paddle boarding, wind surfing, fishing, sailing, and boating, occur along the coast of Virginia almost all year-round. Scuba diving and snorkeling are identified as a dominant use offshore from the Virginia coast year-round with dive sites that include shipwrecks, artificial reefs, and other structures. Recreational boating and sailing are very popular and primarily occur in nearshore coastal waters rather than offshore waters (COP, Section 4.4.6.2 and 4.4.11.1; Dominion Energy 2022).

There is a large and robust recreational fishing industry in Virginia and North Carolina. In 2018, there were about 6.4 million recreational saltwater angler trips (i.e., charter, party, private/rental, and shore boats) in Virginia and about 16.6 million trips in North Carolina. The popular recreational saltwater species caught in the area include, but are not limited to, sciaenid drums including Atlantic croaker (*Micropogonias undulatus*) and seatrout, bluefish, tuna/mackerel, cartilaginous fishes (sharks, skates, and rays), porgies, jacks, and black sea bass (COP, Section 4.4.6.2; Dominion Energy 2022). There are also annual recreational fishing tournaments held in coastal towns in Virginia and North Carolina. Saltwater fishing tournaments target a variety of fish including billfish, tuna, seabass, shark, grouper, and others. Tournaments for specific highly migratory species occur from late June to early September (COP, Sections 4.4.6.2 and 4.4.11.1; Dominion Energy 2022).

Recreational shellfishing is important to the region and occurs primarily in state waters and not in the Offshore Project area, commonly targeting blue crabs, scallops, quahogs, Atlantic surf clams, and softshell clams. Spearfishing occurs in portions of the Offshore Project area and often targets fish at offshore structures, the Triangle wrecks, and surface structures, such as buoys (COP, Section 4.4.6.2; Dominion Energy 2022).

3.18.1.2.1.1 Accomack County

Accomack County lies on the Delmarva Peninsula, on the northern part of Virginia’s eastern shore, and encompasses approximately 1,310 square miles. The county is known for its 45-mile stretch of oceanside barrier islands, which are kept in their natural state and can be accessed by the public (Accomack County 2021). Aside from its barrier islands, bays, and inlets, there are eight public beaches, one yacht club, 29 public boating access sites, and 40 miles of shoreline on both the Chesapeake Bay and the Atlantic Ocean (BOEM 2012). Popular marine recreational activities in the county include swimming in the Atlantic Ocean, surfing, fishing, boating, and wildlife viewing off the shore. There are many businesses that offer boat and fishing tours and rentals, and there are many public piers at which fishing tournaments, crabbing, and clamming take place. Scenic boat cruises are popular among tourists and take place through the Chincoteague and Assateague Channels and along the Assateague Island National Seashore (Chincoteague Chamber of Commerce 2021).

3.18.1.2.1.2 Northampton County

Northampton County is located on the southern part of the Delmarva Peninsula on Virginia's eastern shore and encompasses 795 square miles. The county is known for its over 100 miles of shoreline on the Chesapeake Bay and Atlantic Ocean, and it has three public beaches and two marinas (BOEM 2012). Popular recreational activities include kayaking, fishing on the piers, renting yachts, and visiting the uninhabited barrier islands. There are 12 barrier islands, which are open to the public for non-commercial recreational day use, such as hiking, bird watching, fishing, hunting, crabbing, and clamming (Northampton County 2019). Private ecotours and sunrise/sunset cruises that go between the sandy beaches and islands are very popular (Cape Charles Harbor 2020).

3.18.1.2.1.3 City of Norfolk

The City of Norfolk encompasses 66 square miles, is located is southeastern Virginia, and is bordered by Chesapeake Bay. It has 7 miles of Chesapeake Bay beachfront, and all of the beaches are public. Popular recreational activities include sailing, kayaking, swimming, jogging and walking along the shoreline, surfing, and canoeing. There is a harbor for ocean-going cruise vessels of up to 3,000 passengers, and there is the East Ocean View Community Center Pier, which hosts anglers and boaters (City of Norfolk 2021). A lot of recreational diving that occurs along the Virginia coast is supported by several dive companies in the city that offer charters to artificial reefs, shipwrecks, ledges, and other sites in the Offshore Project area (COP, Section 4.4.11.1; Dominion Energy 2022).

3.18.1.2.1.4 City of Virginia Beach

The City of Virginia Beach is in southeastern Virginia and encompasses 310 square miles. It has 28 miles of public beach, 38 miles of shoreline, and 29 miles of scenic waterways (City of Virginia Beach 2017). There are about six public beaches, nine marinas, and 13 yacht clubs. The shorefront is one of the most popular attractions, where people partake in swimming, annual surfing championships, fishing, paragliding, and sailing (BOEM 2012). The city is also known for its 3-mile Virginia Beach Boardwalk, which is lined with hotels and restaurants, and for its guided boat tours of the Back Bay and Atlantic Ocean (Visit Virginia Beach 2021).

Several dive companies in Virginia Beach, such as Chesapeake Bay Diving Center and Lynnhaven Dive Center, support recreational scuba and free dives by offering charters to artificial reefs, shipwrecks, ledges, and other sites of interest in the Offshore Project area (COP, Section 4.4.11.1; Dominion Energy 2022). Recreational fishing vessels are supported by the ports of Rudee Inlet and Lynnhaven, from where fishermen travel to areas of "hard bottom" seabed structures and other structures near the Offshore Project area. Virginia Beach also hosts a number of very popular fishing tournaments for highly migratory species, which occur from late June to early September (COP, Section 4.4.6.2; Dominion Energy 2022). Whale-watching tours are also popular in coastal Virginia between late November and March but occur year-round in Virginia Beach. Dolphin tours take place between June and late October (COP, Section 4.4.11.1; Dominion Energy 2022).

3.18.1.2.1.5 Chesapeake City

The City of Chesapeake encompasses 353 miles and is adjacent to Virginia Beach City (City of Chesapeake 2021). Since it is surrounded by land, it does not offer as many opportunities for coastal recreation, as does Virginia Beach City.

3.18.1.2.1.6 Currituck County

Currituck County encompasses 526 miles and is located in the northeastern-most corner of North Carolina (United States Census Bureau 2010). It has six public beaches, 20 miles of shoreline, one marina, and two yacht clubs (BOEM 2012). The county is known for its sandy beaches, where tourists partake in surfing, fishing, kayaking, parasailing, paddleboarding, kiteboarding, and walking along the shore (Currituck County 2021). Fishing and crabbing are also popular activities in the Currituck Sound (Currituck County Tourism 2021). In 2009, there were 65 ocean-related establishments that directly employed 451 people (BOEM 2012).

3.18.1.2.1.7 Dare County

Dare County is in northeastern North Carolina, adjacent to the Atlantic Ocean, and it encompasses 1,563 square miles. It has 110 miles of shoreline, known as the Outer Banks (Dare County 2021). The county is known for its beaches, which offer sailing tours, fishing, snorkeling, water sports, and horseback riding (Outer Banks 2021). It has two public beaches, 10 marinas, and 13 yacht clubs. In 2009, there were 269 ocean-related establishments, which employed 3,746 people directly. Popular attractions include the Cape Hatteras Lighthouse and the Bodie Island Lighthouse (BOEM 2012).

3.18.1.2.2 Onshore Recreation

3.18.1.2.2.1 Accomack County

Accomack County is home to myriad habitats, such as farmland, marshes, forests, and wetlands. The 9,000-acre Chincoteague National Wildlife Refuge is located in the north portion of the county and has opportunities for swimming, hiking, fishing, and bird watching. The beaches and salt marshes are particularly popular for viewing shorebirds, seabirds, and other migrating waterfowl. The Accomack County Department of Parks and Recreation takes care of three parks: Arcadia Park (25 acres), Wachapreague Park (15 acres), and Nandua Middle Park (Accomack County 2021). Along the nature trails, tourists partake in bird watching of over 300 species of migratory birds, pony watching, and biking (Chincoteague Chamber of Commerce 2021).

The main areas of tourism in the county are nature, agriculture, and beach and recreational resorts. Tourists partake in wine tours, horseback riding, and golfing. In 2010, domestic travelers spent about $145.08 million in the county, and there were 116 establishments dedicated to leisure and hospitality. Approximately 23 percent of all housing units in Accomack County are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.2.2.2 Northampton County

Northampton County is known for its undeveloped coastal landscapes that allow for many recreational activities, such as wildlife viewing, hiking, and cycling. The county is home to two wildlife refuges: the Eastern Shore of Virginia National Wildlife Refuge (1,200 acres) and Fisherman Island National Wildlife Refuge (1,850 acres) (BOEM 2012). Tourists enjoy bird watching along the Eastern Seaboard during spring and fall migration and enjoy the variety of artist markets, galleries, and film festivals more inland (Northampton County 2019). In 2010, domestic travelers spent $63.26 million, and there were 43 establishments dedicated to leisure and hospitality (BOEM 2012).

3.18.1.2.2.3 City of Norfolk

Inland Norfolk is home to three beach parks, museums, the National Maritime Center, art festivals, and the Norfolk Botanical Garden. Popular activities in the parks include walking, hiking, and wildlife viewing (City of Norfolk 2021). There are also many bike lanes and trails, such as the 10.5-mile Elizabeth River Trail, which are popular among cyclists. Tourists also partake in kayaking and fishing the Lafayette River (Visit Norfolk n.d.).

3.18.1.2.2.4 City of Virginia Beach

Virginia Beach is home to 255 local parks (covering 4,500 acres), several state parks, and one national wildlife refuge: the Back Bay National Wildlife Refuge (10,000 acres) (BOEM 2012). Popular inland activities include traversing the Sandbridge dunes, hiking and cycling along the 200 miles of bikeways and trails, and kayaking and fishing in the 120 miles of waterways. First Landing State Park is a 2,888-acre park with 1.25 miles of beach, and 19 miles of hiking trails through salt marsh habitat, freshwater ponds, dunes, forests, tidal marshes, and cypress swamps. Other popular attractions include museums; Pungo, an 8,000-acre farmland community; breweries; Atlantic Fun Park; and Cape Henry Light House (Virginia Beach 2021). In 2010, domestic travelers spent $1.13 billion in the city, and there were 1,266 establishments for leisure and hospitality (BOEM 2012).

3.18.1.2.2.5 Chesapeake City

The City of Chesapeake is home to the Great Dismal Swamp National Wildlife Refuge, which is a protected area of more than 112,000 acres and contains 200 species of birds, 100 species of butterfly, and other rare native mammals. The refuge has freshwater marshes, cypress swamps, and barrier islands. The city is also home to Lake Drummond, a 3,100-acre lake popular among anglers. Popular activities in the city include hiking, camping, fishing, and birdwatching along the Virginia Birding and Wildlife Trail, which is home to over 213 species of birds (Visit Chesapeake 2021).

3.18.1.2.2.6 Currituck County

There are two wildlife refuges in Currituck County: Currituck National Wildlife Refuge (8,501 acres) and part of Mackay Island National Wildlife Refuge (8,219 acres on Knotts Island). People partake in bird watching, hiking, kayaking, and cycling (BOEM 2012). Tourists also enjoy wildlife viewing due to the population of Corolla Wild Horses in the Currituck Outer Banks (Currituck County 2021). The county is also famous for its Historic Corolla Park and the Currituck Beach Lighthouse (Currituck County Tourism 2021). In 2010, domestic visitors spent $117.12 million in the county, and there were 87 establishments dedicated to leisure and hospitality. Approximately 31.8 percent of housing units in the county are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.2.2.7 Dare County

Dare County has five national protected areas, including the Pea Island National Wildlife Refuge (6,000 acres) and the Alligator National Wildlife Refuge (152,000 acres), which is home to songbirds, raptors, and ducks (BOEM 2012; Dare County 2021; Outer Banks 2021). Popular activities include golfing, touring gardens, visiting historic sites and museums, bird-watching festivals, and traversing fresh and saltwater habitats. Tourism provides more than 13,800 jobs in the county, employing one-third of the county’s residents. Annually, tourism generates more than $116.5 million in state and local tax revenue, and visitor spending is over $1.27 billion (Outer Banks 2021). In 2009, there were 381 establishments dedicated to leisure and hospitality. Approximately 44 percent of housing units are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.3 Visual Resources

As discussed in Section 3.20, *Scenic and Visual Resources*, the proposed Project’s Offshore Components, including the WTGs, inter-array cables, and OSSs would be in federal waters within the Lease Area. The boundary of the Lease Area is 20.45 nautical miles (37.87 kilometers) from the northwest corner to the Eastern Shore Peninsula and 23.75 nautical miles (43.99 kilometers) from Virginia Beach, Virginia. Existing visual intrusions offshore include buoys, channel markers, marine vessel traffic, the Chesapeake Light Tower, and the two existing WTGs of the CVOW-Pilot Project. These features are visible during daytime hours, and safety and warning lights are visible during nighttime hours from certain viewing locations. Air traffic (including nighttime safety lighting on aircraft) arriving and departing from military and civilian airports is also commonly seen in the Offshore Project area. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments (COP, Section 4.3.4.2; Dominion Energy 2022).

Within the 40-mile-radius geographic analysis area, the distance from coastal viewpoints to the Project would vary from slightly more than 25 miles to nearly 40 miles to the nearest WTG. The most apparent views of WTGs were found to be within 27 to 28 miles (43.5 to 45.1 kilometers) from the Lease Area, where views are oriented toward the ocean and horizon. Within these areas, beach/shoreline and elevated viewpoints, such as multi-story buildings and/or lighthouses with ocean views, would have the most conspicuous views of the WTGs (COP, Section 4.3.4.3; Dominion Energy 2022).

3.18.2 Environmental Consequences

3.18.2.1 Impact Level Definitions for Recreation and Tourism

Definitions of impact levels are provided in Table 3.18-1.

Table 3.18-1 Impact Level Definitions for Recreation and Tourism

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on the recreation setting, recreation opportunities, or recreation experiences would be so small as to be unmeasurable.
	Beneficial	No effect or measurable impact.
Minor	Adverse	Impacts would not disrupt the normal functions of the affected activities and communities.
	Beneficial	A small and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to the Project.
	Beneficial	A notable and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Major	Adverse	The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the Project.
	Beneficial	A large local, or notable regional improvement to infrastructure/facilities and community services, or benefit for tourism.

3.18.3 Impacts of the No Action Alternative on Recreation and Tourism

When analyzing the impacts of the No Action Alternative on recreation and tourism, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind activities and ongoing offshore wind activities, on the baseline conditions for recreation and tourism. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.18.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for recreation and tourism in the geographic analysis area described in Section 3.18.1, *Description of the Affected Environment for Recreation and*

Tourism, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities within the geographic analysis area that contribute to impacts on recreation and tourism include ongoing vessel traffic; noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, and offshore cables; and onshore development activities. These activities would contribute to periodic disruptions to recreational and tourism activities but are a typical part of daily life along the Virginia and North Carolina coastline and would not substantially affect recreational enjoyment in the geographic analysis area. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for tourism and recreation. The geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views. The beach, and by proxy the ocean, is a primary concern for the local jurisdictions' tourism industry (City of Virginia Beach 2017). There is one ongoing offshore wind activities within the geographic analysis area that could contribute to impacts on recreation and tourism.

3.18.3.2 Cumulative Impacts of the No Action Alternative

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

BOEM expects future offshore wind activities to affect recreation and tourism through the following primary IPFs.

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

Future offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods beginning in 2024, with two other projects (Kitty Hawk Wind North and Kitty Hawk Wind South) under construction at one time during 2024 through 2027 (Appendix F, Table F3). Increased vessel anchoring during future offshore wind development between 2024 and 2030 would affect recreational boaters. The greatest volume of anchored vessels would occur in offshore work areas during construction. Future offshore wind projects may generate similar numbers of active and anchored vessels to the Proposed Action, depending on project size and construction schedule: the CVOW-C Project would have an estimated average of 46 daily vessel trips generated throughout the duration of construction, ranging from a minimum of 3 trips per day to a maximum of 95 trips per day (COP, Section 3.4.1.5; Dominion Energy 2022). Anchored construction-related vessels may be within temporary safety zones established in coordination with USCG for active construction areas (COP, Section 4.4.9.2; Dominion Energy 2022). """

Vessel anchoring would also occur during maintenance and monitoring activities. Following construction of planned offshore wind projects (if approved), the presence of operating offshore wind projects in the geographic analysis area would result in a long-term increase in the number of vessels anchored during periodic maintenance and monitoring. One ongoing offshore wind project, the CVOW-Pilot Project, is currently in the operations phase. There are only two WTGs, so the long-term increase in the number of vessels during period maintenance and monitoring would be small.

Anchored construction, survey, or service vessels would have localized, temporary impacts on recreational boating. Recreational vessels could navigate around anchored vessels with only brief inconvenience. The temporary turbidity from anchoring would briefly alter the behavior of species important to recreational fishing (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*) and sightseeing (primarily whales, but also dolphins and seals) (Section 3.15, *Marine Mammals*). Inconvenience and navigational complexity for recreational vessels would be localized, variable, and long term, with increased frequency of anchored vessels during surveying and construction and reduced frequency of anchored vessels during operations.

Land disturbance: Future offshore wind development for Kitty Hawk Wind North and Kitty Hawk Wind South would require installation of onshore transmission cable infrastructure, which would cause temporary traffic delays and could temporarily affect access to adjacent properties, resulting in localized, temporary disturbances of recreational activity or tourism-based businesses near cable routes and construction sites for substations and other electrical infrastructure. These impacts would only occur during construction and occasionally during maintenance events. Similar impacts during maintenance of the ongoing two-WTG CVOW-Pilot Project would be similar. The extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts during construction or maintenance and would not have long-term impacts on recreation and tourism use.

Lighting: Construction-related nighttime vessel lighting would be used if future offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for two future offshore wind projects (Kitty Hawk Wind North and Kitty Hawk Wind South) within the geographic analysis area during the project's active construction phase. Vessel lighting would enable recreational boaters to safely avoid nighttime construction areas. The impact on recreational boaters would be localized, sporadic, short term, and minimized by the limited offshore recreational activities that occur at night.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines in the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for up to 71 WTGs. The amassing of these WTGs and associated synchronized flashing strobe lights affixed with red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle within the offshore wind lease areas would have long-term negligible to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations (COP, Section 4.3.4.3; Dominion Energy 2022).

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS). A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles [8 to 13 kilometers]) would adversely affect the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. All of the WTG positions envisioned in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

The Virginia and North Carolina shore are within the viewshed of the WTGs and have been extensively developed for recreation and tourism. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments. Visible aviation warning lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view.

In addition to recreational fishing, some recreational boating in the region involves whale watching and other wildlife-viewing activities. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines "appear to provide for the marking and lighting of [WTGs] that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish" (Orr et al. 2013). By extension, existing lighting guidelines or ADLS (if implemented) would impose a minimal impact on recreational fishing or wildlife viewing.

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

The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. Based on historical air traffic data, activation of the ADLS, if implemented, would occur for about 25 hours and 33 minutes over a 1-year period, as compared to standard continuous FAA hazard lighting (COP, Appendix T; Dominion Energy 2022). It is anticipated that an ADLS-controlled obstruction lighting system could result in over a 99 percent reduction in system-activated duration as compared to a traditional always-on obstruction lighting system.

Cable emplacement and maintenance: Under the No Action Alternative, future offshore wind export cables from the Kitty Hawk Wind North and Kitty Hawk Wind South projects could total approximately 453 miles (729 kilometers), while inter-array cables could total approximately 349 miles (562 kilometers) (Appendix F, Table F2-1). One existing offshore wind project (CVOW-Pilot Project) has approximately 24 miles (44.5 kilometers) of offshore export cable installed. Specific cable locations associated with future offshore wind projects are unknown and, therefore, have not been identified in the geographic analysis area. Cables for other future offshore wind projects would likely be emplaced in the geographic analysis area between 2024 and 2030. Based on the assumptions in Appendix F, these cables could affect up to 130,145[1] acres (52,667.8 hectares) (Appendix F, Table F2-2).

Offshore cable emplacement for future offshore wind development projects would have temporary, localized, adverse impacts on recreational boating while cables are being installed, because vessels would need to navigate around work areas, and recreational boaters would likely prefer to avoid the noise and disruption caused by installation. Cable installation could also have temporary impacts on fish and invertebrates of interest for recreational fishing, due to the required dredging, turbulence, and disturbance; however, species would recover upon completion (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Active work and restricted areas would only occur over the cable segment being emplaced at a given time. Once installed, cables would affect recreational

[1] Kitty Hawk Wind South has 3 export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Carolina) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-mile-wide corridor to Virginia and 1,000-mile-wide corridors to North Carolina to allow for optimal routing of the cables.

boating only during maintenance operations, except that the mattresses covering cables in hard-bottom areas could hinder anchoring and result in gear entanglement or loss.

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

Noise: Noise from construction, pile driving, HRG survey activities, trenching, O&M, and vessels could result in adverse impacts on recreation and tourism.

Onshore construction noise from cable installation at the landfall sites, and inland if cable routes are near parkland, recreation areas, or other areas of public interest, would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore noise from HRG survey activities, pile driving, trenching, and construction-related vessels would intrude upon the natural sounds of the marine environment. This noise could cause some boaters to avoid areas of noise-generating activity, although some of the most intense noise could be within safety zones that USCG may establish for areas of active construction, which would be off-limits to boaters. Noise from pile driving is estimated to produce sound power levels of 87 dBA in-air at 400 feet (122 meters) (COP, Section 4.1.4.2; Dominion Energy 2022). BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region. Results showed the construction phase is expected to have a slightly negative to neutral impact on recreational fisheries due to both direct exclusion of fishing activities and displacement of mobile target species by the construction noise (Kirkpatrick et al. 2017).

During operations, the continuous noise generated by WTG operation is not expected to produce sound in excess of background levels at any onshore locations (COP, Section 4.1.4.2; Dominion Energy 2022). Accordingly, the impact of noise on recreation and tourism during construction would be adverse, intense, and disruptive, but short term and localized. Multiple construction projects at the same time would increase the number of locations in the geographic analysis area that experience noise disruptions. The impact of noise during O&M would be localized, continuous, and long term, with brief, more-intensive noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing in the lease areas and along cable routes, as discussed in Sections 3.9, *Commercial Fisheries and For-Hire Recreational Fishing,* 3.13, *Finfish, Invertebrates, and Essential Fish Habitat,* and 3.15, *Marine Mammals*. Because most recreational fishing takes place closer to shore than the Lease Area, only a small proportion of recreational fishing would be affected by construction in the Lease Area, where most of the noise impacts would occur. Recreational fishing such as for tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience temporary impacts resulting from the noise generated by future offshore wind construction. Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on marine sightseeing that relies on the presence of mammals, primarily whales. However, as noted in Section 3.15, *Marine Mammals,* future projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

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

Future offshore wind surveying and construction would occur in the geographic analysis area between 2024 and 2030. Future offshore wind construction would result in short-term, localized, adverse impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple construction projects would increase the spatial and temporal extent of temporary disturbance to marine species in the geographic analysis area. BOEM's assumed construction schedule for future offshore wind projects in Appendix F, Table F-3 indicates the possibility of two other wind projects under development in the Lease Area. As indicated in Appendix F, up to 190 offshore WTGs and three OSSs could be installed within a 6-year period in the Lease Area, not including the Proposed Action. No long-term, adverse impacts are anticipated that would result in population-level harm to fish and marine mammal populations.

Port utilization: The geographic analysis area for recreation and tourism contains the PMT and Newport News Marine Terminal, which would be used by the Proposed Action (COP, Section 3.3.2.6; Dominion Energy 2022). Areas outside the geographic analysis area for recreation and tourism that are likely to be used for staging and construction, such as the ports that would be used by the Proposed Action, may provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above and other regional ports suitable for staging and construction of future offshore wind development are primarily industrial in character, with recreational activity as a secondary use.

Port improvements could result in short-term delays and crowding during construction but could provide long-term benefits to recreational boating if the improvements result in increased berths and amenities for recreational vessels, or improved navigational channels.

Presence of structures: The placement of 190 WTGs and three OSSs in the Lease Area in the geographic analysis area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, future offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects.

The WTGs and OSSs installed within the Wind Farm Area are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. The increased number of fishing trips out of nearby ports could also support increased angler expenditures at local bait shops, gas stations, and other shore-side dependents (COP, Sections 4.2.4.3, 4.4.11.2, and 4.4.6.3; Dominion Energy 2022).

The presence of future offshore wind structures would increase the risk of allision or collision with other vessels and the complexity of navigation in the Lease Area. Generally, the vessels more likely to allide with WTGs or OSSs would be smaller vessels moving within and near wind installations, such as recreational vessels. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly over the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success, as described in greater detail in Section 3.17, *Other Uses (Marine Minerals, Military Use, Aviation).*

Future offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the future offshore wind structures on recreational boating would be limited by the distance of the wind turbines offshore. AIS data from 2018 show that there is typically very low recreational activity from craft/sailing vessels within and directly adjacent to the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2022). In addition, sailing in the geographic analysis area primarily occurs nearshore, just along the coastline, rather than farther offshore (COP, Section 4.4.11.1; Dominion Energy 2022).

The geographic analysis area would have an estimated 403 foundations with scour protection and 240 acres of hard protection for export and inter-array cables, which results in an increased risk of entanglement (Appendix F, Table F2-2). The cable protection would also present a hazard for anchoring, as anchors could have difficulty holding or become snagged and lost. Accurate marine charts could make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Lessees in the Lease Area continue to engage with both USCG and NOAA in developing a comprehensive aid to navigation plan for the entire Lease Area (COP, Section 4.4.7.1; Dominion Energy 2022). Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Because anchoring is uncommon in water depths where the WTGs for future offshore wind projects excluding the proposed Project would be installed, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating would be localized, continuous, and long term.

Future offshore wind structures could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The wind structures could produce artificial reef effects. The "reef effect" refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat (COP, Section 4.2.4.2, 4.4.11.2, and 4.4.6.3; Dominion Energy 2022). The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters and sightseeing vessels traveling farther from shore to fish in the Lease Area. Although the likelihood of recreational vessels visiting the offshore WTG foundations would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the offshore wind lease areas. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels (Section 3.9, *Commercial Fisheries and For-Hire Fishing*).

As it relates to the visual impacts of structures, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.20, *Scenic and Visual Resources*, describes the visual impacts from offshore wind infrastructure. If the purpose of the viewer's sightseeing excursion is to observe the mass and scale of the WTGs' offshore presence, then the increasing visual dominance would benefit the recreation/tourism experience as the viewer navigates toward the WTGs. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then the increasing visual dominance may detract from the viewer's recreation/tourism experience.

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

- At 15 miles (24.1 kilometers), the percentage of respondents who reported that their beach experience would be worsened by the visibility of WTGs was about the same as the percentage of those who reported that their experience would be improved (e.g., by knowledge of the benefits of offshore wind).
- About 68 percent of respondents indicated that the visibility of WTGs would neither improve nor worsen their experience.
- Reported trip loss (respondents who stated that they would visit a different beach without offshore wind development) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.

- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A study focused on the changes to the vacation rental market after the construction of Block Island Wind Farm found that Block Island Wind Farm led to significantly increased nightly reservations, occupancy rates, and monthly revenues for properties in Block Island during peak tourism season in July and August (Carr-Harris and Lang 2019). The study estimates that the Block Island Wind Farm caused a 7-night increase in reservations, a 19 percent increase in occupancy rates, and a $3,490 increase in rental property revenue during July and August. Outside of peak tourism season, the Block Island Wind Farm did not have an impact on the vacation rental market.

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreation activities such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast. Most (77 percent) supported offshore wind development along the New Hampshire coast, while 12 percent opposed it and 11 percent were neutral. Regarding the impact on their outdoor recreation experience, 43 percent anticipated that offshore wind development would have a beneficial impact, 31 percent anticipated a neutral impact, and 26 percent anticipated an adverse impact (BOEM 2021).

As described under the IPF for light, the Virginia and North Carolina shore within the viewshed of the WTGs is highly developed. Public beaches and tourism attractions in this area are highly valued for scenic, historic, and recreational qualities and draw large numbers of daytime visitors during the summertime tourism seasons. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

Based on currently available studies, portions of the 190 WTGs associated with the No Action Alternative could be visible from shorelines (depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity). WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernable due to the introduction of industrial elements in previously undeveloped views. Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be long term, continuous, and adverse. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole.

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

Vessel traffic for two planned projects in the geographic analysis area (Kitty Hawk Wind North and Kitty Hawk Wind South) is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate an average of 46 daily vessel trips between ports and offshore work areas over the entire construction phase and a maximum of 95 vessel trips daily during peak construction activity (COP, Section 3.4.1.5; Dominion Energy 2022). As shown in Appendix F, Table F-3, between 2024 and 2030 two offshore wind projects (not including the Proposed Action) could be under construction simultaneously (in 2024–2027). During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 46 vessel trips daily from Atlantic Coast ports to worksites along the Virginia and North Carolina Lease Area, with as many as 95 vessels present (either underway or at anchor) during times of peak construction.

Establishment of two future offshore wind projects could occur in the Lease Area between 2024 and 2030. O&M activities for the project are anticipated to generate an average of 46 vessel trips per day between a port and the Wind Farm Areas. Based on the estimates for the proposed projects, the cumulative No Action Alternative would generate an average of 46 vessel trips per day.

Increased vessel traffic would require increased alertness on the part of recreational or tourist-related vessels and would result in minor delays or route adjustments. The likelihood of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. The possibility of delays and risk of collisions would increase if more than one future offshore wind facility is under construction at the same time. Vessel traffic associated with future offshore wind would have long-term, variable, adverse impacts on vessel traffic related to recreation and tourism. Higher volumes during construction would result in greater inconvenience, disruption of the natural marine environment, and risk of collision. Vessel traffic during operations would represent only a modest increase in the background volumes of vessel traffic, with minimal impacts on recreational vessels.

3.18.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, recreation and tourism would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent, **minor** impacts on recreation and tourism.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and recreation and tourism would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on recreation and tourism due to noise, presence of structures, vessel traffic, and port utilization from increased onshore and offshore construction and operation.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing impacts on recreation and tourism. BOEM anticipates that the impacts of ongoing activities, including ongoing vessel traffic and the noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, or offshore cables, would be **negligible**. In addition to ongoing offshore wind activities, planned activities other than offshore wind may also contribute to impacts on recreation and tourism. Offshore activities other than offshore wind would have localized, temporary impacts on recreational boating and would not affect the area's scenic quality. BOEM anticipates that the impacts of planned activities other than offshore wind would be **minor**. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** impacts on recreation and tourism, driven primarily by marine construction and dredging to install and maintain offshore cables, piers, seawalls, and harbors.

Considering all of the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind would result in **minor** adverse impacts and **minor beneficial** impacts. Future offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and vessel traffic during construction and the presence of offshore structures during operations. Noise and vessel traffic would have impacts on visitors, who may avoid onshore and offshore noise sources and vessels, and on recreational fishing and sightseeing as a result of the impacts on fish, invertebrates, and marine mammals. The long-term presence of offshore wind structures would result in increased navigational constraints and risks, potential entanglement and loss, and visual impacts from offshore structures. BOEM also anticipates that the future offshore wind activities in the geographic analysis area would result in **minor beneficial** impacts due to the presence of offshore structures and scour protection, which could provide opportunities for fishing and sightseeing.

3.18.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The Project layout including the number, type, height, and placement of the WTGs and OSSs, and the design and visibility of lighting on the structures.
- The arrangement of WTGs, as it affects accessibility of the Wind Farm Area to recreational boaters.
- The time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Below is a summary of potential variances in impacts.

- **WTG number, size, location, and lighting:** More WTGs and larger, 16-MW turbines located within the Lease Area but closer to shore could increase visual impacts that affect onshore recreation and tourism, as well as recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- **WTG arrangement and orientation:** Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- **Time of construction:** Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season.

3.18.5 Impacts of the Proposed Action on Recreation and Tourism

The Proposed Action would have long-term, minor impacts on recreation and tourism in the geographic analysis area due to the visual impact of the up-to 205 WTGs (or 202 WTGs for Alternative A-1) from coastal locations and the greater navigational risks for recreational vessels in the Wind Farm Area. It would also have long-term, minor beneficial impacts due to the fish aggregation effects associated with the WTGs and OSSs, resulting in new fishing and sightseeing opportunities. The Proposed Action would have short-term, minor impacts during construction due to the temporary impacts of noise and vessel traffic on recreational vessel traffic, the natural environment, and species important for recreational fishing and sightseeing.

Anchoring: Anchoring by construction and maintenance vessels would contribute to disturbance of marine species and inconvenience recreational vessels that must navigate around the anchored vessels. The Proposed Action would generate an average of 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods in the Wind Farm Area (COP, Section 3.4.1.5; Dominion Energy 2022). BOEM anticipates that USCG may establish temporary safety zones around offshore wind construction areas, which would minimize the potential for recreational boater interaction with anchored construction vessels in these areas. Vessel anchoring for construction of the Proposed Action would have localized, short-term, minor impacts on tourism and recreation due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing (COP, Sections 4.2.4.3 and 4.4.9.2; Dominion Energy 2022). The probability of disturbance to marine species and inconvenience to recreational vessels under Alternative A-1 would be lower than under the Proposed Action because of fewer vessel trips and anchoring due to three fewer WTGs, and therefore, potential impacts on tourism and recreation would be less. However, the difference in potential impacts on tourism and recreation from having three fewer WTGs than the Proposed Action's 205 WTGs is anticipated to be negligible.

Land disturbance: Onshore construction and installation of the export cables would affect recreation and tourism where construction activity interferes with access to recreation sites or increases traffic, noise, or temporary emissions that degrade the recreational experience.

The entirety of the 45.4 acres (18.4 hectare) footprint of the proposed Harpers Switching Station would overlap with the Aeropines Golf Club in Virginia Beach, Virginia Within that footprint, the relocation of fairways and a maintenance building would occur on 6.1 acres (2.5 hectares). Construction of the switching station will result in a temporary disruption of access to these facilities until they are relocated. Another golf course, the Battlefield Golf Club, is adjacent to the existing Fentress Substation in Chesapeake, Virginia. Construction activities to upgrade the Fentress Substation may result in temporary impacts on the golf course, such as increases in traffic, noise, or temporary emissions; however, no long-term, permanent impacts on nearby recreational facilities are anticipated. Additionally, construction of the onshore interconnection cable along Dam Neck Road could result in temporary, construction-related impacts on the Princess Anne Athletic Complex in Virginia Beach, Virginia. Because the onshore interconnection cable corridor would use existing ROW to the maximum extent possible and the Princess Anne Athletic Complex is set off the road, long-term impacts are not anticipated.

As discussed in Section 3.11, *Demographics, Employment, and Economics*, the employment and economic impact would be localized, short term, and minor. As discussed in Section 3.14, *Land Use and Coastal Infrastructure*, technologies may be used to minimize impacts on land disturbance. Dominion Energy has committed to implementing a construction schedule to minimize activities in the onshore export cable route during the peak recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (COP, Section 4.4.3.3; Dominion Energy 2022). These measures would minimize impacts on recreation and tourism from construction activities.

Land disturbance under Alternative A-1 would be the same as under the Proposed Action because the removal of three WTGs under Alternative A-1 would not affect the onshore components of the Project.

Light: When nighttime construction occurs, the vessel lighting for vessels traveling to and working at the Proposed Action's offshore construction areas may be visible from onshore locations depending on the distance from shore, vessel height, and atmospheric conditions. Visibility would be sporadic and variable. Although most construction is expected to occur during daylight hours, construction vessels would use work lights to improve visibility during night or poor visibility, in accordance with USCG requirements.

During operations, the Proposed Action would have a discrete contribution to nighttime visibility of the WTGs due to required aviation hazard lighting. FAA lighting from all of the Proposed Action's WTGs could be visible up to 36.2 miles away depending on weather and viewing conditions (COP, Section 4.3.4.3; Dominion Energy 2022). Dominion Energy has considered implementing ADLS as an APM that would activate the Proposed Action's WTG lighting only when aircraft approach the WTGs (COP, Section 4.3.4.3; Dominion Energy 2022). The implementation of ADLS would reduce the duration of the potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. During times when the Proposed Action's aviation warning lighting is visible, this lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the limited duration and frequency of such events and the distance of the Proposed Action's WTGs from shore, visible aviation hazard lighting for the Proposed Action would result in a long-term, intermittent, negligible impact on recreation and tourism. Onshore, Dominion Energy would implement lighting-reduction measures, such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable (COP, Section

4.2.2.3; Dominion Energy 2022). While Alternative A-1 would construct and operate three fewer WTGs than the Proposed Action, the difference in potential impacts on tourism and recreation from lighting of vessels or aviation hazard lighting is anticipated to be negligible.

New cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism. The Proposed Action would require up to 416.9 miles (671 kilometers) of total length of offshore export cables and up to 300 miles (484 kilometers) total length of inter-array cables (COP, Section 1.2, Table 1.2-1; Dominion Energy 2022). Array cable installation would require a maximum of 10 vessels (three main laying, two burial, four support vessels, and one post-installation survey vessel) (COP, Section 3.4.1.5; Dominion Energy 2022). Offshore export cable installation would require a maximum of 11 vessels (three main laying, three main cable jointing, three burial, and two support vessels) (COP, Section 3.4.1.5; Dominion Energy 2022). Recreational vessels traveling near the offshore export cable routes would need to navigate around vessels and access-restricted areas associated with the offshore export cable installation. Dominion Energy has committed to coordinate with USCG through the use of Local Notices to Mariners to communicate with recreational fishers, among others, of construction and maintenance activities and vessel movements, which would minimize potential adverse impacts associated with cable emplacement and maintenance activity (COP, Section 4.4.7.3; Dominion Energy 2022). The localized, temporary need for changes in navigation routes due to Proposed Action construction would constitute a minor impact. The amount of new offshore cable that would be installed under Alternative A-1 would be less than that under the Proposed Action because three fewer WTGs would require fewer array cables and, therefore, potential impacts on recreation and tourism would be less. However, the difference in potential impacts on recreation and tourism from having slightly fewer array cables than under the Proposed Action is anticipated to be negligible.

Cable installation could also affect species of interest for recreational fishing and sightseeing through turbidity resulting from cable installation, although species would recover upon completion (Sections 3.19, *Sea Turtles*, and 3.16, *Navigation and Vessel Traffic*), resulting in localized, short-term, minor impacts on recreation and tourism (COP, Sections 4.2.4.3, 4.2.5.2, and 4.4.6.3; Dominion Energy 2022).

Specific cable locations associated with future offshore wind projects have not been identified in the geographic analysis area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the impacts of cable emplacement and maintenance on recreational marine activities from ongoing and planned activities would likely be short term and minor.

Noise: Noise from O&M, pile driving, trenching, and vessels could result in impacts on recreation and tourism. Temporary impacts on recreation and tourism would result from impacts in the Wind Farm Area and along the offshore export cable route on species important to recreational fishing and marine sightseeing (COP, Sections 4.4.5.2, 4.1.5.3 and 4.2.4.3; Dominion Energy 2022). The temporary behavioral disruptions of offshore fish, shellfish, and whales due to startle responses or avoidance of the ensonified area during construction (Sections 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, and 3.15, *Marine Mammals*) would have a minor impact on recreational fishing or marine sightseeing.

In addition to the temporary disruption to fish and shellfish, noise generated by offshore construction and onshore cable installation would have impacts on the recreational enjoyment of the marine and coastal environments, with minor impacts on recreation and tourism. Offshore construction noise would occur from vessels, trenching, and pile driving along the offshore export cable route and in the Wind Farm Area. Noise from pile driving is estimated to produce sound power levels of 87 dBA in-air at 400 feet (122 meters) (COP, Section 4.1.4.2; Dominion Energy 2022). Where areas within or near the offshore export cable route and Wind Farm Area are available for recreational boating during construction, increased noise from construction would temporarily inconvenience recreational boaters.

Overall, construction noise from the Proposed Action alone would have localized, short-term, minor impacts on recreation and tourism. Offshore operational noise from the WTGs would be similar to the noise described for other projects under the No Action Alternative and would, therefore, have continuous, long-term, negligible impacts. Noise impacts on recreation and tourism under Alternative A-1 would be slightly less than those of the Proposed Action because three fewer WTGs would be constructed. However, the difference in potential impacts compared to the Proposed Action is anticipated to be negligible.

Port utilization: Within the geographic analysis area, the Proposed Action would use facilities at PMT and Newport News Marine Terminal to support the staging of components and construction vessels for the Project. Planned upgrades to the PMT will derive from roughly $8 billion of direct investment by Dominion Energy and a contribution of up to a $40 million from the Commonwealth of Virginia for site improvement and readiness (Chapter 2, *Proposed Action and Alternatives*; COP Section 4.4.1.2; Dominion Energy 2022). Increased vessel traffic and construction activity during upgrades at PMT and Newport News Marine Terminal may result in short-term delays and crowding during construction. The Proposed Action would have a short-term, negligible impact on recreation and tourism due to port utilization within the geographic analysis area. Under Alternative A-1, port utilization would generally be the same as that of the Proposed Action, although there would be slightly less ship traffic at the ports because three fewer WTGs would be constructed, operated, maintained, and decommissioned. Therefore, potential impacts on recreation and tourism from port utilization would be less. However, the difference in potential impacts on recreation and tourism at ports related to three fewer WTGs is anticipated to be negligible.

Presence of structures: The Proposed Action's up-to 205 WTGs and three OSSs would affect recreation and tourism through increased navigational complexity; risk of allision or collision; attraction of recreational vessels to offshore wind structures for fishing and sightseeing; the adjustment of vessel routes used for sightseeing and recreational fishing; the risk of fishing gear loss or damage by entanglement due to scour or cable protection; and potential difficulties in anchoring over scour or cable protection.

Construction and installation, expected to begin in 2023 and be completed in 2027, would affect recreational boaters. Risk of allision with anchored vessels would increase incrementally during construction, because more anchored vessels would be in the geographic analysis area (Appendix F, Table F-3). Dominion Energy has committed to marking potential hazards in coordination with USCG, developing Local Notices to Mariners that would include locations of partially installed structures, and advising mariners of safety zones around all Offshore Project components, which would minimize potential adverse impacts associated with structure construction activities (COP, Section 4.4.7.2; Dominion Energy 2022). AIS data from 2019 show that there is typically very low recreational activity from craft/sailing vessels within and directly adjacent to the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2022). In addition, sailing in the geographic analysis area primarily occurs nearshore, just along the coastline, rather than farther offshore (COP, Section 4.4.11.1; Dominion Energy 2022). Impacts would be mitigated through the use of navigation-related measures.

During O&M of the Proposed Action, the permanent presence of WTGs would create obstacles for recreational vessels. At their lowest point, WTG blade tips would be 82 feet (24 meters) above the surface (COP, Table 3.3-1; Dominion Energy 2022). At this height, larger sailboats would need to navigate around the Wind Farm Area, while smaller vessels could navigate unobstructed (except for the WTG monopiles).

Outside of avoiding certain operations during the construction phase, there are no planned or enforceable restrictions to vessels operating in the Wind Farm Area. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success. Between 2010 and 2019, 18 SAR incidents were recorded in the geographic analysis area: 14 involved material failure or malfunction while three involved injury to personnel; also during this time were 26 SAR incidents in the export cable geographic analysis area: 10 involved material failure or malfunction and five involved personnel injury, four of which were considered serious incidents (COP, Appendix S, Section 9.1.2; Dominion Energy 2022).

Recreational anglers may avoid fishing in the Wind Farm Area due to concerns about their ability to safely fish within or navigate through the area. Navigational hazards and scour/cable protection due to the presence of structures from ongoing and planned activities, including the Proposed Action, would result in major adverse impacts on commercial fisheries and moderate adverse impacts on for-hire recreational fishing; minimal beneficial impacts on for-hire recreational fishing due to the artificial reef effect may be long term. BOEM does not anticipate that fish aggregation due to the presence of structures would result in considerable changes in fish distributions across the geographic analysis area. For-hire fishing operations are part of the recreation and tourism industry and are included in the impacts on recreational boating and fishing anticipated in this section. The detailed discussion of impacts on for-hire fishing activities provided in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, may also be applicable to impacts on recreational fishing in general. Overall, the impacts on recreational fishing, boating, and sailing generally would be negligible, while the impacts on for-hire fishing would be minor because these enterprises are more likely to be materially affected by displacement.

Although some recreational anglers would avoid the Wind Farm Area, the scour protection around the WTG foundations would likely attract forage fish and game fish, which could provide new opportunities for certain recreational anglers. Evidence from Block Island Wind Farm indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). The fish aggregation and reef effects of the Proposed Action could also create foraging opportunities for marine species and mammals, such as seals and harbor porpoises, possibly attracting recreational boaters and sightseeing vessels (Glarou et al. 2020). In addition, future offshore wind development could attract sightseeing boats offering tours of the wind facilities. Based on the impacts of the WTGs and OSSs on navigation and fishing, the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection, the Proposed Action would have long-term, continuous, minor beneficial and minor adverse impacts on recreation and tourism (COP, Sections 4.2.5.2, 4.4.11.2, and 4.4.6.3; Dominion Energy 2022).

Structures from other planned offshore wind development would generate comparable types of impacts as the Proposed Action alone. The geographic extent of impacts would increase as additional offshore wind projects are constructed, but the level of impacts would likely be the same: minor adverse impacts on recreational fishing, recreational sailing and boating, and for-hire recreational fishing, as well as minor beneficial impacts. A lack of a common turbine spacing and layout throughout all wind projects within the geographic analysis area could make it more difficult for SAR aircraft to perform operations in the Lease Area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of offshore structures on marine recreational activities from ongoing and planned activities would be minor due to the increased number of offshore structures and reduction of SAR capacity based on the layout of the WTG and OSSs, and minor beneficial impacts would occur due to the opportunity for fishing and sightseeing provided by WTGs.

As it relates to visual impacts of presence of structures, the Proposed Action's 205 WTGs would also affect recreation and tourism through visual impacts. During construction, viewers in certain locations along the Virginia and North Carolina shore would see increased vessel traffic transporting components from fabrication and manufacturing facilities to the Project area. Vessel traffic is commensurate along the Atlantic Coast and vessel use for construction would be similar to existing vessel traffic in the area. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a temporary, negligible impact on recreation and tourism.

The WTGs would be in open ocean approximately 27 statute miles east of Virginia Beach. The maximum-case WTGs would have a height of 869 feet (265 meters) at the tip of the rotor blade, a hub height at 489 feet (149 meters) (COP, Appendix I-1, Figure I-1-2 and Section I-1.2.3; Dominion Energy 2022). At 31 miles (49.9 kilometers), the tip of the rotor blade (in the upright position) would be above the horizon line (COP, Appendix I-1, Section I-1.4.1; Dominion Energy 2022). Between 28.1 and 35.8 miles, only the WTG blades would be potentially visible above the horizon from the perspective of a beach-elevation viewer (COP, Appendix I-1, Section I-1.4.1, Figure I-1-7; Dominion Energy 2022). Dominion Energy has voluntarily committed to using ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint colors as described in Appendix I, *Environmental and Physical Settings*, to reduce impacts. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL Number 1023) yellow paint from the water line to a minimum height of 50 feet (15 meters) (COP, Appendix I-1, Section I-1.2.3; Dominion Energy 2022).

The visual impact of future offshore wind structures could affect recreation and tourism. The visual contrast created by the WTGs could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's orientation, activity, and purpose for visiting the area. As discussed in Section 3.20, *Scenic and Visual Resources*, the magnitude of impact is defined by the contrast, scale of the change, prominence, field of view (FOV), viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. The seascape character units, open ocean character unit, landscape character unit, and viewer experiences would be affected during construction, O&M, and decommissioning by the Project's features, applicable distances, horizontal and vertical FOV extents, view framing or intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence. These assessments are in Appendix M.

BOEM expects the impact of visible WTGs on the use and enjoyment of recreation and tourist facilities and activities during O&M of the Proposed Action to be long term, continuous, and minor. Beaches with views of WTGs could gain trips from the estimated 2.5 percent of beach visitors for whom viewing the WTGs would be a positive result, offsetting some lost trips from visitors who consider views of WTGs to be negative (Parsons and Firestone 2018).

Portions of 395 WTGs from the Proposed Action combined with future offshore wind projects could be visible from coastal and elevated locations in the geographic analysis area. The simulations prepared by Dominion Energy show anticipated views in clear conditions of future offshore wind projects associated with the No Action Alternative combined with the Proposed Action (COP, Appendix I, Attachment I-1-5; Dominion Energy 2022). The WTGs would be discernable on a clear day, with the color and irregular forms of the WTGs contrasting with the uninterrupted horizontal horizon line associated with the open ocean. As shown in the simulations, the Proposed Action WTGs would contribute the most from the closest locations, such as Virginia Beach. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP, Appendix I, Section I-1.4.1; Dominion Energy 2022).

Under Alternative A-1, there would be three fewer WTGs compared to the Proposed Action's 205 WTGs. Therefore, potential impacts on recreation and tourism related to the presence of offshore structures under Alternative A-1 would be less. However, the difference in potential impacts on recreation and tourism from having three fewer WTGs is anticipated to be negligible.

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk, primarily during Project construction and decommissioning, along routes between ports and the offshore construction areas. The Proposed Action would generate an average of 46 and a maximum of 95 vessel trips during the construction period (COP, Section 3.4.1.5; Dominion Energy 2022). Recreational vessels may experience delays within the ports serving construction (outside the geographic analysis area), but most recreational boaters in the geographic analysis area would experience only minor inconvenience from construction-related vessel traffic. Vessel travel requiring a specific route that crosses or approaches the offshore export cable routes could experience minor impacts (COP, Section 4.4.7.2; Dominion Energy 2022).

For regularly scheduled maintenance and inspections, Dominion Energy anticipates that, on average, the Proposed Action would generate approximately 46 trips daily. Operation of the Proposed Action would have localized, long-term, intermittent, minor impacts on recreational vessel traffic near ports and in open waters due to the periodic and limited nature of regularly scheduled maintenance. Impacts during decommissioning would be similar to the impacts during construction and installation. Under Alternative A-1, vessel traffic would generally be the same as under the Proposed Action, although there would be slightly less ship traffic at the ports because three fewer WTGs would be constructed, operated, maintained, and decommissioned. Therefore, potential impacts on recreation and tourism from vessel traffic would be less. However, the difference in potential impacts on recreation and tourism is anticipated to be negligible.

Activities requiring repair of WTGs, equipment or cables, or spills from maintenance or repair vessels would generally require intense, temporary activity to address emergency conditions or respond to an oil spill. Non-routine activities could temporarily prevent or deter recreation or tourist activities near the site of a given non-routine event. With implementation of the navigation-related APMs, the impacts of non-routine activities on recreation and tourism would be minor.

3.18.5.1 Cumulative Impacts of the Proposed Action

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

The contribution of the Proposed Action or Alternative A-1 to the anchoring impacts on recreational boating from ongoing and planned activities would likely be localized, short term, and minor during the period in which offshore wind projects are being constructed in the geographic analysis area. A greater number of vessels would be anchored when multiple offshore wind projects are under construction at one time within the Lease Area, potentially resulting in minor impacts.

The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for future offshore wind energy projects. Therefore, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined land disturbance impacts on recreation and tourism from ongoing and planned activities would be localized, short term, and minor, as impacts are expected to be similar to those of other common construction projects.

Future offshore wind projects could cause aviation hazard lighting from 190 additional WTGs (395 total WTGs or 392 total WTGs, including the Proposed Action or Alternative A-1, respectively) to be potentially visible in the geographic analysis area. Without the use of ADLS, lighting from future offshore wind projects other than the Proposed Action or Alternative A-1 would include red flashing lights on top of WTG nacelles and at the midpoint of WTG towers. In context of reasonably foreseeable environmental trends, ADLS would reduce the nighttime impact significance from minor to negligible due to substantially limited hours of lighting (COP, Section 4.3.4.3; Dominion Energy 2022).

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the noise impacts on marine recreational activities from ongoing and planned activities would likely be localized, short term, and minor during construction, and long term and negligible during operation.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to port utilization impacts on recreation and tourism from ongoing and planned activities would be negligible.

The combined visual impacts on recreation and tourism from ongoing and planned activities, including the Proposed Action or Alternative A-1, would likely be continuous, long term, and minor in the overall geographic analysis area, with minor impacts on the closest locations. Impacts would be reduced when atmospheric conditions limit the number of WTGs discernable from any one viewing location.

The Proposed Action or Alternative A-1 is anticipated to be under construction concurrently with two other projects: Kitty Hawk Wind North and South, OCS-A 0508. During anticipated concurrent construction periods, construction vessel traffic would increase between the proposed ports and the Lease Areas or cable installation work areas associated with each wind project, requiring increased alertness on the part of recreational or tourist-related vessels, and possibly resulting in a greater number of minor delays or route adjustments. The risk of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. Modest levels of vessel traffic are anticipated from offshore wind operations (COP, Section 4.4.7.2; Dominion Energy 2022). In context of reasonably foreseeable environmental trends, combined vessel traffic impacts on recreation and tourism from ongoing and planned activities, including the Proposed Action or Alternative A-1, would be short term, variable, and minor during construction and long term, intermittent, localized, and negligible during operations.

3.18.5.2 Conclusions

Impacts of the Proposed Action. In summary, the impacts resulting from individual IPFs associated with the Proposed Action or Alternative A-1 alone would range from **negligible** to **minor** and **negligible** to **minor beneficial**. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; and the long-term presence of scour protection and structures in the Wind Farm Area during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action or Alternative A-1 to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **minor** with **negligible** to **minor beneficial** impacts. Considering all of the IPFs together, BOEM anticipates that the contribution of the Proposed Action or Alternative A-1 to the impacts associated with ongoing and planned activities would result in **minor** impacts with **minor beneficial** impacts. The main drivers for this impact rating are the minor visual impacts associated with the presence of structures and lighting; impacts on fishing and other recreational activity from noise, vessel traffic, and cable emplacement during construction; and beneficial impacts on fishing from the reef effect.

3.18.6 Impacts of Alternatives B and C on Recreation and Tourism

Impacts of Alternatives B and C. The impacts of Alternatives B and C on recreation and tourism would be the same as those of the Proposed Action except for the impact of the presence of structures. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives B and C would be similar to those described under the Proposed Action. Construction of Alternative B or C would install fewer WTGs—up to 176 WTGs (inclusive of three spare WTG positions)—and construction of Alternative C would install up to 172 WTGs (inclusive of two spare WTG positions) and their associated inter-array cables, which would reduce the construction impact footprint and installation period. Turbine sizes under Alternatives B and C would also be reduced by using only 14-MW WTGs, whereas the Proposed Action would allow for up to

16-MW WTGs. Alternatives B and C would also align the three OSSs with the common grid layout of the WTGs, similar to Alternative A-1. Lastly, Alternative C would also allow for the removal of four WTGs within priority sand ridge habitat as well as the relocation of one WTG and associated inter-array cables. The removal and relocation of these WTGs would allow for a reconfiguration of inter-array cabling to minimize linear seafloor impacts on priority sand ridge habitat. All other design parameters and potential variability in the design would be the same as under the Proposed Action.

The removal of structures under Alternative B to avoid the Fish Haven area and under Alternative C to further avoid priority sand ridge habitats would decrease the risk of recreational or commercial fishing gear loss or damage due to entanglement on the scour protection and inter-array and export cable hard protection. Navigation would also be improved and the risk of allisions or collisions with other vessels would be reduced by aligning the three OSSs with the common grid layout of WTGs. Though minimized, the risk of allision and collisions would still exist under Alternatives B and C and could discourage recreational boaters traveling to and through the Wind Farm Area.

The exclusion zone would minimize impacts on commercial and recreational fisheries resources in the area. Fishing activities could continue, and mobile target species would be less likely to be displaced by construction noise and presence of structures. However, recreational fishing could see a slight decrease in fish due to fewer structures providing reef habitat for targeted species.

Construction of fewer WTGs proposed under Alternatives B and C would result in fewer vessels and vessel trips during construction as compared to the Proposed Action, which would reduce the risk of discharges, fuel spills, and trash in the area and decrease the risk of collision with marine mammals and sea turtles (Sections 3.15, *Marine Mammals*, and 3.19, *Sea Turtles*).

Alternative C's avoidance of priority sand ridge habitats in the southern portion of the Lease Area would protect soft-bottom habitat and benthic species of interest from disturbance, injury, or mortality; reduce changes in water quality; and reduce underwater noise and vibration during construction. Alternative C would also avoid shipwrecks, which may be of interest to recreational divers.

The removal of 29 WTGs for Alternative B and 33 WTGs for Alternative C would result in a negligible impacts on the viewshed from the shore when compared to the Proposed Action. As described in Section 3.20, *Scenic and Visual Resources*, the visual differences between the WTG array of Alternatives B and C and the Proposed Action WTG array would not be noticeable to the casual viewer standing on the Virginia Beach oceanfront and would not have a substantive effect on recreation and tourism.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action.

3.18.6.1 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would reduce the overall offshore footprint of the Project. Alternatives B and C would remove WTG positions without relocation and reduce turbine sizes, slightly reducing the visual impact of WTGs and reducing the impacts associated with construction and installation, O&M, and decommissioning. Alternatives B and C would also exclude the Fish Haven area in the northern portion of the Lease Area to reduce impacts on fisheries resources. Alternative C would avoid complex habitat through micrositing and relocation and removal of structures. Accordingly, the impacts resulting from individual IPFs associated with Alternatives B and C would be reduced in comparison to the impacts associated with the Proposed Action but would not change the overall impact magnitudes, which are anticipated to be short term and range from **negligible** to **moderate** and **negligible** to **minor beneficial** on recreation and tourism.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **minor** adverse impacts with **negligible** to **minor beneficial** impacts.

3.18.7 Impacts of Alternative D on Recreation and Tourism

Impacts of Alternative D. Alternative D would have the same number of WTGs and the same offshore cable route as the Proposed Action and, therefore, the same anticipated impacts on offshore recreation and tourism. Alternative D has two potential cable routes. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). Alternative D-2 would follow the same route as Interconnection Cable Route Option 6, except for the switching station. Alternative D-1 would be installed entirely overhead. The overall length of Alternative D-1 and Alternative D-2 would be the same (14.2 miles). However, portions of Alternative D-2 would be installed via underground methods, while Alternative D-1 would be installed entirely overhead.

The Chicory Switching Station associated with Alternative D-2, Interconnection Cable Route Option 6, would cover a larger operational footprint than the Harpers Switching Station; however, this is not anticipated to result in additional impacts on recreation and tourism. Trenching required for underground installation of portions of the interconnection cable route under Alternative D-2 may have potential short-term implications for recreational beach users, such as temporary beach closures. No long-term implications are anticipated. Therefore, land disturbance and visual impacts associated with recreational activities and tourism from interconnection cable construction and operation would be slightly less under Alternative D in comparison to the Proposed Action. Overall, the differences in impacts on recreation and tourism between Alternative D and the Proposed Action would be negligible.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.18.7.1 Conclusions

Impacts of Alternative D. No long-term implications are anticipated. Therefore, land disturbance and visual impacts associated with recreational activities and tourism from interconnection cable construction and operation would be slightly less under Alternative D in comparison to the Proposed Action. Overall, the differences in impacts on recreation and tourism between Alternative D and the Proposed Action would be negligible.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action: short-term impacts ranging from **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities on recreation and tourism would be the same as the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts.

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3.19 Sea Turtles

This section discusses potential impacts on sea turtles from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area. The sea turtle geographic analysis area, as shown on Figure 3.19-1, encompasses two LMEs, namely the Northeast U.S. OCS and Southeast U.S. OCS LMEs. These LMEs capture most of the movement range of sea turtles within the U.S. Atlantic Ocean waters. Due to the size of the geographic analysis area, for analysis purposes in this EIS, the focus is on sea turtles that would likely occur in the proposed Project area and be affected by Project activities. The geographic analysis area does not include all areas that could be transited by Project vessels (e.g., it does not consider vessel transits from Europe).

3.19.1 Description of the Affected Environment for Sea Turtles

This section discusses potential impacts on sea turtle species from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.19-1. The geographic analysis area for sea turtles includes large marine ecosystems along the Northeast and Southeast Atlantic OCS to capture the majority of habitats in the United States and movement for sea turtle species.

This section summarizes information on sea turtles occurring offshore Virginia is provided in the COP (Section 4.2.6, Appendix R, Table 4.2-26, Figure 4.2-37; Dominion Energy 2022) as well as BOEM wind project documents (BOEM 2012, 2014), the *Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf* (Baker and Howsen 2021), the Ocean Biodiversity Information System (OBIS 2021), and the most recent recovery plans and 5-year reviews available for each species.

Five sea turtle species have reported occurrences along the East Coast in both coastal and offshore waters. They are the loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), green sea turtle (*Chelonia mydas*), Kemp’s ridley sea turtle (*Lepidochelys kempii*), and Atlantic hawksbill sea turtle (*Eretmochelys imbricata*). All five species are listed as either threatened or endangered under the Endangered Species Act and are also identified as threatened or endangered by Virginia Department of Wildlife Resources (2021).

Except for the polar regions, sea turtles occupy all oceans, with higher densities and most nesting occurring in tropical and subtropical seas and foraging well into temperate regions. Sea turtles can remain underwater for extended periods, which allows them to spend as little as 3 to 6 percent of their time at the water surface (Lutcavage et al. 1997; NSF and USGS 2011); although dive patterns vary with activity and environment. Sea turtles often travel long distances between their feeding grounds and nesting beaches (Meylan 1995) making them a common group found in offshore and nearshore environments of Virginia.

Sea turtle species distribution and presence in the Project area is described in the COP (Section 4.2.6.1; Dominion Energy 2022) and summarized in Table 3.19-1. The species most likely to occur in the Project area are loggerhead, Kemp’s ridley, leatherback sea turtles, and green sea turtles. Visual survey and PSO sightings data indicate loggerhead and leatherback sea turtles are expected to be most common in waters offshore Virginia, while Kemp’s ridley and green, though seen regularly, are observed in few numbers (COP, Section 4.2.6.1; Dominion Energy 2022; OBIS 2021; Virginia Institute of Marine Science 2021). Only two records of Atlantic hawksbill sea turtle have been reported offshore Virginia since 1979 and they were considered an extralimital occurrence (Virginia Institute of Marine Science 2021). Hawksbill sea turtle typically prefers tropical habitats and occurrence in Virginia’s offshore waters is considered extralimital (COP, Section 4.2.6.1, Dominion Energy 2022; OBIS 2021; Virginia Institute of Marine Science 2021).

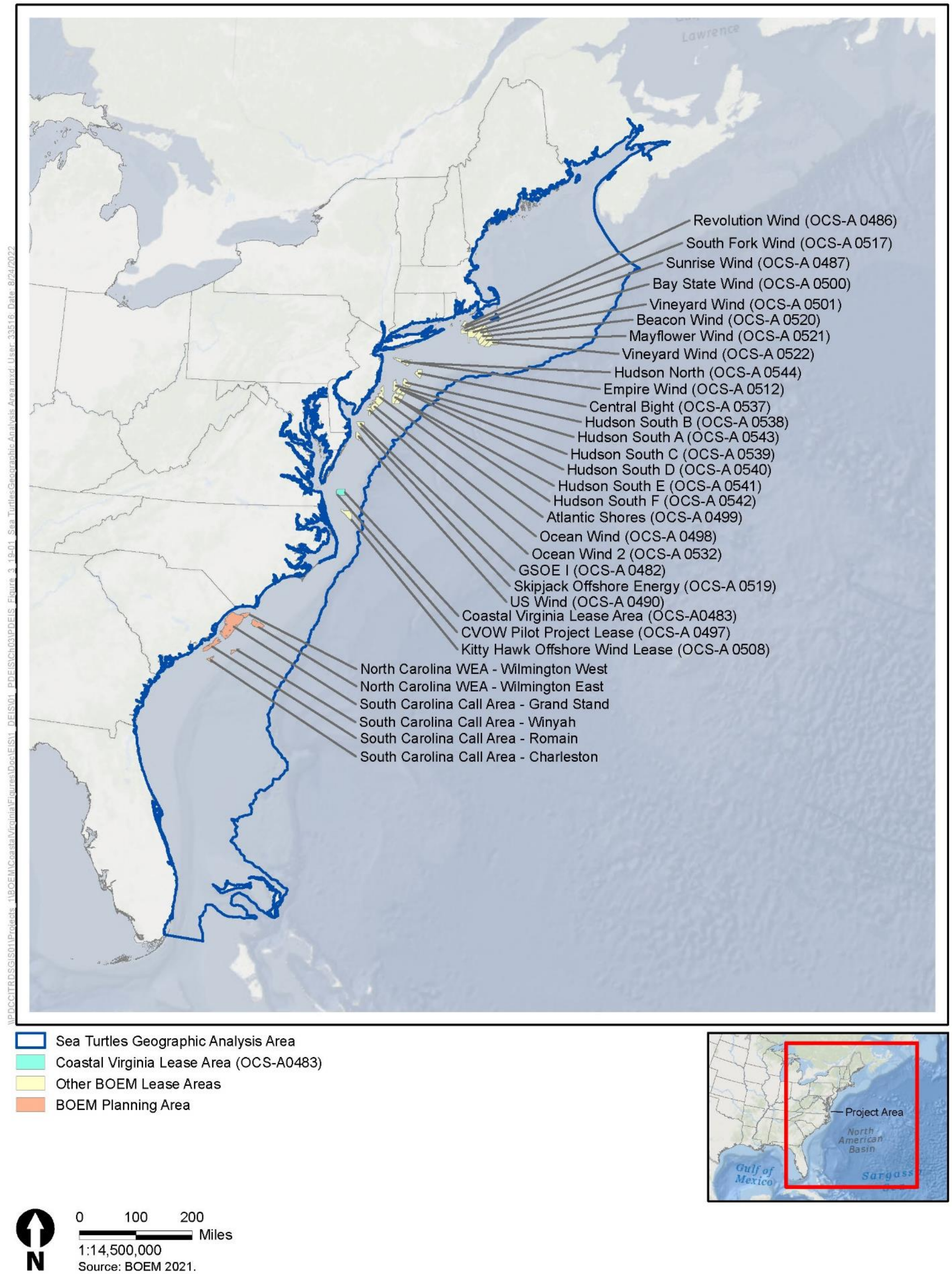

Figure 3.19-1 Sea Turtles Geographic Analysis Area

Table 3.19-1 Presence, Distribution, and Population Status of Sea Turtle Species Known to Occur in Coastal and Offshore Waters of Virginia Around the Project Area

Common Name	Scientific Name	Distinct Population Segment	Estimated Population Abundance	Distribution Around Project Area	Relative Occurrence in Project Area[1]	Seasonality	Federal Population Status	Virginia Population Status
Loggerhead sea turtle	*Caretta caretta*	Northwestern Atlantic	588,000	Throughout; offshore and nearshore	Common	Year-round	Threatened	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	N/A	65,000	Predominantly offshore	Common	Year-round	Endangered	Endangered
Green sea turtle	*Chelonia mydas*	North Atlantic	215,000	Predominantly nearshore	Uncommon	Year-round	Threatened	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	N/A	284,300	Predominantly nearshore	Common	Year-round	Endangered	Endangered
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	N/A	19,000	Extralimital	Extralimital	Spring/Summer	Endangered	Endangered

N/A = not applicable to species.
[1] Relative occurrence defined as:

- Common: Project area within typical range of the species, and species sightings are regularly documented.
- Uncommon: Project area within typical range of the species, but species sightings are only occasionally documented.
- Extralimital: Project area considered outside the typical range of the species, and few species sightings have been documented.

There is no designated sea turtle critical habitat offshore Virginia (NMFS 2021). Loggerhead sea turtles are commonly documented nesting in Virginia (Parker 2020), but there was a documented record of green sea turtles nesting in Croatan Beach in July 2021 just south of Virginia Beach (Croatan Civic League 2021). However, sea turtles in the Project area would most likely be migrating or foraging and spending the most of their time below the surface. One notable exception is in cooler months when sea turtles face the risk of colder water temperatures decreasing their overall body temperature and will bask at the water surface to counteract this effect (Sapsford and van der Riet 1979; Dodge et al. 2014; Freitas et al. 2019). Lower sea surface temperatures can result in cold stunning of turtles that causes them to become lethargic and float to the surface, which makes them more vulnerable to predators, anthropogenic effects, and strandings (NMFS 2021). During cooler sea temperatures in the temperate ocean conditions offshore Virginia, sea turtles can raise their body temperatures by basking at the water surface, which may make them more vulnerable to vessel strikes. However, there is limited published data regarding basking behavior in all species of sea turtles in relation to sea temperatures or air temperatures. Published data that are available show more surface basking behavior off Nova Scotia than in Massachusetts, inferring potentially more frequent or longer surface periods (Dodge et al. 2014). This suggests that while sea turtles may be more available for vessel strike in northern waters during cold conditions, this may not hold true for more temperate waters off Virginia.

The COP Section 4.2.6 (Dominion Energy 2022) and Table 3.19-1 summarize information and data regarding sea turtles in the Project area obtained from a review of protected species observer data, the NMFS sea turtle directory, Ocean Biodiversity Information System data (OBIS 2021), USFWS information for planning and consultation (USFWS 2021), VDWR (2021), the Virginia Natural Heritage Data Explorer (Virginia Department of Conservation and Recreation 2021), and other available reports and literature.

Sea turtles are wide-ranging and long-lived, making population estimates difficult; population abundance estimation and visual survey methods vary depending on species and location (TEWG 2007; NMFS and USFWS 2013, 2015, 2019). Leatherback sea turtle regional nesting trends were negative across three different temporal scenarios and became more negative as the time series became shorter (Northwest Atlantic Leatherback Working Group 2018). For loggerhead sea turtle, progress toward recovery has been made since publication of the *2008 Loggerhead Sea Turtle Recovery Plan*, but recovery units have not met most of the critical benchmark recovery criteria (NMFS and USFWS 2019). Recent models indicate a persistent reduction in survival, recruitment, or both to the nesting population of Kemp's ridley sea turtle, suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015). The most recent status review for the North Atlantic distinct population segment of green sea turtle estimates that nesting trends are generally increasing (Seminoff et al. 2015). However, a study by Ceriani et al. (2019) has indicated that using nest counts as a direct proxy for adult female population status can be misleading and is not evidence of a strong population recovery. Because sea turtles have large ranges and highly migratory behaviors, the current conditions and trends of sea turtle populations are affected by factors in the geographic analysis area, which encompasses areas both inside and outside the Project area. The following lists provide information about species foraging and nesting.

- Loggerhead sea turtle:
  - Predominantly carnivores that feed on a variety of floating prey during their open ocean life phase as hatchlings and young juveniles; they feed mainly on benthic species such as whelks, other mollusks, horseshoe crabs, and other crabs during their late juvenile and adult phases when they have migrated to nearshore coastal habitats (NMFS 2021).
  - Primary nesting habitats in the United States are in Florida, Georgia, South Carolina, and North Carolina, but hatchlings have been observed on beaches in Virginia, Maryland, and Delaware (Bies 2018; Parker 2020; Pomeroy 2020).

  - No critical habitat has been designated for this species in or near the Project area, but their *Sargassum* critical habitat occurs over the OCS, as well as over deeper waters of the continental slope (NMFS 2021).
- Kemp's ridley sea turtle:
  - Hatchlings inhabit the open ocean where they use *Sargassum* algae as a refuge to rest and forage on small animals and plants; adults travel to nearshore coastal areas where their preferred prey are crab species (NMFS 2021).
  - The main nesting habitat for this species is in the Gulf of Mexico; however, they have also been observed nesting in coastal areas of Georgia, South Carolina, and North Carolina, as well as the Atlantic coast of Florida (NMFS 2021).
  - No critical habitat has been designated for this species.
- Leatherback sea turtle:
  - Preferred prey include soft-bodied animals such as jellyfish and salps (NMFS 2021).
  - The only designated critical habitat for this species is around their main nesting habitat in the U.S. Virgin Islands; a few records of leatherback nesting activity have been documented in Florida (NMFS 2021).
- Green sea turtle:
  - Green sea turtles are the only herbivorous species feeding mainly on seagrass, although they will occasionally feed on sponges and invertebrates (NMFS 2021).
  - The primary nesting habitats for green sea turtles are in Costa Rica, Mexico, Cuba, and the Southeast U.S. including Florida, Georgia, South Carolina, and North Carolina (NMFS 2021).
  - Critical habitat has been designated for this species off Puerto Rico outside the geographic analysis area (NMFS 2021).
- Atlantic hawksbill sea turtle:
  - Atlantic hawksbills are omnivorous foragers whose preferred prey in most habitats are sponges, but they will also prey on marine algae, bivalves, and crustaceans (NMFS 2021).
  - Primary nesting habitats are in the Caribbean; nesting events for this species in the U.S. are rare and have been limited to southeast Florida and the Florida Keys (NMFS 2021).
  - Critical habitat has been designated for this species off Puerto Rico outside the geographic analysis area (NMFS 2021).

Risks to sea turtle populations include fisheries bycatch, marine debris, habitat loss, vessel traffic, underwater noise, EMFs, and artificial lighting (NMFS 2021; NMFS and USFWS 2013, 2014, 2015, 2019). Globally, entanglement in and ingestion of human-made debris is a substantial threat to sea turtles and it is believed that entanglements are underestimated (i.e., not all are reported) (Duncan et al. 2017). Research by Duncan et al. (2017) estimated that globally, over 1,200 entangled sea turtles are encountered per year with just over a 90 percent mortality rate. Commercial fisheries operating in the geographic analysis area include bottom trawl, midwater trawl, dredge, gillnet, longline, and pots and traps. Commercial vessel traffic in the region is variable depending on location and vessel type.

3.19.2 Environmental Consequences

3.19.2.1 Impact Level Definitions for Sea Turtles

Definitions of impact levels are provided in Table 3.19-2.

Table 3.19-2 Impact Level Definitions for Sea Turtles

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
Minor	Adverse	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.
	Beneficial	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts could increase survival and fitness, but would not result in population-level effects.
Moderate	Adverse	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Adverse effects would likely be recoverable and would not affect population or DPS viability.
	Beneficial	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Impacts would be measurable at the population level.
Major	Adverse	Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level effects that are not recoverable, even with mitigation.
	Beneficial	Impacts would be significant and extensive and contribute to population or DPS recovery.

3.19.3 Impacts of the No Action Alternative on Sea Turtles

When analyzing the impacts of the No Action Alternative on sea turtles, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities on the baseline conditions for sea turtles. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.19.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for sea turtles described in Section 3.19.1, *Description of the Affected Environment for Sea Turtles*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned non-offshore wind activities. The primary IPFs for sea turtles within the geographic analysis area are generally associated with noise and vessel strikes, the presence of structures, and ongoing climate change. Fuel spills and releases of trash and debris have lesser potential impact on sea turtles due to their low probability of occurrence and relatively limited spatial impact. Land use and coastal development affect sea turtles mostly through habitat loss from development near sea turtle nesting areas, which occur outside of the Project area. Specific non-offshore wind activities that may affect sea turtles include commercial fisheries bycatch; marine transportation; military use; oil and gas activities; undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; dredging and port improvement; marine mineral use and ocean dredged material disposal; and global climate change (see Appendix F, Section F.2, for a complete description of ongoing and planned activities). Most of these activities would only likely result in temporary displacement and behavioral changes; however, vessel strikes and entanglement in marine debris could result in potential injury or mortality of individuals. Global climate change could also result in population-level impacts on sea turtle species by displacement, impacts on prey species, altered population dynamics, and increased mortality.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include:

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

Ongoing O&M of the Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect sea turtles through the primary IPFs of noise, presence of structures, and traffic. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and traffic that are described in detail in Section 3.5.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.19.3.2 Cumulative Impacts of the No Action Alternative

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

Under the No Action Alternative, BOEM would not approve the COP (Dominion Energy 2022) and the Proposed Action would not be implemented. Existing environmental trends within the geographic analysis area would continue, potentially influenced by the development of planned future activities on the OCS and associated coastal areas over the coming decade. These include other offshore wind and renewable energy projects, and potential port improvements to support the development of this industry regionwide (see Appendix F).

BOEM expects future offshore wind activities to affect sea turtles through the following primary IPFs: accidental releases, discharges, EMFs, new cable emplacement/maintenance, noise, port utilization, and the presence of structures. Offshore wind activities have the potential to produce impacts from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys, and installation and operation of turbine structures. The IPFs identified for sea turtle species are summarized in this section for offshore wind activities without the Proposed Action. This section provides a general description of these mechanisms; the extent and significance of potential effects on conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed. Where appropriate, certain potential effects resulting from these future actions can be generally characterized by comparison to effects resulting from the Proposed Action that are likely to be similar in nature and significance. The intent of this section is to provide a general overview of how future activities might influence future environmental conditions. Should any or all of the future activities described in Appendix F proceed, each would be subject to independent NEPA analyses of environmental effects and regulatory approvals.

Accidental releases: Trash or water quality contaminants could be accidentally released as a result of increased human activity associated with future offshore wind development activities. All species of sea turtles have been documented ingesting plastic debris (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016), as well as a variety of other anthropogenic waste (Tomás et al. 2002), likely mistaking debris for potential prey items (Schyuler et al. 2014). Ingesting trash or exposure to aquatic contaminants could result in lethal or sublethal effects including depressed immune system function; poor body condition; and reduced growth rates, fecundity, and reproductive success (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Additionally, entanglement in lost fishing gear is the primary anthropogenic cause of mortality in both juvenile and adult sea turtles (National Research Council 1990 as cited in Shigenaka et al. 2010). Furthermore, accidental releases may indirectly affect sea turtles through effects on prey species (see Section 3.13.1.1 for more details). However, all vessels associated with offshore wind development projects would comply with USCG regulations and BOEM regulations that would avoid and minimize accidental release of trash or other debris and aquatic contaminants. Each project would also be expected to have its own oil spill response plan to implement in the case of accidental releases. Therefore, potential accidental release volumes would not appreciably contribute to adverse impacts on sea turtles, and no population-level impacts are expected for any species.

EMF: Under the No Action Alternative, the future development of planned offshore wind projects would result in up to 5,595 miles (9,004 kilometers) of new submarine electrical transmission cables in the geographic analysis area for sea turtles (Appendix F, Table F2-1). Each cable would generate EMF potentially detectable by sea turtles in the immediate area around the cable. The available evidence indicates that sea turtles are magnetosensitive and orient to the Earth's magnetic field for navigation. Although they may be able to detect magnetic fields as low as 0.05 milligauss, sea turtles are unlikely to detect magnetic fields below 50 milligauss (Normandeau et al. 2011; Snoek et al. 2016). However, potential EMF effects would be reduced by cable shielding and burial to an appropriate depth, and new submarine cables would be installed to maintain a minimum separation of at least 330 feet (101 meters) from other known cables to avoid damaging existing infrastructure during installation. This separation distance would avoid additive EMF effects from adjacent cables. While artificial EMF effects on sea turtles are not well studied, current construction and mitigation methods would limit projected EMF effects below levels that are likely to cause notable biological effects. Deviations in migration therefore would be small and would not be expected to substantially affect energy expenditure in sea turtles. Further discussion of potential EMF effects on sea turtles can be found in the *South Fork Wind Farm Biological Assessment* (BOEM 2021), the NMFS biological opinion for the Vineyard Wind Energy Project (NOAA 2020), and the COP (Section 4.2.6.2; Dominion Energy 2022).

Light: Nighttime lighting associated with offshore structures and vessels could represent a source of attraction, avoidance, or other behavioral responses in sea turtles. Although responses to light have been studied in various species and life stages of sea turtles, the effects are expected to be negligible (BOEM 2019). Shoreline development is the predominant existing artificial lighting source in the nearshore component of the geographic analysis area while vessels, mainly fishing vessels, are the predominant source of artificial lighting offshore. Future wind energy development would contribute additional light sources to the offshore component of the geographic analysis area; onshore components of offshore wind projects are not expected to produce a substantial amount of light or be present in areas where sea turtles are expected. Offshore sources of light consist of short-term lighting from vessels used during construction and the long-term use of navigational lighting on new WTGs and OSSs. Over 3,287 structures are forecasted for construction in the geographic analysis area. Each structure would have minimal yellow flashing navigational lighting, as well as red flashing Federal Aviation Administration hazard lights in accordance with BOEM (2019) lighting and marking guidelines. Data from oil and gas platform operation in the Gulf of Mexico, which can have considerably more lighting than offshore WTGs, have not resulted in any known impacts on sea turtles (BOEM 2019) and no long-term or population-level impacts from offshore lighting produced by offshore wind projects is expected.

New cable emplacement/maintenance: Future offshore wind projects could disturb over 177,718[1] acres (719 square kilometers) of seabed while installing associated undersea cables, causing an increase in suspended sediment (Appendix F, Table F2-2). This disturbance would be localized and temporary. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be limited in extent, short term in duration, and likely too small to be detected (NOAA 2021). Seafloor disturbance during construction of future offshore wind projects may affect sea turtle foraging success or some prey species; however, impacts would be temporary and generally localized to the cable corridor. Use of trailing suction hopper dredgers during installation, if used, could also pose an entrainment risk for sea turtles; however, this is more common with large-scale beach nourishment and navigational channel dredging projects, which would cover a larger area and be in operation for longer periods of time than what is needed for offshore wind projects (Ramirez et al. 2017). Additionally, most future offshore wind projects would consider multiple methods of cable emplacement and use of a trailing suction hopper dredger is not a primary option, whereas other emplacement methods would present a lower entrainment risk for sea turtles. Given the likelihood of this activity occurring and the small time and spatial scale over which these activities would occur, no population-level effects on sea turtles would be expected.

Noise: Human activities would continue to generate underwater noise with potential to affect sea turtles. Several wind energy projects could be developed between 2023 and 2030 with overlapping construction periods that add several new sources of underwater noise to the ambient soundscape through pile driving and vessel traffic (Appendix F, Table F-3). As discussed in Appendix F, some projects could be constructed concurrently at multiple locations on the OCS, which could result in larger or overlapping areas of increased underwater anthropogenic noise.

Potential impacts on sea turtles from underwater noise include PTS, TTS, and behavioral disturbances. Acoustic thresholds, which represent the estimated sound level at which the onset of a particular effect may occur, that are recommended by Finneran et al. (2017) for all sea turtle species by impact are listed in Table 3.19-3. Data are currently only available for sea turtle behavioral responses to impulsive sound sources (described in Section 3.15.1.1, *Future Offshore Wind Activities [without Proposed Action]*), so these thresholds are assumed to apply to all noise categories.

Table 3.19-3 Acoustic Thresholds for Sea Turtles for Each Type of Impact and Noise Category

Impact	Impulsive Noise Threshold	Non-impulsive Noise Thresholds
PTS	$L_{p,pk}$ 232 dB re 1 μPa	$L_{E,24hr}$: 220 dB re 1 μPa^2 s
	$L_{E,24hr}$: 204 dB re 1 μPa^2 s	
TTS	$L_{p,pk}$: 226 dB re 1 μPa	$L_{E,24hr}$: 200 dB re 1 μPa^2 s
	$L_{E,24hr}$: 189 dB re 1 μPa^2 s	

[1] Kitty Hawk Wind South has three export cables (57 miles [92 kilometers] to Virginia, 200 miles [322 kilometers] to North Carolina, and an additional 96 miles [154 kilometers] of inshore export cable to North Carolina) for a total of 352.9 miles (568 kilometers, and corridor widths ranging from the 1,520-mile-wide (2,414-kilometer-wide) corridor to Virginia and the 1,000-mile-wide (1,609-kilometer-wide) corridors to North Carolina to allow for optimal routing of the cables.

Impact	Impulsive Noise Threshold	Non-impulsive Noise Thresholds
Behavioral disturbance	L_P: 175 dB re 1 μPa	

Source: Finneran et al. 2017.
μPa = micropascal; $μPa^2$ s = micropascal square second; dB = decibel; $L_{E,24hr}$ = sound exposure level over 24 hours; $L_{p,pk}$ = peak sound pressure level; L_P = root-mean-square sound pressure level.

A few experimental studies have been conducted on the hearing capabilities of sea turtles. While general hearing sensitivities for all species are below 2 kHz, primary hearing frequency ranges vary per species and life stage (Bartol and Ketten 2006; Bartol et al. 1999; Dow Piniak et al. 2012a, 2012b; Martin et al. 2012; Piniak et al. 2016).

Both impulsive and non-impulsive noise may be produced by HRG survey activities used during pre-, during-, and post-construction site characterization surveys and impact pile driving used to install WTG and OSS foundations. Some HRG survey equipment (e.g., boomers, sparkers) can produce high-intensity impulsive noise while other survey equipment (e.g., compressed high-intensity radiated pulse [CHIRP] sonar) produce lower intensity noise without the characteristic rise in pressure (Crocker and Frantantonio 2016; Crocker et al. 2019). Both types of HRG survey equipment have the potential to result in short-term impacts on sea turtles such as behavioral disturbances, avoidance, stress, or TTS. Given the intensity of noise generated by these equipment (Crocker and Frantantonio 2016; Crocker et al. 2019) and short duration of proposed surveys (Appendix F), it is unlikely to result in PTS for any turtle species. The *Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf* (Baker and Howsen 2021) concluded that disturbance of sea turtles from noise related to HRG survey activities would likely result in temporary displacement or behavioral responses that would not result in biologically notable physiological consequences, no injury or mortality would occur, and impacts on sea turtles would not result in stock or population-level effects.

Impulsive noise from impact pile driving during future offshore wind development, due to the anticipated frequency and spatial extent of effect, represents the highest risk of exposure and potential for adverse effects on sea turtles in the geographic analysis area. While these potential effects are acknowledged, their significance is unclear because sea turtle sensitivity and behavioral responses to impulsive underwater noise are subjects of ongoing study. Potential behavioral effects may include altered submergence patterns, short-term disturbances, startle responses (e.g., diving, swimming away), short-term displacement of feeding or migrating activity, and a temporary stress response if present within the ensonified area (NSF and USGS 2011; Samuel et al. 2005). The accumulated stress and energetic costs of avoiding repeated exposures to pile-driving noise over a season or life stage could have long-term effects on survival and fitness (U.S. Department of the Navy 2018). Conversely, sea turtles could become habituated to repeated noise exposures over time and not suffer any long-term consequences (Hazel et al. 2007). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2012; U.S. Department of the Navy 2018).

Sea turtles that are exposed to impact pile driving have the potential to experience mortality, non-lethal injury, or acoustic injury such as TTS or PTS. In theory, reduced hearing sensitivity could limit the ability to detect predators, prey, or potential mates and reduce the survival and fitness of affected individuals. However, the role and importance of sound in these biological functions for sea turtles remains poorly understood (Lavender et al. 2014). Assuming that mitigation measures similar to those described in the COP (Section 4.2.3.3, Table 4.2-13; Dominion Energy 2022) would be required in all offshore wind development projects, impacts on sea turtles from construction-related noise would be limited to minimal or moderate short-term effects on a small number of individuals. Short-term effects on individuals would not be notable at the population level and therefore minor overall.

Non-impulsive sources of noise in the geographic analysis area from future offshore wind projects include helicopters and fixed-wing aircraft, construction and operation and maintenance vessels, vibratory pile driving during construction, operational WTG noise during operation and maintenance, and other HRG survey equipment (e.g., CHIRP sonar) different from the impulsive HRG survey sources described above. Aircraft may be used during initial site surveys, protected species monitoring prior to and during construction, facility monitoring, and crew transfers during construction. Sea turtle sensitivity to airborne noise is not well studied, but available information indicates potential disturbances would be minimal. Bevan et al. (2018) observed no evident behavioral responses from sea turtles exposed to drones flown directly overhead at altitudes ranging from 59 to 102 feet (18 to 31 meters). Aircraft would operate at altitudes of 1,001 feet (305 meters) or more except when landing or departing from service vessels. NMFS (2016) determined that noise and disturbance effects on sea turtles from aircraft operations for a single offshore wind project would be negligible, and effects from aircraft use during multiple projects within the geographic analysis area would similarly be expected to be negligible as these noises are not expected to overlap in time or space.

Vibratory pile driving may be used prior to impact pile driving to reduce the risk of pile run for some offshore wind projects and during export cable installation and port facility construction. Typical noise levels generated by vibratory pile driving are lower than noise levels produced by impact pile driving. Available measurements indicate the L_P was, on average, 165 dB referenced to 1 micropascal at 33 feet (10 meters), and decreased to 140 dB referenced to 1 micropascal when measured 656 feet (200 meters) away (Illingworth and Rodkin 2017). These measurements are based on smaller piles in shallower water locations, appropriate for export cable installation activities, and it is expected that vibratory pile driving conducted for the foundations prior to impact pile driving will produce a greater area of ensonification. However, based on these sound levels, it is still not expected that the PTS thresholds (Table 3.19-3) would be exceeded more than 328 feet (100 meters) from the pile, even in deeper water environments, the PTS. Ranges to the behavioral disturbance threshold for sea turtles (Table 3.19-3) may extend further; however, the behavioral disturbance threshold is an L_P of 175 dB referenced to 1 micropascal and would not be exceeded beyond 1,640 feet (500 meters) from the source. Additionally, vibratory pile driving activities would be relatively short term, occurring over approximately 4 hours per pile for the foundations, and over several days for export cable installation. Therefore, vibratory pile-driving noise effects on sea turtles would be negligible at the individual and population levels because of the low exposure probability.

Construction and operational vessels are the most broadly distributed source of non-impulsive noise associated with offshore wind projects. Sea turtle exposure to underwater vessel noise would incrementally increase as a result of future offshore wind projects, especially during construction periods (Appendix F) (COP, Section 3.4; Dominion Energy 2022; South Fork Wind 2021). Applying vessel activity estimates developed by BOEM (2019), vessel activity could peak in 2025 with as many as 207 vessels involved in the construction of expected future wind energy projects. However, this increase must be considered relative to the baseline level of vessel traffic in the geographic analysis area (Appendix F, Table F1-14). Sea turtles are less adept at detecting sound compared to faunal groups like marine mammals and no injury or behavioral effects from vessel noise are anticipated for future offshore wind projects. Although sea turtles could become habituated to repeated noise exposure over time (Hazel et al. 2007), vessel noise effects for future wind development projects are expected to be broadly similar to noise levels from existing vessel traffic in the region. Nonetheless, periodic localized, short-term behavioral impacts on sea turtles could occur. Based on sea turtle responses to other types of disturbance (e.g., Bevan et al. 2018) turtle behavior is expected to return to normal when vessel noise dissipates. Given turtles' limited sensitivity to underwater noise produced by vessels, the temporary nature of any behavioral responses, and the patchy distribution of sea turtles throughout the geographic analysis area, the effects of vessel noise from future offshore wind activities would be negligible. No population-level effects would occur.

No notable effects on sea turtles are anticipated from non-impulsive noise produced by WTG operation. Noise associated with operational WTGs would be expected to attenuate below ambient levels at a relatively short distance from WTG foundations (Kraus et al. 2016; Miller and Potty 2017; Thomsen et al. 2015; Tougaard et al. 2009). Maximum anticipated noise levels produced by operational WTG are estimated to be between 125 and 130 decibels referenced to 1 micropascal at 1 meter (Lindeboom et al. 2011; Tougaard et al. 2009), and HDR (2019) measured sound pressure level (L_P) below 120 decibels referenced to 1 micropascal at 164 feet (50 meters) from operating turbines at the Block Island Wind Farm, which are below recommended thresholds for sea turtle injury and behavioral disturbance (Table 3.19-2). Current generation WTGs use direct drive motors that produce even lower noise levels than earlier generation technologies considered in prior studies (BOEM 2019). Sea turtles appear to habituate to repetitive underwater noise not accompanied by an overt threat (Bartol and Bartol 2012; Hazel et al. 2007; U.S. Department of the Navy 2018). This suggests that even if WTGs generate noise detectable to sea turtles in the immediate proximity, the exposed individuals are not expected to experience measurable adverse effects. Therefore, the effects of operational noise from future offshore wind projects on sea turtles would be negligible at both individual and population levels.

Port utilization: Any port expansions could increase the total amount of disturbed benthic habitat and result in impacts on some sea turtle prey species. However, given that port expansions would likely occur in subprime areas for foraging and the disturbance would be relatively small in comparison to the overall sea turtle foraging areas in the geographic analysis area, port expansions are not expected to affect sea turtles. Dredging for port facility improvement could lead to additional impacts on turtles from incidental entrainment, impingement, or capture. Dredging impacts on sea turtles are relatively uncommon; most observed injury and mortality events in the U.S. were associated with hopper dredging in and around core habitat areas in the southern portion of the geographic analysis area and in the Gulf of Mexico outside the geographic analysis area (Michel et al. 2013; USACE 2020). Ongoing maintenance dredging of these facilities may incrementally increase related risks to individual turtles over the lifetime of the facilities; however, typical mitigation measures such as timing restrictions should minimize this potential. Additionally, the size, scope, and location of the dredging activities conducted for offshore wind projects would be less than that identified for other projects such as beach nourishment or port deepening, and the type of equipment used reduces the risk of entrainment or impingement. Compared to the dredging activities for planned offshore wind projects, navigation dredging projects, which occur primarily in channels close to shore, generally pose a greater risk of entrainment of sea turtles because of their tendency to concentrate in channels (Ramirez et al. 2017). For example, the number of sea turtles entrained by hopper dredging in BOEM offshore borrow areas has historically been relatively low when compared to navigation channel dredging (Ramirez et al. 2017). Between 1995 and 2015, there were 69 reported sea turtle takes in the North Atlantic (i.e., north of North Carolina) by trailing suction hopper dredges, versus approximately 260 taken in hopper dredges operating in the South Atlantic. The takes per project across the entire South Atlantic were estimated to be 0.96 (the North Atlantic was not analyzed). Therefore, given the extent of and location of navigation projects using hopper dredges, the limited amount of dredging conducted as part of the Proposed Action is not expected to result in population effects as few to no takes of sea turtles would reasonably be expected. The risk of injury or mortality to individual sea turtles resulting from dredging associated with future offshore wind projects exclusive of the Proposed Action is low and population-level effects are unlikely to occur.

Presence of structures: The addition of over 3,287 new offshore structures (WTGs, OSSs, and meteorological tower) in the geographic analysis area could increase sea turtle prey availability through the creation of new hard-bottom habitat, increasing pelagic productivity in local areas, or promoting fish aggregations at foundations (Bailey et al. 2014 cited in English et al. 2017). Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, discusses reef creation and the potential for anthropogenic structures to attract fish. Fish aggregations around new wind farm structures can provide additional foraging opportunities for sea turtles that may result in negligible or minor beneficial impacts given the broad geographic range of species during their annual foraging migrations. However, the presence of structures may indirectly concentrate recreational fishing around foundations, which could indirectly increase the potential for sea turtle entanglement in both lines and nets and result in minor adverse impacts on sea turtles given their proclivity for entanglement in lost fishing gear (Nelms et al. 2016; Gall and Thompson 2015; Shigenaka et al. 2010).

Human-made structures, especially tall vertical structures like WTG and OSS foundations, alter local water flow at a fine scale and could result in localized impacts on sea turtle prey distribution and abundance. A discussion of the effects of altered water flow can be found in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*. The presence of many WTG structures could affect oceanographic and atmospheric conditions in ways that alter local environments and potentially increasing primary productivity in the vicinity of these structures (Carpenter et al. 2016; Schultze et al. 2020). However, this may not translate to a beneficial increase in sea turtle prey abundance if the increase in primary productivity is consumed by filter feeders (e.g., mussels) that colonize the surface of the structures (Slavik et al. 2019).

The long-term effects of offshore structure development on ocean productivity and sea turtle prey species, and therefore sea turtles are difficult to predict with certainty because they are expected to vary by location, season, and year depending on broader ecosystem dynamics. For example, the presence of new hard surfaces could increase the abundance of associated organisms (e.g., mussels, crustaceans) on and around the structures, providing a prey resource for sea turtles. Increased primary and secondary productivity in proximity to hard-bottom structures could increase the abundance of prey species like jellyfish (English et al. 2017). Additionally, hard-bottom (scour control, cable protection) and vertical structures (WTG and OSS foundations) in a soft-bottom habitat can create a 3-dimensional artificial reef structure, thus inducing the “reef effect” and resulting in higher densities and biomass of mollusks, fish, and decapod crustaceans (Causon and Gill 2018; Taormina et al. 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, sea turtles, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019) indicating that offshore wind facilities can generate beneficial long-term impacts on local ecosystems, translating to increased foraging opportunities for sea turtle species. Sea turtles may also use vertical structures for shelter from strong currents to conserve energy and for cleaning their carapace (Barnette 2017). In contrast, increased fish biomass around the structures could attract commercial and recreational fishing activity, creating an increased risk of injury or mortality from gear entanglement and ingestion of debris (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014).

Some level of displacement of sea turtles from future wind farm lease areas into areas with a higher potential for interactions with ships or fishing gear could occur, particularly during construction phases. However, the addition of structures could locally increase pelagic productivity and prey availability for sea turtles and decrease the likelihood of long-term displacement from the wind farm lease areas. While the effect would be present long term throughout the life of future offshore wind projects, the overall impact on sea turtles is not expected to be biologically notable.

Vessel traffic: Vessel strikes are an increasing concern for sea turtles. The percentage of loggerhead sea turtles stranded due to vessel strikes increased from approximately 10 percent in the 1980s to 20.5 percent in 2004 (NMFS and USFWS 2007). Sea turtle strandings reported to have vessel strike injuries have been reported to be as high as 25 percent in Chesapeake Bay, Virginia (Barco et al. 2016), and Foley et al. (2019) reported that roughly one-third of stranded sea turtles in Florida had injuries indicative of a vessel strike. Sea turtles are expected to be most susceptible to vessel strikes in shelf waters where they forage. Furthermore, they cannot reliably avoid being struck by vessels traveling in excess of 2 knots (Hazel et al. 2007); typical vessel speeds in the geographic analysis area may exceed 10 knots. Up to 207 vessels associated with offshore wind development may be operating in the geographic analysis area during the peak construction period in 2025 (BOEM 2019) (Appendix F, Table

F1-14). Increased vessel traffic could result in a higher number of vessel strikes, resulting in sea turtle injury or mortality. However, despite the potential for individual fatalities, no population-level impacts on sea turtles are expected. It is expected that planned offshore wind projects will adhere to vessel speed restrictions and visual monitoring, which, while geared primarily towards marine mammals, will help reduce the risk of a strike occurring that results in a serious injury or mortality. PSO sightings data indicate sighting rates for sea turtles during vessel operations were approximately 13 sea turtle detections per 100 hours of vessel effort (Marine Ventures International, Inc. 2022; RPS 2021). These detection rates are relatively high, and even with these high detection rates there were only 18 vessel strike mitigation actions required (2.8 percent of all sea turtle detections) and no strikes reported. With the implementation of these measures, impacts are expected to be moderate.

Gear utilization (biological/fisheries monitoring surveys): A primary threat to sea turtles is their unintended capture in fishing gear, which can result in drowning or cause injuries that lead to injury and mortality (e.g., swallowing hooks). For example, trawl fishing is among the greatest continuing primary threats to the loggerhead turtle (NMFS and USFWS 2019), and sea turtles are also caught as bycatch in other fishing gear including longlines, gillnets, hook and line, pound nets, pot/traps, and dredge fisheries. A substantial impact of commercial fishing on sea turtles is the entrapment or entanglement that occurs with a variety of fishing gear. Although the requirement for the use of bycatch mitigation measures, such as requirements for “turtle excluder devices” in trawl fishing gear, has reduced sea turtle bycatch, Finkbeiner et al. (2011) compiled data on sea turtle bycatch in U.S. fisheries and found that in the Atlantic, a mean estimate of 137,700 interactions, 4,500 of which were lethal, occurred annually since implementation of bycatch mitigation measures. The impacts of gear utilization associated with fisheries use on sea turtles are expected to be minor. A reduction of sea turtle interactions with fisheries is a priority for sea turtle recovery.

Climate change: Global climate change is an ongoing potential risk to sea turtles, although the associated impact mechanisms are complex, not fully understood, and difficult to predict with certainty. Possible impacts on sea turtles due to climate change include increased storm severity and frequency; increased erosion and sediment deposition; increased disease frequency; ocean acidification; and altered habitat, prey availability, ecology, and migration patterns. Over time, climate change, in combination with coastal development, would alter existing habitats and render some areas unsuitable for some species and more suitable for others.

3.19.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, sea turtle species would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on sea turtles. These effects are primarily driven by offshore construction and operation impact, presence of structures, noise, and traffic.

., BOEM expects ongoing activities and future offshore wind activities to have continuing temporary to permanent impacts on sea turtles, primarily through construction-related lighting, noise, habitat alteration, risk of vessel strikes, and artificial reef effect. In addition to ongoing activities, planned activities other than offshore wind development include increasing vessel traffic, new submarine cables and pipelines, maintenance dredging, channel-deepening activities, military activities, and the installation of new towers, buoys, and piers (Appendix F).

Potential impacts on sea turtles from ongoing activities, particularly the risk of accidental releases of trash and debris and vessel strikes, would be **minor** for sea turtles. Additionally, the impacts on sea turtles from planned actions from non-offshore wind activities, which would likely incrementally increase the number of vessels in the water and therefore the risk of accidental releases and vessel strikes, would be **moderate**.

The combination of ongoing activities and reasonably foreseeable non-offshore wind activities would result in **moderate** impacts on sea turtles in the geographic analysis area.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and sea turtles would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on sea turtles due to habitat loss from increased offshore construction and operations.

Considering all IPFs collectively, the overall impacts associated with future offshore wind activities in the geographic analysis area would result in **moderate adverse** impacts, particularly during pile driving, but would also include **minor beneficial** impacts throughout the life of the projects due to the presence of the structures. Most of the structures in the geographic analysis area would be attributable to offshore wind development. Sea turtles present in these project areas during construction would be exposed to increased underwater noise levels during impact pile driving of new WTG and OSS foundations and would be at risk of vessel strikes from project vessels used throughout all phases of development. However, these impacts would be localized to the project area of a given wind farm project and impacts on sea turtles would be temporary and would not be biologically notable.

3.19.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The primary PDE parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*) that would influence the magnitude of the impacts on sea turtles include the number, size, and location of WTGs and OSSs; and the number of vessels used during Project activities.

Variability of the proposed Project design exists as outlined in Appendix E. Potential variability in impacts from the number, size, and location of WTGs and OSSs would be directly proportional to the number installed; fewer WTGs and OSSs would present a lower risk to sea turtles.

3.19.5 Impacts of the Proposed Action on Sea Turtles

Accidental releases: During construction and operation of the Project there could be a short-term risk of sanitary and other waste fluids or fuels and other petrochemicals accidentally entering the water from vessels operating during Project activities. If sea turtles were exposed to an oil spill or discharge of waste material, potential impacts would be the same as those discussed in Section 3.19.3.2, *Cumulative Impacts of the No Action Alternative*. Any non-routine spills or accidental releases that could result in negligible and short-term impacts on surface water resources would be avoided or minimized through the implementation of the Project Oil Spill Response Plan and other environmental protection measures (COP, Section 4.2.6.3, Table 4.2-51; Dominion Energy 2022). Impacts on sea turtles from accidental spills or pollutant releases are considered minor because of the low probability of accidents and mitigation measures that will be implemented. Trash and debris from Project-related vessels that enters the water also represents a risk factor to sea turtles because they could ingest or become entangled in debris, causing lethal or injurious impacts. Plastic materials (e.g., plastic bags) are often mistaken for prey (e.g., jellyfish, salps) and ingested, which can block the turtles' intestinal tracts, causing injury or mortality. The risk of spills under Alternative A-1 would be slightly less than under the Proposed Action due to the construction and operation of three fewer WTGs; therefore, potential impacts on sea turtles would be slightly less. However, the difference in potential impacts from accidental releases is anticipated to be negligible when compared to the Proposed Action. Personnel working offshore would receive training on sea turtle awareness and marine debris awareness (COP, Section 4.2.6.3, Table 4.2-51; Dominion Energy 2022) in addition to other proposed measures which would lower the probability of such risk. Therefore, impacts from accidental releases on sea turtles are expected to be negligible for the Proposed Action or Alternative A-1.

EMFs: EMFs would be produced by the inter-array and offshore export cables throughout the life of the Project. These effects would be most intense directly above the cables at locations where they could not be buried to the full proposed burial depth and are laid on the seafloor beneath stone or concrete mattresses. Approximately 300 miles (484 kilometers) of inter-array cable and 417 miles (671 kilometers) of export cable in the offshore portion of the preferred cable route would be installed (COP, Table 1.2-1; Dominion Energy 2022). Estimated EMF levels modeled by Exponent for the COP (Appendix AA; Dominion Energy 2022) predict a maximum magnetic field from the inter-array cable of 68 milligauss, and 112 milligauss from the export cable at the seabed. However, the magnetic field is reduced to 5.2 and 8.7 milligauss for the inter-array and export cable, respectively, at 3 feet (1 meter) above the seafloor; similar reductions are expected at increasing horizontal distance from the cables (COP, Appendix AA; Dominion Energy 2022). BOEM has conducted literature reviews and analyses of potential EMF effects from offshore renewable energy projects on indigenous fauna (CSA Ocean Sciences and Exponent 2019; Normandeau et al. 2011). These and other available reviews and studies (Gill et al. 2005; Kilfoyle et al. 2018) suggest that most marine species cannot sense very low intensity electric or magnetic fields at the typical AC power transmission frequencies associated with offshore renewable energy projects. As discussed in Section 3.19.3.2, sea turtles are likely magnetosensitive and orient to Earth’s magnetic field for navigation, but they are unlikely to detect magnetic fields below 50 milligauss (Normandeau et al. 2011). The transmission cables used during Project operations may exceed 50 milligauss at locations where full burial is not possible, but these areas would be limited (i.e., the magnetic field above 50 milligauss would be limited to the area immediately above the cables) (COP, Appendix AA; Dominion Energy 2022). This indicates that sea turtles would only be able to detect induced magnetic fields within a few meters of the exposed cables or immediately above buried cables. Alternative A-1 would have slightly less inter-array cabling than the Proposed Action because three fewer WTGs would be constructed; however, EMFs produced under Alternative A-1 are not anticipated to be substantively different than those of the Proposed Action. Given the lack of sensitive life stages of sea turtles present in the Project area, the limited extent of detectable magnetic field levels, and limited potential for sea turtles to encounter field levels above detectable levels for extended periods of time, the effects of Project-related EMF exposure on sea turtles would be negligible for the Proposed Action or Alternative A-1

Light: Lights would be required on vessels and heavy equipment during construction and would also include a variety of operational lighting, including navigational lighting for mariners, obstruction lighting for aviators, and vessel/work lighting for maintenance and operations. As discussed in Section 3.19.3.2 behavioral responses to artificial lighting have been observed in sea turtles; however, none of these responses are expected to result in long-term or biologically notable impacts. Additionally, typical migrating or foraging behavior of sea turtles (i.e., remaining predominantly submerged) limits their exposure to operational lighting, and lighting would be limited to the minimum required for by regulation for safety. While Alternative A-1 would construct and operate three fewer WTGs than the Proposed Action, the difference in potential impacts on sea turtles from light associated with construction and operations is anticipated to be negligible. Based on available information and Project design parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*), it is expected the impact of Project-related lighting on sea turtles would be negligible for the Proposed Action or Alternative A-1.

New cable emplacement/maintenance: Sea turtles in or near the Project area would likely be foraging or migrating between foraging and nesting habitats. Prey items within the Project area could include benthic species that could be affected by seabed disturbance associated with installation of the offshore export cables and inter-array cables. This disturbance would be short-term and prey species would be expected to return to the area once the cables are installed (Section 3.13.3). Similar levels of impact would be realized during cable maintenance. While Alternative A-1 would require slightly less inter-array cables than the

Proposed Action, impacts from seabed disturbance for cable emplacement on sea turtles is anticipated to be the same. While trailing hopper suction dredgers are being considered for use for the Proposed Action or Alternative A-1, it is not definite and potential risks of sea turtle entrainment would be low as discussed in Section 3.19.3.2. Because impacts during cable installation or maintenance would be temporary and localized, the impact of Project activities on sea turtles would be negligible for the Proposed Action or Alternative A-1.

Noise: A short-term increase in underwater noise is the most likely IPF that could affect sea turtles, predominantly during installation of the WTG and OSS foundations, cofferdams, and nearshore structures during Project construction. The Project PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations and OSS jacket foundations, as well as vibratory pile driving, which would be used to install the cofferdams and impact pile driving of the goal post piles (COP, Appendix Z; Dominion Energy 2022). All these activities have potential to produce noise above recommended sea turtle acoustic thresholds (Table 3.19-3). Underwater acoustic modeling was conducted for the COP (Appendix Z; Dominion Energy 2022) for both activities, and the results are summarized in Table 3.19-4. For the purposes of this assessment, the deep modeling location using the maximum hammer energy with all noise attenuation is provided for each modeled scenario.

Table 3.19-4 Summary of Underwater Acoustic Modeling Conducted for the Coastal Virginia Offshore Wind Project Construction and Operations Plan

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold ($L_{p,pk}$)	Distance to PTS Threshold ($L_{E,24hr}$)	Distance to Behavioral Threshold (L_P)
Standard Driving Installation – Impact Pile Driving	0	104	2,628	5,162
	6	48	1,408	2,829
	10	10	1,044	2,146
Standard Driving Installation – Vibratory Pile Driving	0	N/A	65	189
	6		18	119
	10		6	82
Hard-to-Drive Installation – Impact Pile Driving	0	104	2,918	5,162
	6	48	1,533	2,829
	10	10	1,142	2,146
Hard-to-Drive Installation – Vibratory Pile Driving	0	N/A	40	189
	6		0	119
	10		0	82
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	0	104	3,685	5,162
	6	48	2,053	2,829
	10	10	1,410	2,146
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	0	N/A	78	189
	6		24	119
	10		8	82
OSS Piled Jacket – Impact Pile Driving	0	0	1,695	2,041
	6	0	914	1,134
	10	0	653	742
OSS Piled Jacket – Vibratory Pile Driving	0	N/A	14	85
	6		0	38

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold ($L_{p,pk}$)	Distance to PTS Threshold ($L_{E,24hr}$)	Distance to Behavioral Threshold (L_P)
	10		0	7
Cofferdam Installation – Vibratory Pile Driving	0	N/A	0	0
	6		0	0
	10		0	0
Goal Post Pile Installation – Impact Pile Driving	0	0	0	0
	6	0	0	0
	10	0	0	0

Source: Tetra Tech 2022.

As discussed in Section 3.19.3.2, the low-frequency noise associated with impact and vibratory pile driving during installation of the WTG and OSS foundations is within the estimated hearing range of sea turtles. Results of the modeling show there is some risk of exposure to noise above the PTS threshold during impact pile driving given the maximum range to the threshold may extend to 0.9 mile (1.4 kilometers) with 10 dB noise attenuation (Table 3.19-4). However, the PTS threshold is a represented as a sound exposure level over 24 hours ($L_{E,24hr}$) indicating that the duration of the exposure is just as important as the level of the noise an animal is exposed to. The $L_{E,24hr}$ assumes an individual is exposed to noise at or above the threshold within 24 hours for the onset of PTS to occur, so if an animal moves away from the noise before accumulating enough sound to meet the threshold they are not likely to develop PTS. It is expected that sea turtles will swim away from the ensonified area during construction, which reduces the risk of PTS occurring. Additionally, mitigation measures such as soft start, pre-clearance, and shutdown procedures, while geared primarily towards marine mammals, will help ensure that the amount of time the Project area is ensonified above the thresholds and the amount of time an animal is present within the ensonified area is reduced, further reducing the risk of PTS being realized. Modeling also indicated a risk of behavioral disturbances occurring as the maximum range to this threshold may extend to 1.3 miles (2.1 kilometers) from the source with 10 dB noise attenuation (Table 3.19-4). However, as discussed for PTS, the proposed mitigation measures will help reduce the overall duration sea turtles may be exposed to above-threshold noise. If sea turtles avoid the ensonified area during pile driving that may represent a loss of foraging habitat during the construction period; however, this would not be expected to be a long-term behavioral disturbance as sea turtles would regain access to this habitat after pile driving, and there are likely to be ample foraging opportunities outside the Project area, so no impacts that would affect the viability of any sea turtle population are expected. While Alternative A-1 would result in a slightly reduced duration of underwater noise due to the construction of fewer WTGs compared to the Proposed Action (up to 202 WTGs under Alternative A-1), potential impacts on sea turtles are anticipated to be the same. Because of the risk of PTS for sea turtles and temporary avoidance of the ensonified area, moderate impacts on sea turtles are expected to result from the Proposed Action or Alternative A-1.

Vibratory pile driving during installation of the cofferdams is not expected to exceed PTS or behavioral thresholds at any distance (Table 3.19-4). Therefore, vibratory pile driving associated with cofferdam installation is expected to result in a negligible impact on sea turtles from the Proposed Action or Alternative A-1; it is more likely sea turtles would respond to noise from construction vessels staging on site prior to vibratory pile driving.

Impact pile driving during installation of the goal post piles used to support trenchless installation of the export cable is similarly not expected to result in any PTS-onset or behavioral disturbances. Though impact pile driving produces louder noise than vibratory pile driving, the size of the piles, location of the activity, and duration of the pile driving for the goal posts make this less likely to produce above-threshold noise for sea turtles. Modeling shows that PTS and behavioral thresholds will not be met or exceeded at any distance from the source (Table 3.19-4), and impacts on sea turtles during goal post installation under the Proposed Action or Alternative A-1 would therefore result in negligible impacts.

Underwater noise levels produced by construction and maintenance vessels throughout the life of the Project are not expected to exceed PTS thresholds for sea turtles. The main frequency range of vessels (10 to 1,000 Hz) overlaps with the frequency range of sea turtle hearing (100 to 1,200 Hz) (Ketten and Bartol 2006; Lavender et al. 2014); sea turtles can detect vessel noise and could respond with a startle or temporary stress response (NSF and USCG 2011). However, sea turtles may also habituate to vessel traffic associated with the Project as they inhabit areas that experience regular marine traffic (Hazel et al. 2007). A conservative assumption is that Project construction and support vessels could elicit behavioral changes in individual sea turtles present in the Project area during vessel operations, but these changes would be limited to evasive maneuvers such as diving, changes in swimming direction, or changes in swimming speed. These changes are not expected to be biologically notable and impacts on sea turtles from Project vessel noise would therefore be negligible for the Proposed Action or Alternative A-1.

Aircraft used during Project activities would follow established guidance (BOEM 2019) and would maintain altitudes of 1,001 feet (305 meters) or more above the water surface during normal flight operations, exclusive of takeoffs and landings. As discussed in Section 3.19.3.2, there is limited information regarding sea turtle responses to airborne aircraft noise. Based on available information, it is expected that short-term, non-biologically notable behavioral responses may occur (BOEM 2017; NSF and USCG 2011; Samuel et al. 2005). These changes in behavior are expected to end when the aircraft has left the area. Consequently, potential effects on sea turtles from aircraft noise are expected to be negligible for the Proposed Action or Alternative A-1.

HRG survey equipment would likely be used during pre-construction surveys to support design finalization. This equipment produces noise in the 1.1 to 200 kHz frequency range at sound levels that may exceed sea turtle behavioral thresholds. No injurious impacts are expected for sea turtles from any HRG survey equipment (Baker and Howsen 2021). Behavioral disturbances may occur up to 295 feet (90 meters) from impulsive sources and up to 7 feet (2 meters) from non-impulsive sources assuming equipment are operating at the highest power settings (Baker and Howsen 2021). Some low-level behavioral disturbances could potentially occur during Project-related HRG surveys; however, implementation of mitigation measures (COP, Section 4.2.6.3, Table 4.2-51; Dominion Energy 2022) and the relatively short duration of these surveys would reduce the risk of exposure. Impacts from HRG surveys on sea turtles is therefore expected to be negligible for the Proposed Action or Alternative A-1.

Sea turtles would likely be able to hear the continuous underwater noise of operational WTGs throughout the life of the proposed Project. Sea turtle hearing (frequencies less than 1,200 Hz) is within the frequency range for operational WTG (less than 500 Hz) (Popper et al. 2014; Thomsen et al. 2006; Tougaard et al. 2009, 2020). Thus, it is possible that WTG noise may influence sea turtle behavior. Potential responses to WTG noise generated during normal operations may be behavioral and include avoidance of the noise source, disorientation, and disturbance of normal behaviors such as feeding (MMS 2007). Noise generated during normal operations might affect many individuals and for a much longer time period (MMS 2007). As discussed previously for marine mammals in Section 3.15.3, operational WTGs can produce L_P ranging from 92 to 137 dB referenced to 1 micropascal at distances of 65 to 656 feet (20 to 200 meters) from the source (Tougaard et al. 2020). However, though WTG noise may exceed ambient sound levels present within the Project area, they are not expected to exceed noise produced by vessel traffic out to 0.6 mile (1 kilometer) (Tougaard et al. 2020) and impacts would therefore be similar to those described for vessel noise under *Cumulative Impacts of the No Action Alternative* and would be expected to be negligible.

Port utilization: Offshore wind on the mid-Atlantic OCS, including the Proposed Action and Alternative A-1, may require the expansion or improvement of regional ports to support planned and future projects.

While no dredging activities are directly proposed under the Proposed Action or Alternative A-1, the likelihood of sea turtle exposure to dredging (should it become necessary) is minimal. Most sea turtles occurring in the area would be migrating or foraging offshore, and while one species has been documented nesting in Virginia Beach, nesting locations are north of the Project switching station in military reserves and national wildlife refuges, outside the area of effect (Parker 2020). Therefore, dredging impacts on sea turtles from port utilization during Project construction would be negligible for the Proposed Action or Alternative A-1.

Presence of structures: The Proposed Action would alter approximately 272.04 acres (1.1 square kilometers) of seafloor, with 205 WTG foundations with associated scour protection and up to three OSS foundations altering approximately 2.9 acres of seafloor over the life of the Project (COP, Table 4.2-17; Dominion Energy 2022). Under Alternative A-1, up to 202 WTG foundations and three OSSs would be installed. Accordingly, seafloor disturbance would be slightly reduced compared to the Proposed Action. The alteration of the seafloor under both the Proposed Action and Alternative A-1 would result in a long-term conversion of existing benthic habitat to new, stable, hard structures. The presence of the foundations poses a potential risk for sea turtle displacement which would result in lost foraging opportunities or reduced access to foraging and breeding habitat. However, there is no designated critical habitat for any sea turtles in the Project area so there is not expected to be any substantial loss of foraging opportunities that could have population-level effects. Based on the best available information, negligible impacts, if any, are anticipated for the Proposed Action or Alternative A-1. Sea turtles would be expected to use habitat in between the WTGs, as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if benthic communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed during migrations, the presence of structures is not expected to result in noticeable changes to overall migratory patterns in sea turtles. However, presence of these structures is also expected to attract fishing activity which may increase the risk of accidental releases of trash and debris. Interactions with lost fishing gear around WTG foundations is another potential long-term risk and may be high intensity, resulting in hooking, entanglement, ingestion, injury, and death (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Given sea turtle proclivity for utilizing anthropogenic structures and documented effects of discarded fishing gear on sea turtles (Barnette 2017), minor adverse impacts may occur for sea turtles from entanglement risk the Proposed Action or Alternative A-1.

Once construction is complete, these surfaces would be available for colonization by sessile organisms and would draw other species that are typically attracted to hard-bottom habitats (Causon and Gill 2018; Langhamer 2012). This phenomenon is known as the reef effect as discussed in Section 3.19.3.2. Additional information about the reef effect on sea turtle prey species can be found in Section 3.13.3. The Project foundations could result in increased primary production and zooplankton abundance, which could serve as food for some sea turtle species, as well as some sea turtle prey species. This may result in minor beneficial impacts from the presence of foundations for the Proposed Action or Alternative A-1.

Within the context of other available habitats along the OCS and expected future offshore wind projects (Appendix F), habitat availability due to presence of WTG and OSS foundations, including the Proposed Action or Alternative A-1, would result in minor adverse impacts on sea turtles. The presence of structures, which would attract fish, may attract fishing vessels around the wind farms, which increases the risk of lost gear being present where sea turtles are foraging or migrating. However, the increased fish presence and potential primary productivity rates around these structures would also provide additional foraging opportunities, and the structures themselves provide shelter for sea turtles which would result in minor beneficial effects on sea turtles.

Vessel traffic: Vessels associated with Project construction and O&M during the Proposed Action or Alternative A-1 would result in a nominal increase in vessel traffic relative to the overall existing volume of vessel traffic offshore Virginia and within the OCS in general (Appendix F, Table F1-14). Larger vessels used during construction would largely transit to the Project work site and remain there for most of the construction period. Smaller support vessels are expected to make more frequent trips between Project ports and the work site to deliver supplies and crew members. Regular trips would also be made by Project vessels throughout operations and maintenance for routine maintenance of Project components. Increased vessel traffic from Project activities presents a vessel strike risk to the sea turtle species identified as potentially occurring in the Project area, all of which are listed as threatened or endangered under the Endangered Species Act; a strike that results in serious injury or mortality could have severe consequences. Sea turtle stranding data reported that stranded sea turtles with evidence of vessel strike injury were as high as 25 percent in the Chesapeake Bay, Virginia (Barco et al. 2016). Similarly, Foley et al. (2019) reported that roughly one-third of stranded loggerhead, leatherback, and green sea turtles in Florida had injuries indicative of a vessel strike. However, all Project vessels would implement mitigation measures outlined in the COP (Section 4.2.6.3, Table 4.2-51; Dominion Energy 2022) following guidance from both NOAA and BOEM to reduce the likelihood of vessel strike on sea turtles. Mitigation measures such as vessel speed restrictions and protected species monitoring, while geared towards marine mammals, will subsequently benefit sea turtles by reducing the risk of a vessel strike occurring. PSOs for offshore wind site investigation surveys have reported sightings of sea turtles during vessel transits and survey operations (Marine Ventures International, Inc. 2022; RPS 2021). RPS (2021) recorded 75 leatherback sea turtles, 470 loggerhead sea turtles, and 83 unidentified turtles over a 2-year period totaling roughly 4,893 observation hours, which equates to approximately 13 sea turtle detections per 100 hours of survey and vessel effort. These detection rates are relatively high, and even with these high detection rates there were only 18 vessel strike mitigation actions required (2.8 percent of all sea turtle detections) and no strikes reported. Therefore, with the implementation of vessel strike avoidance measures such as visual monitoring, impacts from vessel traffic on sea turtles would be moderate under the Proposed Action or Alternative A-1.

3.19.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on sea turtles include but are not limited to various coastal development projects. As the Proposed Action or Alternative A-1 would account for about 9.7 percent or 9.6 percent (up to 205 or 202 of 3,287) of the new WTGs on the OCS, a majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action or Alternative A-1.

Accidental releases: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be minor. Entanglement in lost fishing gear is the primary anthropogenic cause of mortality in both juvenile and adult sea turtles (National Research Council 1990 as cited in Shigenaka et al. 2010) and is expected to be the primary source of risk to sea turtles from accidental releases of trash and debris within the geographic analysis area.

EMFs: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be negligible. New subsea cable installation would be predominantly attributed to future offshore wind development, which would result in up to 5,595 miles (9,004 kilometers) of export cables and 5,554 miles (8,938 kilometers) of inter-array cables installed between 2023 and 2030, within which the Proposed Action or Alternative A-1 comprises a relatively small portion of the overall length of the cables (Appendix F, Table F2-1). While each cable would generate EMF effects in the immediate surrounding area, only sea turtles at or directly above the seafloor near the cables would likely be able to detect it, and impacts would be limited to negligible, short-term behavioral responses.

Light: The expected negligible impact of the Proposed Action or Alternative A-1 alone would not noticeably increase the overall impacts of light beyond the impacts described under the No Action Alternative (Section 3.19.3). Under the expanded planned action scenario, over 3,287 offshore structures would have lights, and these would be incrementally added over time beginning in 2023 and continuing through 2030 (Appendix F, Table F2-1). Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021) guidance. In the context of reasonably foreseeable environmental trends, combined lighting impacts on sea turtles from ongoing and planned actions, including the Proposed Action or Alternative A-1 would be expected to have negligible, non-measurable impacts on sea turtles. Ongoing and future non-offshore wind activities are not expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

New cable emplacement/maintenance: The expected negligible incremental impact of the Proposed Action or Alternative A-1 combined with ongoing and planned actions would result in seafloor disturbance from the offshore export cable and inter-array cables. In the context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, could occur if impacts are in close temporal and spatial proximity. However, these impacts from cable emplacement would be expected to be negligible and would not be expected to be biologically notable.

Noise: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be moderate for sea turtles. The main activity that would result in adverse effects on sea turtles is impact pile driving during installation of WTG and OSS foundations. The expected moderate incremental impact of the impact pile driving under the Proposed Action or Alternative A-1, combined with future offshore wind activities, would result in increased underwater noise levels during construction starting in 2023 and continuing through 2030, but the effects of this activity would be removed once pile driving stopped (Appendix F, Table F2-1). All other noise-producing activities under the Proposed Action or Alternative A-1 are expected to result in negligible impacts on sea turtles, and combined impacts with ongoing and planned actions would similarly be negligible. Impacts from other noise -producing activities are lower in intensity relative to impact pile driving, and impacts would be localized, temporary, and not biologically notable for sea turtle populations.

Port utilization: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be negligible.

Presence of structures: The Proposed Action would contribute to the cumulative impacts of structures on sea turtles, which are expected to minor.

Vessel traffic: In the context of reasonably foreseeable environmental trends, the combined vessel traffic impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be moderate.

3.19.5.2 Conclusions

Impacts of the Proposed Action. Project construction, operations and maintenance, and conceptual decommissioning would likely result in habitat disturbance, underwater noise, vessel traffic, artificial lighting, and potential accidental discharges or spills and trash. BOEM anticipates the impacts resulting from the Proposed Action or Alternative A-1 would range from **negligible** to **moderate**. Therefore, the overall impacts on sea turtles are expected to be **moderate**, as the overall effect would be notable, but the resource is expected to recover completely with remedial or mitigating action.

Cumulative Impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action or Alternative A-1 would range from **negligible** to **moderate**, but could include **minor beneficial** impacts. Considering all the IPFs collectively, impacts from ongoing and planned actions, including the Proposed Action or Alternative A-1, would result in **moderate** impacts on sea turtles in the geographic analysis area. The main drivers for this impact rating are underwater noise, particularly impact pile driving; risk of vessel strikes; and presence of the structures. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through additional impact pile driving, vessel traffic, and WTG/OSS structures that would be present in the region during Project construction and operations and maintenance. Therefore, overall impacts on sea turtles are expected to be **moderate** because a measurable impact is anticipated, but the resource would likely recover completely when pile driving activities cease or remedial or mitigating actions are taken.

3.19.6 Impacts of Alternatives B and C on Sea Turtles

Impacts of Alternatives B and C. Alternatives B and C would reduce the number of proposed WTGs but would lead to the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. However, Alternatives B and C would remove 29 and 33 turbines, respectively; therefore, there would be a smaller area of seabed disturbance and water column disturbance and a shorter duration of noise impacts. The area of seabed disturbed by Alternatives B and C would be decreased by approximately 14 percent and 17 percent compared to the Proposed Action, respectively. Although this would decrease the overall duration of impact pile driving expected during the construction period, the noise produced per pile would be expected to be similar to that described under the Proposed Action and impacts on sea turtles would be expected to remain moderate.

Operational impacts of reduced WTGs on sea turtles under Alternatives B and C would be minimally decreased compared to the Proposed Action due to the fewer number of WTGs and subsequent smaller area of impact. Less habitat would be altered and affected by WTG operational noise, artificial lighting, and EMF from the inter-array cable. However, in the vicinity of the Project, effects would not be measurably different from those of the Proposed Action.

If Alternative B or Alternative C were approved, associated risks to sea turtles, particularly related to pile-driving noise, would be less than those expected under the Proposed Action.

Cumulative Impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action.

3.19.6.1 Conclusions

Impacts of Alternatives B and C. Although Alternatives B and C would decrease the number of WTGs and their associated inter-array cables, BOEM expects that the impacts resulting from Alternatives B and C alone would be similar to those of the Proposed Action and would range from **negligible** to **moderate**.

Cumulative Impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action, with individual IPFs leading to **negligible** to **moderate** impacts, with potential for **minor beneficial** impacts. While Alternatives B and C may result in a slightly lower risk of impacts on sea turtles than described under the Proposed Action, the overall impacts of Alternatives B and C on sea turtles would be the same as under the Proposed Action and would remain **moderate**. This impact rating is determined primarily by ongoing activities such as those that produce underwater noise and vessel activities. As described for the Proposed Action, Dominion Energy’s existing commitments to mitigation measures and BOEM’s potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.19.7 Impacts of Alternative D on Sea Turtles

Impacts of Alternative D. Alternative D would result in the same types of impacts on sea turtles from construction, O&M, and decommissioning as the Proposed Action. The scope of construction and installation activities and their associated IPFs under Alternative D are designed to reduce the impact on onshore habitats but, as described in Section 3.19.1, sea turtles around the Project area are primarily expected to remain offshore in the Project area. Loggerhead sea turtles are the only species that have been documented nesting in Virginia (Parker 2020) and, given the availability of nest beaches relative to the proposed onshore cable construction footprint, no biologically relevant impacts on breeding for this population are expected under Alternative D. The primary IPFs that would affect sea turtles are underwater noise and vessel traffic, which would not differ from that described under the Proposed Action, and impacts on sea turtles would be expected to remain negligible to moderate.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action.

3.19.7.1 Conclusions

Impacts of Alternative D. Although Alternative D would minimize impacts on onshore habitats, this is not expected to result in a notable benefit for sea turtles in this region, and overall potential impacts would be the same as under the Proposed Action and would range from **negligible** to **moderate**.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action, with individual IPFs leading to **negligible** to **moderate** impacts, with potential for **minor beneficial** impacts. While Alternative D is designed to minimize impacts on onshore habitats, the overall impacts of Alternative D on sea turtles would be the same as under the Proposed Action and would remain **moderate**. This impact rating is determined primarily by ongoing activities, such as those that produce underwater noise and vessel activities. As described for the Proposed Action, Dominion Energy’s existing commitments to mitigation measures and BOEM’s potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.20 Scenic and Visual Resources

This section discusses potential impacts on seascape and landscape character and views from the proposed Project, alternatives, and ongoing and planned activities in the scenic and visual resources geographic analysis area, as advised in the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States* (BOEM 2021a) and the *Guidelines for Landscape and Visual Impact Assessment* (3rd Edition) (Landscape Institute and Institute of Environmental Management and Assessment 2016).

The analysis of scenic and visual resources is made up of two separate but linked parts: seascape, open ocean, and landscape impact assessment (SLIA) and visual impact assessment (VIA). SLIA analyzes and evaluates impacts on both the physical elements and the aesthetic, perceptual, and experiential aspects that make the landscape, seascape, or open ocean distinctive. These impacts affect the "feel" or "character" of the landscape, seascape, or open ocean, rather than the composition of a view from a particular place. In SLIA, the impact receptors (the entities that are potentially affected by the proposed Project) are the seascape/open ocean/landscape itself defined by its physical features and distinctive character.

VIA analyzes and evaluates the impacts of the proposed development on people. VIA evaluates the composition changes of selected views and assesses how the people who are likely to be at that viewpoint may be affected by the change. The inclusion of both SLIA and VIA in the BOEM seascape, landscape, and visual impact assessment (SLVIA) methodology is consistent with NEPA's objective of providing Americans with aesthetically and culturally pleasing surroundings and its requirement to consider all potentially significant impacts of development.

This section is a summary of the SLIA and VIA analysis and findings. A detailed description of methodology and analysis can be found in Appendix M, *Seascape, Landscape, and Visual Impact Assessment.*

BOEM utilized viewsheds, context photographs, and visual simulations from select viewing locations as tools for this analysis. These resources can be found in the attachments to Appendix I-1, *Offshore Visual Impact Assessment* and Appendix I-2, *Onshore Visual Impact Assessment* (CVOW-C COP Dominion Energy 2022). The visual simulations represent the diverse weather conditions found along coastal Virginia and North Carolina; however, the NEPA analysis is based on clear sky views and numeric calculations, regardless of the weather represented in the photographs. For a more complete discussion of methods and analysis of offshore wind structures potential impact on seascape and landscape character, please refer to Appendix M.

The PDE parameters reviewed for potential visual effects are summarized in Table I-1-1 of the COP Appendix I-1, and include a general layout of up to 205 WTGs, up to 3 OSSs, their respective foundations, and preferred and maximum capacity WTGs (14–16 MW). The 40-mile (64.4-kilometer) Offshore Visual Study Area shown on Figure I-1-9 of COP Appendix I-1 extends approximately 14.9 miles (24.1 kilometers) inland and includes the coastline and offshore areas associated with the Delmarva Peninsula, Virginia Beach, and the northern tip of North Carolina to incorporate potential views of the Project (see Figure 3.20-1). Offshore visual effects are analyzed for the maximum parameters in the PDE.

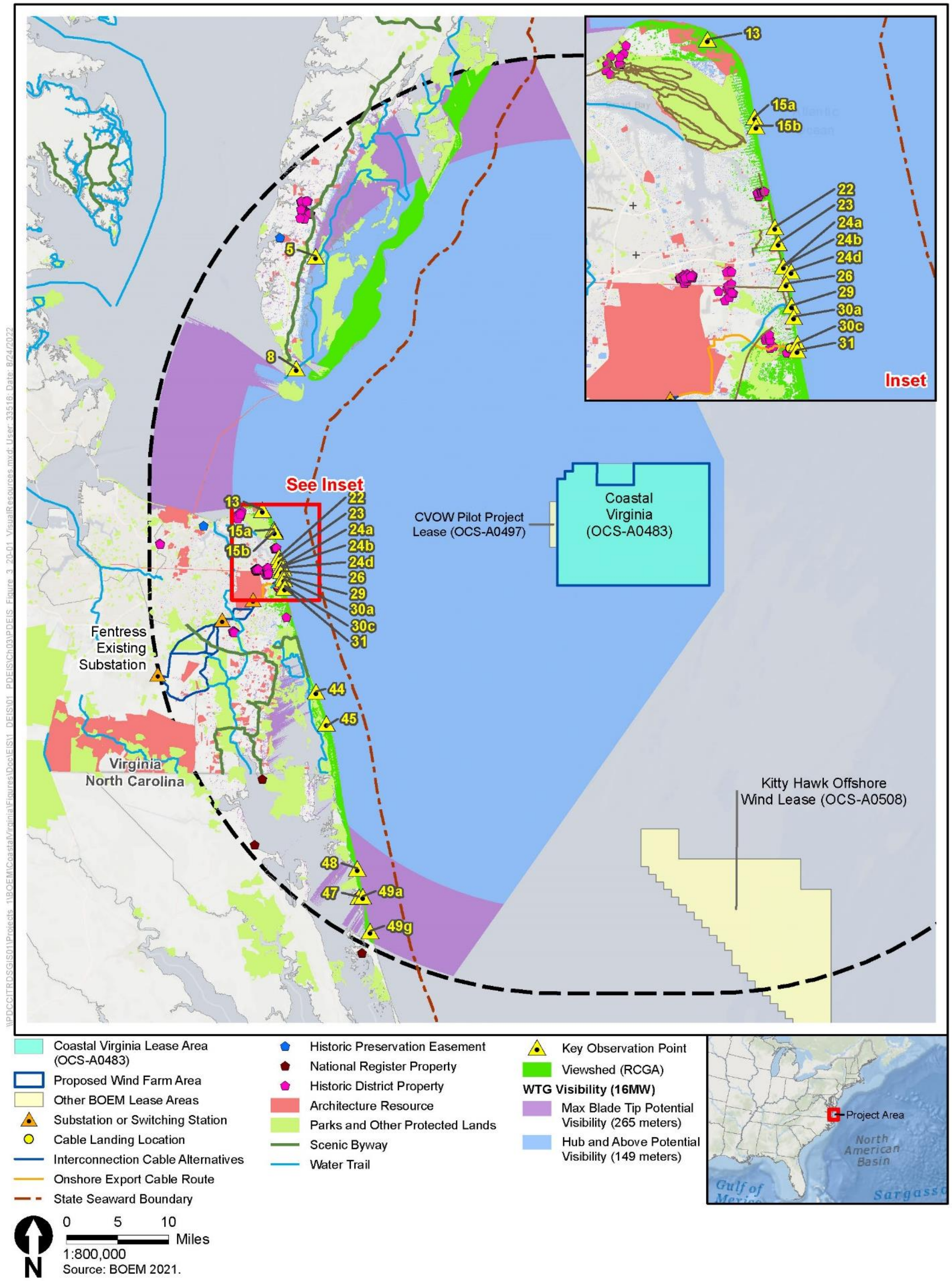

Figure 3.20-1 Scenic and Visual Resources Geographic Analysis Area

The onshore geographic analysis area encompasses a 5-mile (8-kilometer) perimeter for the following Onshore Project components:

- Cable Landing Location at the Virginia State Military Reservation.
- Underground transmission line connecting it to a point north of Harpers Road in Virginia Beach, known as the Onshore Cable Route Corridor.
- Harpers Switching Station.
- Fentress Substation.
- Chicory Switching Station proposed for the Hybrid Route.
- One overhead transmission line route and one underground/overhead hybrid transmission route, known as Route 1 and Hybrid Route 6.

The PDE parameters reviewed for potential visual effects from onshore components are summarized in the COP Appendix I-2 (Dominion Energy 2022). Onshore visual effects are analyzed for the above components and includes foreground to background views except where vegetation and structures prevent view of these facilities; refer to Appendix M for detailed analysis.

3.20.1 Description of the Affected Environment for Scenic and Visual Resources

This section summarizes the coastal zone management; seascape, open ocean, and landscape baseline conditions; and viewer baseline conditions as described in the VIA (Appendix I of the COP; Dominion Energy 2022).

3.20.1.1 Coastal Zone Management

NOAA approved the Virginia Coastal Management Program in 1986, and the Virginia Department of Environmental Quality serves as the lead agency. Authorized by a commonwealth executive order, the coastal management program is structured as a network of agencies that have authority for implementing policies covering wetlands, fisheries, water quality, dunes and beaches, subaqueous lands, and other coastal resources in the Virginia coastal zone. The North Carolina Coastal Management Program, approved by NOAA in 1978, is administered by the Division of Coastal Management within the North Carolina Department of Environment and Natural Resources. The primary authority for the coastal management program is the Coastal Area Management Act (1974). Specific state and local land use plans and guidance that address scenic and visual resources are summarized in Appendix M.1.1and described in detail in Appendix I-2 of the COP (Dominion Energy 2022).

The demarcation line between seascape and open ocean is the U.S. state jurisdictional boundary, 3 nautical miles (3.45 statute miles) (5.5 kilometers) seaward from the coastline (U.S. Congress Submerged Lands Act, 1953). This line coincides with the area of sea visible from the shoreline. The line defining the separation of seascape and landscape is based on the juxtaposition of apparent seacoast and landward landscape elements, including topography, water (bays and estuaries), vegetation, and structures.

3.20.1.2 Seascape, Open Ocean, and Landscape Baseline Conditions

This subsection provides the baseline information for analyzing the seascape, open ocean, and landscape visual impacts as described in the BOEM 2021 SLVIA guidelines (BOEM 2021a). The geographic analysis area is classified by broadly defined physiographic areas and more specific Character Areas. Lands and water areas are based on major differences in landscape structure that define the physical character of the geographic analysis area and include open ocean, shoreline, coast, marsh and bay, and inland areas. Each area is subdivided into Character Areas that are defined by similar land use patterns, topography, ecological characteristics, and proximity to the ocean. Character Areas provide a more specific description of the existing landscape and provide a framework to systematically analyze potential visual effects throughout the geographic analysis area (COP, Appendix I-1, Section 4.3.1.3; Dominion Energy 2022). Table 3.20-1 summarizes the land and water areas and corresponding Character Areas, used in this analysis.

Table 3.20-1 Land and Water Areas

Land and Water Areas	Character Areas	Examples of Character Areas
Atlantic Ocean	Open Ocean	Chesapeake Light Station
Seascape, Shoreline, and Coastal Features	Beach	Broad sandy areas sloping gently toward the Atlantic Ocean and adjacent dunes with unobstructed views over the ocean
	Beachfront Residential	Residential properties on the oceanfront (North End Beach and Croatan Beach), single-family homes parallel to shore with ocean views and beach access
	Rural Coastal Plain	Delmarva Peninsula and rural residential areas of North Carolina
	Industrial/Military	Large military complexes: Fort Story, Dam Neck Naval Base, and State Military Reservation with shoreline views
	Virginia Beach/Tourism	Virginia Beach city center and dense urbanized mixed development within 0.5 miles (0.8 kilometers) of the shoreline
	Recreation	Natural conservation areas, public open spaces, and golf courses. First Landing State Park, False Cape State Park, and Bodie Island
	Historic Resources and Disadvantaged Communities	Cape Henry Lighthouse, Currituck Beach Lighthouse, neighborhoods along Virginia Beach Boardwalk at 17^{th} and 16^{th} Streets
	Transportation Corridor/Scenic Byways	Major interstates and state highways paralleling the coastline (US 60, US 58 and I-264)
	Streets and Highways	Local roads and streets adjacent to the shoreline
Marsh and Bay Features	Inland Bay	Non-ocean open water and inland lakes: Chesapeake Bay, Lynnhaven Bay, Broad Bay, Back Bay, Smith Island Bay, Magothy Bay, Currituck Sound, Coinjack Bay, Sanders Bay, Lake Rudee, Lake Wesley, Lake Christine
	Lower Coastal Plain/Tide Water	Saltmarsh and brackish open water bays: Smith Island, Mink Island, Myrtle Island, National Wildlife Refuges, coastal reserves, state wildlife management areas
Inland Landscape (Land, Water, and Surface Features)	High Density/Apartment District	Two- to four-story multi-family housing
	Low Density Residential	Single-family residential areas inland and near coastline, some with ocean front views
	Agriculture and/or Open, Undeveloped Lands[1]	Working agricultural fields, primarily inland

Land and Water Areas	Character Areas	Examples of Character Areas
	Commercial and Developed – Commercial[1]	Retail, commercial, shopping areas, and parking lots located inland
	Developed - Rural Residential[1]	Single-family homes on large lots surrounded by varied landscape patterns
	Developed – Industrial[1]	Low-lying buildings for production and storage with minimal landscaping and substantial parking
	Developed -Suburban Residential[1]	Single-family homes, planned communities, and subdivisions
	Industrial/Military	Joint Expeditionary Base Little Creek-Fort Story, Oceana Naval Air Station
	Developed Recreation Areas[1]	Playgrounds, picnic areas, and athletic fields
	Forested[1]	Upland forests and forested wetlands
	Open Water[1]	Inland lakes and rivers including water trails
	Streets and Highways	Local roads and streets inland

[1] SCA/LCA identified in the Onshore VIA COP.

The geographic analysis area's landforms, water, vegetation, and built environment structures contain common and distinctive landscape features as outlined in Table 3.20-2.

Table 3.20-2 Landform, Water, Vegetation, and Structures

Category	Landscape Features
Landform	Flat shorelines to gently sloping beaches, dunes, barrier islands, and inland topography including gently rolling hills.
Water	Ocean, bay, estuary, tidal river, tidal and brackish wetlands, lagoons, marshes, ponds, river, and stream water patterns.
Vegetation	Level IV ecoregions of Virginia and North Carolina include the following: • Virginian Barrier Islands and Coastal Marshes: Northern Cordgrass Prairie, Oak-Hickory-Pine Forest on upland sites, and Atlantic Coastal Plain Maritime Forest. • Chesapeake-Pamlico Lowlands and Tidal Marshes: Oak-Hickory-Pine forests on drier ground, with dominant species being hickory, longleaf pine, shortleaf pine, and loblolly pine, white oak, and post oak. There are also southern floodplain forests and northern cordgrass prairies. This region also includes nonriverine wet hardwood forests dominated by swamp chestnut oak, cherry bark oak, laurel oak, and water oak. • Delmarva Uplands: original forests have been cleared and converted to agriculture including corn, soybeans, fruits, and assorted truck crops.
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, jetties, public art, and infrastructure.

Existing scenic resources in the geographic analysis area—including parks and preserves, historic properties, national and state conservation areas, scenic byways, and other resources—are mapped on the Scenic Resources and Key Observation Points (Figure 3.20-2).

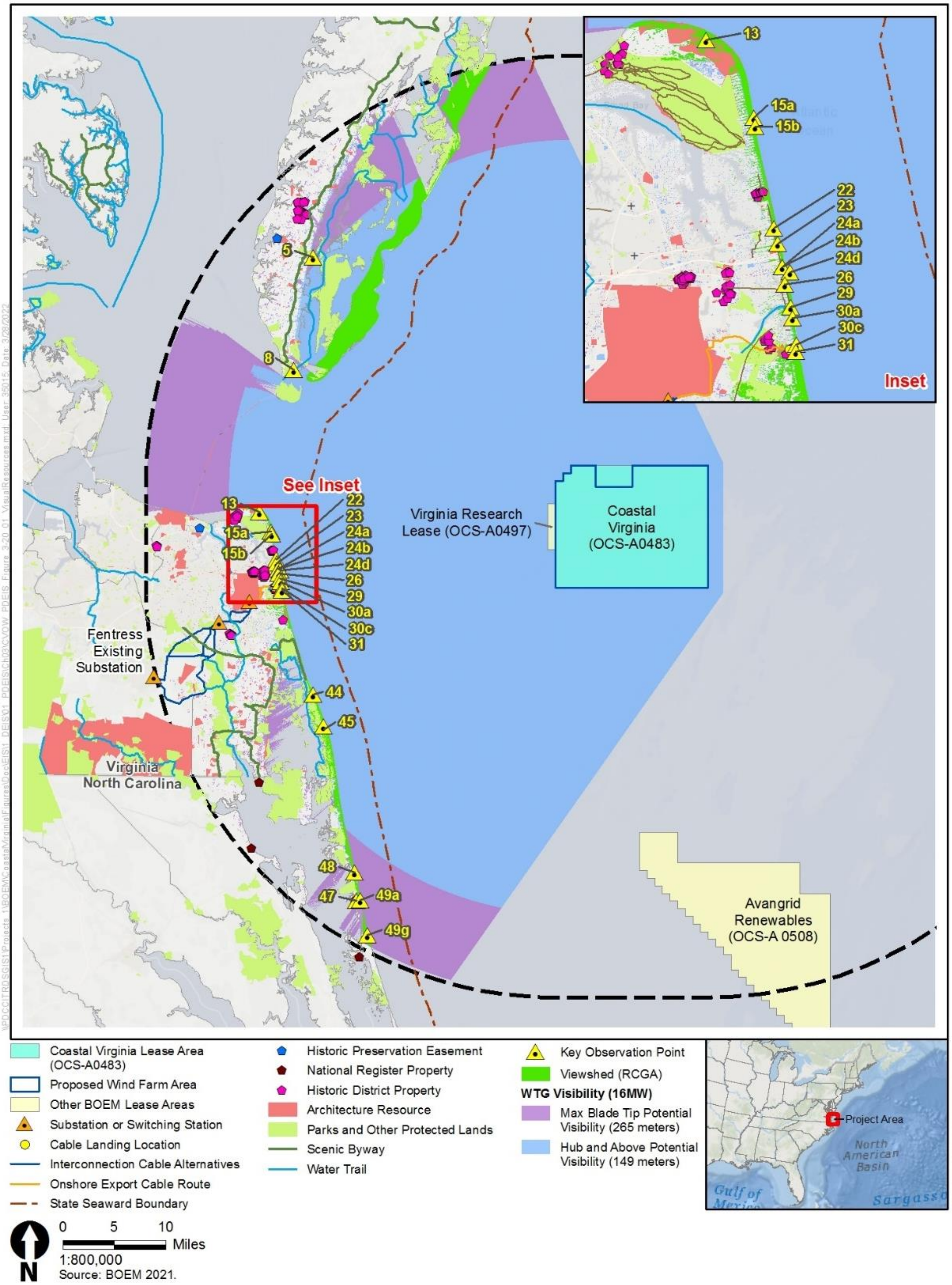

Figure 3.20-2 Scenic Resources and Key Observation Points

The visual characteristics of the seascape, open ocean, and landscape conditions in the geographic analysis area, including surroundings of the Wind Farm Area, landfall sites, offshore and onshore export cable corridors, and onshore substation areas, contain both locally common and regionally distinctive physical features, characters, and experiential views (Table 3.20-3).

Table 3.20-3 Seascape, Open Ocean, and Landscape Conditions

Category	Visual Characteristics
Seascape	
Experiential Views	Inter-visibility within coastal and adjacent marine areas (3.45 miles [5.6 kilometers]) within the 40-mile (64.4-kilometer) geographic analysis area by pedestrians and boaters.
Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, and whitecaps.
Character	Experiential characteristics stem from built and natural landscape forms, lines, colors, and textures to the foreground water's tranquil, mirrored, and flat; active, rolling, and angular; vibrant, churning, and precipitous. Forms range from horizontal planar to vertical structures', landscapes', and water's slopes; lines range from continuous to fragmented and angular; colors of structures, landscape, and the water's foam, and spray reflect the changing colors of the daytime and nighttime, built environment, land cover, sky, clouds, fog, and haze; and textures range from mirrored smooth to disjointed coarse.
Open Ocean	
Experiential Views	Inter-visibility within the open ocean (beyond the 3.45-mile [5.5-kilometer] seascape area) within the 40-mile (64.4-kilometer) geographic analysis area from seagoing vessels, including recreational cruising and fishing, commercial "cruise ship" routes, commercial fishing activities, tankers, and cargo vessels; and air traffic over and near the WTG array and cable routes.
Features	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, and whitecaps.
Character	Experiential characteristics range from tranquil, mirrored, and flat; to active, rolling, and angular; to vibrant, churning, and precipitous. Forms range from horizontal planar to vertical slopes; lines range from continuous and horizontal to fragmented and angular; colors of water, foam, and spray reflect the changing colors of sky, clouds, fog, haze, and the daytime and nighttime, built environment and land cover; and textures range from mirrored smooth to disjointed coarse.
Landscape	
Experiential Views	Inter-visibility within ocean, coastal, and adjacent inland areas; nighttime views diminished by ambient light levels of shorefront development; open, modulated, and closed views of water, landscape, and built environment; and pedestrian, bike, and vehicular traffic throughout the region.
Features	Natural elements: barrier islands, bays, beaches, dunes, marshlands, shorelines, vegetation, tidal rivers, flat topography, and natural areas. Built elements: boardwalks, bridges, buildings, gardens, jetties, landscapes, life-saving stations, umbrellas, lighthouses, parks, piers, roads, seawalls, skylines, trails, single-family residences, commercial corridors, village centers, mid-rise motels, and moderate to high-density residences, and high-rise hotels.
Character	Experiential characteristics range from tranquil and pristine, to vibrant and ordered, to chaotic and disordered.

Category	Visual Characteristics
Public Designated Places	
Designated National, State, and Local Parks, Preserves, and Parkways	24th Street Park, Atlantic Wildfowl Heritage Museum, Barbour Hill Campground, Bayville Farms Park, Boardwalk at Lake Holly, Briarwood, Boy Scout Field, Buck Bay National Wildlife Refuge and Visitor Center, Cape Charles Lighthouse, Cape Henry Lighthouse, Cape Henry Memorial Park, Carova Beach, Chris's Beach, Chesapeake Bay Bridge Tunnel Scenic Overlook Trail, Corolla Adventure Park, Croatan Beach, Currituck County Courthouse, Currituck Beach Lighthouse, Currituck National Wildlife Refuge, E Beach, Eastern Shore of Virginia National Wildlife Refuge, False Cape State Park, First Landing State Park Beach and Campground, Fisherman Island National Wildlife Refuge, Great Neck Park, Grommet Island Park Boardwalk, Horn Point, Kendall Grove Historic District, Kiptopeke State Park, Lynnhaven Beach and Boat Ramp, MacKay Island National Wildlife Refuge, Magothy Bay Natural Area Preserve, Marshview Park, Munden Point Park, Mockhorn Island Wildlife Management Area, Museum of Contemporary Art, Myrtle Island Beach, Naval Aviation Monument Park, Neptunes Park, North End Beaches, Ocean View Beach, Oceanfront Beach Park, Old Dam Neck Park, Pine Meadows Park, Princess Anne Memorial Park, Redwing Golf Course, Resort Beach, Sandridge Beach, Sandridge Fishing Pier, Seatack Park, Smith Island Beach, South Beach Trail, Surf Cabana Club, The Narrows, Virginia Aquarium and Marine Science Center, Virginia Beach Boardwalk, Virginia Beach Fishing Pier, Virginia National Wildlife Refuge, Walsh Woods Environmental Center, Wreck Island Natural Area Preserve.

Sensitivity of the seascape, open ocean, and landscape receptor is driven by susceptibility to change and its perceived value to society. Susceptibility to change is a measure of the seascape/open ocean/landscape to accommodate the proposed Project without substantial change to its characteristics. Perceived value is based on many factors including quality or condition, rarity, representativeness, conservation interest, recreation value, perceptual value, and associations with important people or historical events. Sensitivity rating criteria for each SLIA receptor is described below, followed by a discussion of susceptibility.

The sensitivity of the geographic analysis area's seascape character is defined by its innate features, elements, and value to residents and visitors. Seascape sensitivity rating criteria are high, medium, or low defined as follows:

- **High:** Seascape characteristics are distinctive and highly valued by residents and visitors.
- **Medium:** Seascape characteristics are moderately distinctive and moderately valued by residents and visitors.
- **Low:** Seascape characteristics are common and unimportant to residents and visitors.

The sensitivity of the open ocean character is defined by the activities of viewers, innate character, and susceptibility to the type of change proposed for the Project. Ocean sensitivity rating criteria are high, medium, or low as follows:

- **High:** Open Ocean characteristics are pristine, highly distinctive, and highly valued by residents and visitors.
- **Medium:** Open Ocean characteristics are moderately distinctive and moderately valued by residents and visitors.
- **Low:** Open Ocean characteristics are common or with minimal scenic value.

Landscape character sensitivity is defined by its innate features, elements, and value to residents and visitors. Landscape sensitivity ratings high, medium, and low are defined as follows:

- **High:** Landscape characteristics are highly distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape.
- **Medium:** Landscape characteristics are moderately distinctive and moderately valued by residents and visitors.
- **Low:** Landscape characteristics are unlikely to be affected by the type of change proposed, or within a landscape of minimal scenic value.

Table 3.20-4 summarizes the conditions within seascape, open ocean, and landscape settings with high, medium, and low sensitivity.

Table 3.20-4 Seascape, Open Ocean, and Landscape Sensitivity

Settings	Conditions
High-Sensitivity Seascape[1]	Ocean shoreline areas, beach, and dune areas, and ocean areas within 3.45 statute miles (5.5 kilometers) of the shoreline (Table 3.20-2). Seascapes with national, state, or local designations: 24th Street Park, Barbour Hill Campground, Back Bay National Wildlife Refuge (NWR) and Visitor Center, Cape Charles Lighthouse, Cape Henry Lighthouse, Cape Henry Memorial Park, Carova Beach, Chris's Beach, Coast Guard Station Cobb Island Public Boat Ramp, Croatan Beach, Currituck Beach Lighthouse, Currituck NWR, Dam Neck Naval Base, E Beach, Eastern Shore of Virginia NWR, False Cape State Park, First Landing State Park Beach and Campground, Fisherman Island NWR, Grommet Island Park Boardwalk, Horn Point, Little Island Park, Lynnhaven Beach and Boat Ramp, MacKay Island NWR, Magothy Bay NAP, Marshview Park, Munden Point Park, Mockhorn Island Wildlife Management Area, Myrtle Island Beach, Neptunes Park, North End Beaches, Ocean View Beach, Oceanfront Beach Park, Resort Beach, Sandridge Beach, Sandridge Fishing Pier, Seatack Park, Sandbridge Beach, Sandbridge Fishing Pier, Smith Island Beach, South Beach Trail, Surf Cabana Club, Virginia Beach Boardwalk, Virginia Beach Fishing Pier, Virginia NWR, Wreck Island Natural Area Preserve Beaches, Atlantic Wildfowl Heritage Museum, Navy Seal Monument, Virginia Legends Park. Beaches seaward boardwalks, jetties, and piers.
High-Sensitivity Open Ocean	Ocean areas within the geographic analysis area.
Moderate-Sensitivity Open Ocean	Ocean areas within the visual setting and vicinity of the Chesapeake Light Station.
High-Sensitivity Landscape[2]	Landward portions of scenic and medium to high resident and visitor use volume coastal areas and bays, sounds, and adjoining estuaries (Table). Cemeteries, churches, historic sites, lighthouses, scenic overlooks, schools, town halls, and residential areas within the geographic analysis area. Landscapes with national, state, or local designations. Landscapes with national, state, or local designations: Linkhorn Bay, Little Neck Creek, Broad Bay, First Landing State Park, Pleasure Point Natural Area, Owl Creek, Lake Rudee, Lake Wesley, Lake Christine, Lake Redwing, Lake Tecumseh, Kiptopeke State Park, Lake Holly Boardwalk, North Landing River Natural Area Preserve, Pungo Ferry Road Virginia Scenic Byway, North Landing River Scenic River.

Settings	Conditions
Medium-Sensitivity Landscape	Inland landscapes with moderately distinctive areas of medium scenic value and/or low resident or visitor use volume beaches, coastal areas and bays, sounds, adjoining estuaries, and inland areas with national, state, or local designations. Fentress Naval Air Landing Field, Great Neck Park, Military Aviation Museum, Mount Trashmore Park, Munden Point Park, Pine Meadows Park, Old Dam Neck Park, Princess Anne Memorial Park, Etheridge Lakes Park, Princess Anne Athletic Complex, Kempsville, Redwing Park, Bayville Farms Park, Cessford, Dr. John Masure Miller House, Eastville Shops/James Brown Dry Good Store.
Low-Sensitivity Landscape	Indistinctive areas with low scenic value and limited to absent resident or visitor use volume.

[1] Locations also listed under Landscape extend to both Seascape and Landscape.
[2] Locations also listed under Seascape extend to both Landscape and Seascape.

Seascape character susceptibility is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Seascape susceptibility rating criteria include:

- **High:** Seascape characteristics are highly vulnerable to the proposed changes, distinctive, and highly valued by residents and visitors.
- **Medium:** Seascape characteristics are reasonably resilient to the proposed changes, moderately distinctive, and moderately valued by residents and visitors.
- **Low:** Seascape characteristics are unlikely to be affected by the proposed changes, common, and unimportant to residents and visitors.

Open Ocean susceptibility is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Open ocean susceptibility rating criteria include:

- **High:** Open Ocean characteristics are highly vulnerable to the proposed changes, distinctive, and highly valued by residents and visitors.
- **Medium:** Open Ocean characteristics are reasonably resilient to the proposed changes, moderately distinctive, and moderately valued by residents and visitors.
- **Low:** Open Ocean characteristics are unlikely to be affected by the proposed changes, common, and unimportant to residents and visitors.

Landscape susceptibility is defined by both the vulnerability to impact from the Project, and the visual resources' rarity and scenic value. Landscape susceptibility ratings include:

- **High:** Landscape characteristics are highly vulnerable to proposed changes, distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape.
- **Medium:** Landscape characteristics are reasonably resilient to the type of change proposed, moderately distinctive, and within a landscape of locally valued scenic quality.
- **Low:** Landscape characteristics are unlikely to be affected by the proposed changes, common, or within a landscape of minimal scenic value.

Table 3.20-5 summarizes the conditions within seascape, open ocean, and landscape settings with high, medium, and low susceptibility.

Table 3.20-5 Seascape, Open Ocean, and Landscape Susceptibility

Settings	Conditions
High-Susceptibility Seascape	Ocean shoreline, beach, and dune areas (Table 3.20-2). Seaward boardwalks, jetties, and piers. Seascapes with national, state, or local designations: 24th Street Park, Back Bay NWR, Cape Charles Lighthouse, Cape Henry Lighthouse, Cape Henry Memorial Park, Carova Beach, Chris's Beach, Coast Guard Station Cobb Island Public Boat Ramp, Croatan Beach, Currituck Beach Lighthouse, Currituck NWR, Dam Neck Naval Base, E Beach, Eastern Shore of Virginia NWR, False Cape State Park, First Landing State Park Beach, Fisherman Island NWR, Grommet Island Park Boardwalk, Little Island Park, Lynnhaven Beach, MacKay Island NWR, Magothy Bay Natural Area Preserve, Marshview Park, Munden Point Park, Mockhorn Island Wildlife Management Area, Myrtle Island Beach, Neptunes Park, North End Beaches, Ocean View Beach, Oceanfront Beach Park, Resort Beach, Sandridge Beach, Sandridge Fishing Pier, Seatack Park, Sandbridge Beach, Sandbridge Fishing Pier, Smith Island Beach, South Beach Trail, Surf Cabana Club, Virginia Beach Boardwalk, Virginia Beach Fishing Pier, Virginia NWR, Wreck Island Natural Area Preserve Beaches, Virginia Legends Park.
Medium-Susceptibility Seascape	Highly developed tourism areas, coastal roads, and scenic byways.
High-Susceptibility Open Ocean	Open Ocean within the geographic analysis area.
Medium-Susceptibility Open Ocean	Open Ocean within the visual setting and visibility of the Chesapeake Light Station.
High-Susceptibility Landscape	Landward portions of coastal areas and bays, sounds, and adjoining estuaries and rivers, forested lands (Table 3.20-2). Landscapes with national, state, or local designations or valued places: Atlantic Intracoastal Waterway, Albemarle and Chesapeake Canal, Linkhorn Bay, Little Neck Creek, Broad Bay, First Landing State Park, Pleasure Point Natural Area, Owl Creek, Lake Rudee, Lake Wesley, Lake Christine, Lake Redwing, Lake Tecumseh, Kiptopeke State Park, Lake Holly Boardwalk, North Landing River Natural Area Preserve, Pungo Ferry Road Virginia Scenic Byway, National Aviation Monument, North Landing River Scenic River, Stumpy Lake Natural Area, Pocaty River, Princess Anne (and Guard Shore) Wildlife Management Area.
Medium-Susceptibility Landscape	Inland landscapes including suburban and military residential areas, active recreation, agriculture and commercial areas: Fentress Naval Air Landing Field, Great Neck Park, Military Aviation Museum, Mount Trashmore Park, Munden Point Park, Pleasure House Point Natural Area, Pine Meadows Park, Old Dam Neck Park, Princess Anne Memorial Park, Etheridge Lakes Park, Princess Anne Athletic Complex, Kempsville, Redwing Park, Bayville Farms Park, Cessford, Seatack Park, Ocean Lakes Park, Red Mill Farms Park.
Low-Susceptibility Landscape	Inland areas including high density residential, industrial/military areas, streets and highways, and other developed lands with limited to no visibility of the Project.

Table 3.20-6 lists the jurisdictions and City of Virginia Beach neighborhoods with ocean beach views and their view distance susceptibility to the PDE. The nearest and most distant mainland view conditions, Little Island Park - Back Bay NWR (KOP-44, 26.8 miles [43.1 kilometers]) and Whale Head Bay

Albacore Street Entrance (KOP-49g, 39.1 miles [62.9 kilometers]), are portrayed on Figure 3.20-3 and Figure 3.20-4, respectively. View distances from the Projects' WTGs to Myrtle Island Beach, the nearest beach, range from 23.7 miles (38.14 kilometers) at the northwestern-most WTG to 42 miles (67.5 kilometers) to the southeastern-most WTG. The farthest view conditions are found along Parramore Island, Virginia, north of the PDE and Corolla Beach, North Carolina, south of the PDE (COP, Appendix I; Dominion Energy 2022). The barrier island beaches of Myrtle and Parramore Island are only accessible by boat.

Table 3.20-6 Jurisdictions with Ocean Beach Views and Distance-based Susceptibility

Susceptibility and Distance in Miles (Kilometers)	Jurisdiction
High 24.1 to 28 (38.8 to 45.1)	City of Virginia Beach, Sandbridge, Dam Neck, Croatan, Rudee Heights, Lake Holly area, Little Island, Pine Meadows Place
Medium 28 to 31 (45.1 to 49.9)	Highgate Greens, Ocean Lakes North, Oceana Gardens East, Redwing, Northend Beaches, Kiptoeke, Capeville, Fairview, North Virginia Beach, Crystal Lake neighborhoods, Wadsworth Shores, Lago Mar, Carova
Low 31 to 40 (49.9 to 64.4)	City of Norfolk Ocean View Beach, Bayville, Great Neck, Munden Point, Cape Charles, Indiantown, Brownsville Farm, Cheriton, Oyster, Beverly, Northwest, Pungo

Figure 3.20-3 Little Island Park/Back Bay National Wildlife Refuge – Seascape

Figure 3.20-4 Whale Head Bay Albacore Street Entrance – Seascape

3.20.1.3 Viewer Baseline Conditions

The VIA assesses how the proposed development impacts viewers as seen from selected representative sensitive viewpoints and as seen by different viewer groups. The following presents baseline conditions for understanding impacts to people.

Onshore to offshore view distances to the Wind Farm Area range from 23.7 miles (38.1 kilometers) to 40 miles (64.4 kilometers). At the 23.7-mile (38.1-kilometer) distance, the wind farm would occupy 26° (21 percent) of the typical human's 124° horizontal field of view (FOV) and 0.4° (0.73 percent) of the typical 55° vertical FOV (measured from eye level). This vertical measure also indicates the perceived proportional size and relative height of the wind farm. At 40 miles (64.4 kilometers) distance, the Project may appear 0.03° above the horizon and 16° along the horizon, 0.04 percent and 12 percent of the human vertical and horizontal FOV, respectively. WTG and OSS visibility would be variable throughout the day depending on specific factors, including view angle, sun angle, atmospheric conditions, and distance, which would affect the visibility and noticeability. Visual contrast of WTGs and OSSs would vary throughout the day depending on whether the WTGs and OSS are backlit, side-lit, or front-lit and based on the visual character of the horizon's backdrop. These variations through the course of the day may result in periods of moderate to major visual effects while at other times of day would have minor or negligible effects.

At distances of 12 miles or closer, the form of the WTG may be the dominant visual element creating the visual contrast regardless of color. At greater distances, color may become the dominant visual element creating visual contrast under certain visual conditions that give visual definition to WTG form and line.

The range of sensitivity of view receptors and people viewing the Project is determined by their engagement and view expectations. Table 3.20-7 lists the sensitivity issues identified for the SLVIA and the indicators and criteria used to assess impacts for the Draft EIS. It is important to note that in some instances there may be a high number of viewers, but few individuals who notice or are focused on the view (i.e., a scenic roadway). In other instances, there may be few viewers, but their sensitivity to change is very high (i.e., wilderness areas or remote stretches of beach).

Table 3.20-7 View Receptor Sensitivity Ranking Criteria

Sensitivity Rating	Susceptibility to Change	Value Attached to Views
High	Residents with views of the Project from their homes; people with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; people engaged in outdoor recreation whose attention or interest is focused on the seascape and landscape and on particular views; visitors to historic or culturally important sites, where views of the surroundings are an important contributor to the experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views.	Heavily visited and widely recognized viewpoints; viewpoints designated as scenic, scenic roadways or rivers designated at the national, state, or local level; association with a historic or culturally important site, especially within a designated area; appearances in guidebooks, tourist maps, web sites, online photo collections, and social media; references to the views in literature or art; public facilities to promote enjoyment of views including parking areas, restrooms, benches, interpretive panels, and telescopes; areas identified in consultation with residents, visitor bureaus, tourism service providers, and other local entities.
Medium	People engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, and where the seascape and landscape setting is not important to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are dominated by non-scenic developments.	Moderately visited viewpoints; viewpoints with modest visual distractions or that are slightly lacking harmony; limited appearances in guidebooks, tourist maps, websites, online photo collections, and social media references; with limited access and support facilities that encourage visitation.
Low	People who regard the visual environment as an unvalued asset.	Infrequently visited viewpoints, with an incongruous setting, discordant features, no official designations, and no support facilities.

3.20.1.4 Key Observation Points

Key Observation Points (KOPs) are locations that represent where individuals or groups of people visit, work, live, and gather who may be affected by changes in views and visual amenity. Based on higher viewer sensitivity, viewer exposure, and context photography, 39 designated KOPs provide the locational bases for detailed analyses of the geographic analysis area's seascape, landscape, and viewer experiences, as shown on Figure 3.20-2 (COP, Appendix I; Dominion Energy 2022). Sensitive receptors in the vicinity of the Harpers Switching Station, interconnection cable corridors, Fentress Substation, and onshore export cable corridors are identified in COP Appendix I-2 (Dominion Energy 2022). KOPs and their view contexts are summarized in Table 3.20-8.

Table 3.20-8 Representative View Receptor Contexts and Key Observation Points

View Context	Key Observation Points
Vantage Point	KOP-13 Cape Henry Lighthouse/Fort Story Military Base KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-31 Picnic Views at SMR KOP-47 Currituck Beach Lighthouse *Onshore Components* KOP-10 (HF Routes 1, and 6) KOP-11 (HF Route 1, and 6) KOP-13 (HF Routes 1 and 6)
Linear Receptor	KOP-5 Oyster Village Horse Island Trail KOP-15a North End Beach Residential View 1—Daytime KOP-15b North End Beach Residential View 1—Nighttime KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance - Elevated Representative KOP-50 Cruise Ship Shipping Lanes *Onshore Components* KOP-3 (HF Route 1) KOP-5 (HF Route 1) KOP-12 (HF Routes 1 and 6) KOP-14a (HF Routes 1 and 6) KOP-14b (HF Routes 1 and 6) KOP-17 (HF Routes 1, and 6)
Scenic Area	KOP-8 Eastern Shore of Virginia National Wildlife Refuge KOP-44 Little Island Park/Back Bay National Wildlife Refuge KOP-45 False Cape State Park KOP-48 Currituck National Wildlife Refuge Representative KOP-51 Recreational Fishing, Pleasure, and Tour Boat Area
Substation/ Switching Station Area	*Onshore Components* KOP-3 Harpers Switching Station KOP-10 Fentress Substation KOP-18 Chicory Switching Station

The susceptibility to change of individual KOP locations and viewers sensitivity are determined with reference to geographic location and its viewer activity.

- Relevant designations and the level of policy importance that they signify (such as landscapes designated at the national, state, or local level).

- Value criteria such as scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects, and artistic associations.
- Facilities and spaces for view enjoyment (such as interpretive panels, benches, viewing platforms, piers, and telescopes).

Judgements regarding seascape, landscape, and KOP sensitivity are informed by the VIA (COP, Appendix I; Dominion Energy 2022). Table 3.20-9 lists onshore KOP viewer sensitivity ratings.

Table 3.20-9 Project Area Key Observation Point Viewer Sensitivity Ratings

Rating	Key Observation Points
High	KOP-5 Oyster Village Horse Island Trail KOP-8 Eastern Shore of Virginia National Wildlife Refuge KOP-13 Cape Henry Lighthouse/Fort Story Military Base KOP-15a North End Beach Residential View 1—Daytime KOP-15b North End Beach Residential View 1—Nighttime KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views on Beach KOP-44 Little Island Park/Back Bay National Wildlife Refuge KOP-47 Currituck Beach Lighthouse KOP-48 Currituck National Wildlife Refuge KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance – Elevated Representative KOP-50 Cruise Ship Shipping Lanes Representative KOP-51 Recreational Fishing, Pleasure, and Tour Boat Area
Medium	KOP-29 Grommet Island Park/Boardwalk *Onshore Components* KOP-3 Harpers Switching Station (HF Routes 1) KOP-14a (HF Routes 1 and 6) KOP-14b (HF Routes 1 and 6) KOP-17 (HF Routes 1 and 6) KOP-18 Chicory Switching Station (HF Hybrid Route 6)
Low	*Onshore Components* KOP-10 Fentress Substation (HF Routes 1 and 6) KOP-11 (HF Route 1 and 6) KOP-12 (HF Routes 1 and 6) KOP-13 (HF Routes 1 and 6)

WMA = Wildlife Management Area.

In addition to onshore viewers, the Project components will be visible to offshore viewers at sea and from the air from a variety of commercial and recreational watercraft and aircraft. The Chesapeake Bay and waters of coastal Virginia are heavily trafficked shipping lanes. Offshore viewing receptors include recreation and commercial fishing boats, recreation pleasure craft, cruise ships, and undefined watercraft. Overall, watercraft through the Lease Area is considered "light". Commercial fishing tracks through the lease area are infrequent and broadly distributed as shown in Figures 4.4-22 through Figure 4.4-25 of the COP (COP, Sections 4.4.6, and 4.4.7; Dominion Energy 2022). In contrast, recreational fishing vessels and dive boats routinely transit within and through the Offshore Project area (COP, Section 4.4.6, Dominion Energy 2022). Daytime and nighttime views from all vessels range from immediate foreground to background distances.

Daytime and nighttime aircraft receptors, arriving and departing Norfolk International Airport and Oceana Naval Air Station traffic, and others traversing the Atlantic Coast, range from foreground to background viewing situations. Aircraft receptors are more frequently affected by view-limiting atmospheric conditions than are land and water receptors.

Typical meteorological conditions limit visibility of the Wind Farm Area from inland and the coast on 80 percent of days and provide clear visibility on 20 percent of days during daytime hours (approximately 1 of every 5 days are clear for a minimum of 50 percent of the day throughout the year with visibility at 20 nautical miles) (COP, Appendix I-1; Dominion Energy 2022). Views from nearer the shoreline are more limited by atmospheric conditions than views from inland areas. Many viewers, particularly recreational users, are more likely to be present on beaches, boardwalks, jetties, and piers on clearer days, when viewing conditions are better than on rainy, hazy, or foggy days. Therefore, affected environment and VIAs of the Project are based on clear-day and clear-night visibility. Elevated boardwalks, piers, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments.

3.20.2 Environmental Consequences

3.20.2.1 Impact Level Definitions for Scenic and Visual Resources

Definitions of impact levels are provided in Table 3.20-10. There are no beneficial impacts on scenic and visual resources.

Table 3.20-10 Impact Level Definitions for Scenic and Visual Resources

Impact Level	Impact Type	Definition
Negligible	Adverse	SLIA: Very little or no effect on seascape/landscape unit character, features, elements, or key qualities either because unit lacks distinctive character, features, elements, or key qualities; values for these are low; or Project visibility would be minimal. VIA: Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or Project visibility would be minimal.

Impact Level	Impact Type	Definition
Minor	Adverse	SLIA: The Project would introduce features that may have low to medium levels of visual prominence within the geographic area of an ocean/seascape/ landscape character unit. The Project features may introduce a visual character that is slightly inconsistent with the character of the unit, which may have minor to medium negative effects on the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Project would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. If the value, susceptibility, and viewer concern for change is medium or high, the nature of the sensitivity is evaluated to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change but a high level of viewer concern (combination of susceptibility/value) may justify adjusting to a moderate level of impact.
Moderate	Adverse	SLIA: The Project would introduce features that would have medium to large levels of visual prominence within the geographic area of an ocean/ seascape/landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect on the unit's features, elements, or key qualities. In areas affected by large magnitudes of change, the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Project would introduce a moderate to large level of change to the view's character; may have moderate to large levels of visual prominence that attracts and holds but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change, or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, the nature of the sensitivity is evaluated to determine if elevating the impact to the next level is justified.
Major	Adverse	SLIA: The Project would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/ landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect on the unit's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the character unit is high. VIA: The visibility of the Project would introduce a major level of character change to the view; attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. If the magnitude of change to the view's character is medium but the susceptibility or value at the KOP is high, the nature of the sensitivity is evaluated to determine if elevating the impact to major is justified. If the sensitivity (combination of susceptibility/ value) at the KOP is low in an area where the magnitude of change is large, the nature of the sensitivity is evaluated to determine if lowering the impact to moderate is justified.

3.20.3 Impacts of the No Action Alternative on Scenic and Visual Resources

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

3.20.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for seascape, open ocean, landscape, and viewers described in Section 3.20.1, *Description of the Affected Environment for Scenic and Visual Resources*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on seascape, open ocean, landscape, and viewers include activities related to development of undersea transmission lines, gas pipelines, and submarine cables; dredging and port improvements; marine minerals extraction; military use; marine transportation; and onshore development activities (see COP Section 4.4.11 (Dominion Energy 2022) for a description of ongoing and planned activities in the geographic analysis area). Ongoing and planned activities have the potential to affect seascape character, open ocean character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on scenic resources include:

- Continued O&M of the CVOW-Pilot Project (2 WTGs) in Lease Area OCS-A 0497.

Ongoing O&M of the CVOW-Pilot Project would result in impacts on scenic resources through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, land disturbance, lighting, and presence of structures.

3.20.3.2 Cumulative Impacts of the No Action Alternative

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

BOEM expects future offshore wind development activities to affect seascape character, open ocean character, landscape character, and viewer experience through the following primary IPFs. Tables M-13 through M-16 in Appendix M consider effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action.

Presence of structures: Under the No Action Alternative, existing offshore wind development at the CVOW-Pilot Project consists of two 6-MW WTGs with a maximum rotor blade height of 620 feet (189 meters) above mean low low water and a maximum hub height of 364 feet (111 meters) above mean sea level. These smaller stature turbines contribute minimally to adverse scenic impacts. Other offshore wind development will add structures offshore including WTGs and OSSs. Two offshore wind projects, Kitty Hawk Wind North and Kitty Hawk Wind South, would be constructed in the geographic analysis area between 2024 and 2030. The placement of 190 WTGs (excluding the Proposed Action) within the geographic analysis area under the planned activities scenario (Appendix F, Table F2-1) would contribute to adverse impacts on scenic and visual resources. Appendix M provides simulations of offshore wind development without the Proposed Action from five KOPs with views to the southeast (see Appendix M, Attachment M-2). The total number of WTGs that would be theoretically visible from any single KOP would likely be less than the 190 WTGs considered under the planned activities scenario, except in elevated conditions. For example, approximately 82 WTGs would be theoretically visible from KOP-26 Marriott Virginia Beach Oceanfront Hotel, 45 WTGs would be visible from KOP-45 False Cape State Park, and 190 WTGs would be visible from KOP-47 Currituck Beach Lighthouse (BOEM 2021d). The presence of structures associated with future offshore wind development would affect seascape character, open ocean character, landscape character, and viewer experience, as simulated from sensitive onshore receptors (Appendix M). The seascape character and open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to moderate wind farm character by approximately 2030.

Lighting: Construction-related nighttime vessel lighting would be used if future offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for two future offshore wind projects within the geographic analysis area (excluding the Proposed Action). The impact of vessel lighting on scenic and visual resources during construction would be localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M of planned offshore wind facilities and the impact on seascape character, open ocean character, nighttime viewer experience, and valued scenery from vessel lighting would be intermittent and long term.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines within the geographic analysis area and would have impacts on scenic and visual resources. FAA hazard lighting systems would be in use for the duration of O&M for up to 190 WTGs in addition to the existing 2 CVOW-Pilot Project WTGs. The CVOW-Pilot Project WTGs have FAA L-864 medium density aeronautical lights with a flash rate of 20 flashed per minute atop each nacelle and USCG quick flashing amber lights located on the base tower not higher than 50 feet (15 meters) above the highest astronomical tide. The cumulative effect of these WTGs and associated synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle within the offshore wind lease areas would have long-term major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and clouds would influence visibility and perception of hazard lighting from sensitive viewing locations. Although the implementation of ADLS to activate the hazard lighting system when aircraft are detected would greatly reduce nighttime lighting impacts, the existing CVOW-Pilot Project has not implemented this system and the proposed Kitty Hawk Wind North and Kitty Hawk Wind South projects have not proposed implementing this system.

The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night compared to the standard continuous, medium-intensity red strobe FAA warning system due to the reduced duration of activation.

Traffic (vessel): Current O&M vessel traffic on the two CVOW-Pilot Project WTGs is unknown, but because of the very small scale of this project the impact on scenic and visual resources is considered negligible. Future offshore wind project construction and decommissioning and, to a lesser extent, O&M would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the future offshore wind construction areas. Vessel traffic for Kitty Hawk Wind South is not known but is anticipated to be similar to that of Kitty Hawk Wind North, which is projected to generate an average of 46 daily vessel trips between ports and offshore work areas over the entire construction phase and a maximum of 95 vessel trips daily during peak construction activity (COP, Section 3.4; Dominion Energy 2022). As shown in Appendix F, Table F-3, between 2024 and 2030 two offshore wind projects other than the Proposed Action, Kitty Hawk North and Kitty Hawk South, could be under construction simultaneously. Kitty Hawk North and Kitty Hawk South would have overlapping construction periods with CVOW-C between 2024 and 2027. During such periods, construction of offshore wind projects would generate an average of 92 vessel trips daily from Portsmouth, Virginia, ports to worksites in the geographic analysis area, with as many as 190 vessels present (either underway or at anchor) during times of peak construction. Stationary and moving vessels would slightly increase the daytime and nighttime seascape and open ocean character from open ocean to active waterway.

Onshore and offshore visual impacts would continue from visible vessel activity related to O&M of offshore wind facilities. O&M activities of future offshore wind projects are anticipated to generate an average of four vessel trips per week between a port and the Wind Farm Area. Vessel traffic would result in long-term, occasional contrasts to seascape and open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during decommissioning at the end of the assumed operating period of each project, with impacts like those described for construction.

Land disturbance: Ongoing and future offshore wind development would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electric grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of project infrastructure for future offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases: Accidental releases during construction, O&M, and decommissioning of ongoing and future offshore wind projects (excluding the Proposed Action) could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean area, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning of future offshore wind projects, and would be lower but continuous during O&M.

3.20.3.3 Conclusions

Impact of the No Action Alternative. Under the No Action Alternative, visual and scenic resources would continue to be affected by existing environmental trends and ongoing activities. Ongoing non-offshore wind activities would have continued short- and long-term impacts on seascape, open ocean, landscape, and viewer experience, primarily through the daytime and nighttime presence of structures, lighting, and vessel traffic. The character of the coastal landscape would change in the short term and long term through natural processes and planned activities that would continue to shape onshore features, character, and viewer experience. Ongoing activities in the geographic analysis area that contribute to visual impacts include construction activities and vessel traffic, which lead to increased nighttime lighting, visible congestion, and the introduction of new structures, that would have **minor** to **moderate** impacts on scenic and visual resources in the geographic analysis area.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and visual resources would continue to be affected by natural and human-caused IPFs.

Planned activities in the geographic analysis area other than offshore wind include new cable emplacement and maintenance, dredging and port improvements, marine minerals extraction, military use, marine transportation, and onshore development activities. Other offshore wind projects planned within the geographic analysis area would lead to the construction of approximately 190 WTGs in areas where no offshore structures currently exist and would change the surrounding marine environment from undeveloped ocean to a wind farm environment. The seascape character and open ocean character would reach the maximum level of change to their features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030.

Under the No Action Alternative, current regional trends and activities would continue, and scenic and visual resources would continue to be affected by natural and human caused IPFs. The No Action Alternative would result in **minor** impacts on scenic and visual resources from ongoing activities. The No Action Alternative combined with all other foreseeable planned activities (including other offshore wind activities) would result in **moderate** to **major** impacts on visual and scenic resources within the geographic analysis area due to addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.

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

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

- The Project layout, including the number, size, and placement of the WTGs and OSSs, and the design of lighting systems for structures.
- The number and type of vessels involved in construction, O&M, and decommissioning, and time of day that construction, O&M, and decommissioning would occur.
- Onshore cable export route options and the size and location of onshore substations.

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

- **WTG number, size, location, and lighting:** More WTGs and larger turbine sizes closer to shore would increase visual impacts from onshore KOPs.
- **Size, scale, and orientation of the project:** The larger the size and scale of the project and its proximity to shore the greater the impact to the scenic value of the ocean, seascape, and landscape Character Areas.
- **Design and type of WTG lighting:** The design and type of WTG lighting would affect nighttime visibility of WTGs from shore. Implementation of ADLS technology would substantially reduce visual impacts.
- **Vessel lighting:** Nighttime construction, O&M, and decommissioning activities that involve nighttime lighting would increase visibility at night.
- **Location and scale of Onshore Project components:** Installation of larger-scale Onshore Project components in closer proximity to sensitive receptors would have greater impacts.

3.20.5 Impacts of the Proposed Action on Scenic and Visual Resources

This section addresses the impacts associated with construction, O&M, and decommissioning of the Proposed Action on seascape character, open ocean character, landscape character, and viewer experience in the geographic analysis area. The impact level is judged with reference to the sensitivity of the view receptor and the magnitude of impact, which considers the noticeable features; distance and FOV effects; view framing and intervening foregrounds; and the form, line, color, and texture contrasts, scale of change, and prominence in the characteristic seascape, open ocean, and landscape.

The degree of adverse effects is determined by the following criteria.

- The Proposed Action's characteristics, contrasts, scale of change, prominence, and spatial interactions with the special qualities and extents of the baseline seascape, open ocean, and landscape character.
- Intervisibility between viewer locations and the Proposed Action's features.
- The sensitivities of viewers.

Viewers or visual receptors within the Proposed Action's zone of theoretical visibility include the following.

- Residents living in coastal communities or individual residences.
- Tourists visiting, staying in, or traveling through the area.
- Recreational users of the seascape, including those using ocean beaches and tidal areas.
- Recreational users of the open ocean, including those involved in yachting, fishing, boating, and passage on ships.
- Recreational users of the landscape, including those using landward beaches, golf courses, cycle routes, and footpaths.
- Tourists, workers, visitors, or local people using transport routes.
- People working in the countryside, commerce, or dwellings.
- People working in the marine environment, such as those on fishing vessels and crews of ships.

KOPs 3 through 49g are representative of sensitive receptors (and their vicinities) in the shoreward (seascape and landscape) parts of the geographic analysis area, and two representative offshore (open ocean) KOPs (KOP-50 and KOP-51) are typical of views of the Lease Area from boats and cruise ships. KOP-15b North End Beach – Residential View 1—nighttime (28.1 miles, 45.2 kilometers to nearest WTG), KOP-24b Virginia Beach Boardwalk – 16th Street Entrance—nighttime (27.8 miles, 44.7 kilometers to nearest WTG), and KOP-24d Virginia Beach Boardwalk-Fishing Pier—nighttime (27.6 miles, 44.4 kilometers to nearest WTG) represents the nighttime assessment. COP Appendices I-1 and I-2 (Dominion Energy 2022) presents visual simulations from each of 38 onshore KOPs considered in this analysis. Cumulative visual simulations in Appendix M, Attachment M-2 portray future conditions of the Proposed Action alone and in combination with other future offshore wind development from five representative locations: KOP-26 Marriott Virginia Beach Oceanfront Hotel Rooftop; KOP-31 Picnic/Beach Views at State Military Reservation; KOP-45 False Cape State Park; KOP-47 Currituck Beach Lighthouse; and KOP-49a Whale Head Bay Residential Area. Table 3.20-11 lists the distance from each KOP to the nearest WTG by project.

Table 3.20-11 Distance from KOPs Considered to Nearest WTG, by Project

	Camera Elevation – Feet (Meters)	CVOW-C Offshore Wind – Miles (Kilometers)	CVOW-Pilot Offshore Wind – Miles (Kilometers)	Kitty Hawk North – Miles (Kilometers)[1]
Virginia				
KOP-26 Marriott Virginia Beach Oceanfront Hotel	236 (72)	28 (45)	26.8 (43.2)	45 (72.4)

	Camera Elevation – Feet (Meters)	CVOW-C Offshore Wind – Miles (Kilometers)	CVOW-Pilot Offshore Wind – Miles (Kilometers)	Kitty Hawk North – Miles (Kilometers)[1]
KOP-31 Picnic/Beach Views at State Military Reserve	14 (4.3)	27.6 (44.4)	26.8 (43)	43.0 (69.2)
KOP-45 False Cape State Park	15 (4.6)	27.1 (43.6)	28.5 (64.2)	33.3 (53.6)
North Carolina				
KOP-47 Currituck Beach Lighthouse	155 (47.2)	36.8 (59.2)	39.9 (64.2)	28.3 (45.5)
KOP-49a Whale Head Bay Residential Area	25 (7.6)	39.1 (62.9)	39.7 (63.8)	27.9 (44.9)

[1] Distances based CVOW Cumulative Effects Simulations, Dominion Energy n.d.

Presence of structures: The Proposed Action would install 205 WTGs extending up to 869 feet (265 meters) above mean high water and three OSSs extending up to 220 feet (67 meters) above mean high water within the Lease Area. The WTGs would be painted white or light grey, no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey. RAL 7035 Light Grey would help reduce potential visibility against the horizon. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL 1023) yellow paint from the water line to a minimum height of 50 feet (15.2 meters). The presence of structures within the geographic analysis area under the Proposed Action would affect seascape character, open ocean character, landscape character, and viewer experience. The magnitude of impact is defined by the contrast, scale of the change, prominence, FOV, viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. COP Appendix I, Attachment I-1-5 presents visual simulations from each of 20 onshore KOPs considered in this analysis (Dominion Energy 2022). The visual simulations reflect variables in weather, sun angle, cloud cover, and viewer height. The visual analyses consider of view at each KOP a clear-day day. Table M-1 in Appendix M identifies visibility variables for selected KOP simulations.

Appendix M provides additional (cumulative effects) simulations of the Proposed Action from five KOPs with views to the southeast (Appendix M, Attachment M-2) and provides an assessment of the Proposed Action's noticeable elements, distance effects, FOV effects, foreground elements and influence, and contrast rating effects by seashore character unit, landscape character unit, and offshore and onshore KOP.

The seascape character units, open ocean character unit, landscape character units, and viewer experiences would be affected by the Proposed Action's noticeable elements and applicable distances (Appendix M, Table M-3), FOV extents (Table M-45 and M-5); form, line, color, and texture contrasts in the characteristic seascape, open ocean, and landscape (Table M-7); and open views versus view framing or intervening foregrounds (Table M-11). Higher impact significance stems from unique, extensive, and long-term appearance of strongly contrasting vertical structures in the otherwise horizontal open ocean environment, where structures are an unexpected element and viewer experience includes formerly open views of high-sensitivity seascape, open ocean, and landscape, and from high-sensitivity view receptors. Table 3.20-12 considers the totality of the Proposed Action's level of impact by seascape character unit, open ocean character unit, landscape character unit, and offshore and onshore KOPs. Table 3.20-13 considers the impact of the Proposed Action on viewer experience.

Table 3.20-12 Proposed Action Impact on Seascape Character, Open Ocean Character, and Landscape Character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, Landscape Character Units, and Offshore and Onshore Key Observation Points
Major	SLIA: Open Ocean Character Unit Landscape Character Units: Forested, Open Water and Marshlands, Agriculture/Open Land
Moderate	SLIA: Seascape Character Units: Beach, Developed, Lower Coastal Plain/Tide Water, Tourism, Rural Coastal Plain, Low Density Residential, Historic, Developed Shoreline Landscape Character Units: Agriculture, Transportation Corridor, Developed – Suburban, Industrial/Military, and Rural Residential
Minor	SLIA: Landscape Character Units: Forested, Open Water and Marshland, Bay/Shoreline, Agriculture, Developed Recreation, Developed – Suburban Residential
Negligible	SLIA: Landscape Character Units: Agriculture/Open Land, Developed – Suburban Residential

SLIA = seascape, open ocean, and landscape impact assessment.

Table 3.20-13 Proposed Action Impact on Viewer Experience

Level of Impact	Offshore and Onshore Key Observation Points
Major	VIA: KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area KOP-51 Commercial and Cruise Ship Shipping Lanes *Onshore Components* KOP-3 Harpers Switching Station (HF Route 1) KOP-5 (HF Route 1) KOP-10 Fentress Substation (HF Routes 1, and 6) KOP-17 (HF Routes 1, and 6) KOP-18 Chicory Switching Station (HF Route 6)
Moderate	VIA: KOP-13 Cape Henry Lighthouse/Fort Story Military Base KOP-15b North End Beach – Residential View – Nighttime KOP-24b Virginia Beach Boardwalk – 16th Street Entrance Nighttime KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-44 Little Island Park/Back Bay NWR *Onshore Components* KOP-11 (HF Route 1, and 6) KOP-14a/b (HF Routes 1, and 6)
Minor	VIA: KOP-15a North End Beach – Residential View KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A

Level of Impact	Offshore and Onshore Key Observation Points
	KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR KOP-48 Currituck Beach Lighthouse
Negligible	VIA: KOP-5 Oyster Village Horse Island Trail KOP-8 Eastern Shore of Virginia NWR KOP-47 Currituck National Wildlife Refuge KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance – Elevated *Onshore Components* KOP-12 (HF Routes 1, and 6) KOP-13 (HF Routes 1, and 6)

The Proposed Action would also add one onshore substation, Harpers Switching Station north of Harpers Road on Navy property in Virginia Beach and expand the existing Fentress Substation in the community of Chesapeake. The substation and switching stations should be painted U.S. Bureau of Land Management color Covert Green or Shadow Grey to mitigate contrast. Dark grey color help incongruous structures recede into the background throughout the seasons. Additional landscaping should also be planted to screen views that may not be captured in the simulations. Onshore export cable infrastructure would be underground for 4.4 miles (7.1 kilometers) and would not contribute to impacts on scenic and visual resources. Interconnection cables would be collocated to the extent feasible, along existing Dominion Energy transmission lines.

Light: Nighttime vessel lighting could result from construction, O&M, and decommissioning of the Proposed Action if these activities are undertaken during nighttime, evening, or early morning hours. Vessel lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore and offshore viewing locations based on viewer distance and atmospheric conditions. The impact of vessel lighting on scenic and visual resources during construction and decommissioning would be localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M but long-term impacts would be less due to the lower number of forecast vessel trips.

The OSSs would be lit and marked in accordance with Occupational Safety and Health Administration lighting standards to provide safe working conditions when O&M personnel are present. The OSSs would have nighttime lighting up to 220 feet (67 meters) above sea level. Due to the Earth's curvature, from eye levels of 5 feet (1.5 meters), these lights would become invisible above the ocean surface beyond approximately 21 miles (33.7 kilometers). Lights of the three OSSs, when lit for maintenance, would not be visible from beaches and adjoining areas during hours of darkness. The nighttime sky light dome and cloud lighting caused by reflections from the water surface may be seen from distances beyond the 40-mile (64.4-kilometer) geographic analysis area, depending on variable ocean surface and meteorological reflectivity.

Dominion has committed to installing ADLS on WTGs, which activates the FAA hazard lighting system in response to detection of nearby aircraft (Dominion Energy 2022). The synchronized flashing of the aviation warning lights occurs only when aircraft are present, resulting in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The ADLS report (COP, Appendix T; Dominion Energy 2022) indicates that based on historical air traffic data for flights passing through the light activation zone would activate obstruction lights for a total of 25 hours 33 minutes and 49 seconds over a one-year period. March would have the highest proportion of ADLS night lighting activation and September would have the smallest proportion. It is anticipated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS, although ADLS would have major impacts on viewers when activated. The shorter-duration synchronized flashing of ADLS will substantially reduce visual impacts to beaches and coastlines within the geographic analysis area at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. ADLS hazard lighting would be in use for the duration of O&M of the Proposed Action and would have negligible intermittent and long-term effects on sensitive onshore and offshore viewing locations based on viewer distance and angle of view, and assuming no obstructions.

Traffic (vessel): Construction, O&M, and decommissioning of the Proposed Action would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the future offshore wind construction areas. Construction of the Proposed Action is projected to generate an average of 46 vessels per day operating in the Wind Farm Area or over the offshore export cable route at any given time (Section 3.16, *Navigation and Vessel Traffic*). The minimum would be 3 vessels per day and the maximum would be 95 vessels per day. O&M activities for the Proposed Action are anticipated to generate an average of 52 vessel trips per year between a port and the Wind Farm Area.

Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action. As shown in Appendix F, Table F-3, between 2023 and 2027 one additional offshore wind project (excluding the Proposed Action) could be under construction simultaneously (Kitty Hawk North and Kitty Hawk South would have overlapping construction period with CVOW-C between 2024 and 2027). During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 92 vessel trips daily from Atlantic Coast ports to worksites in the geographic analysis area, with as many as 190 vessels present (either underway or at anchor) during times of peak construction. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean characters from open ocean to active waterway.

Onshore and offshore visual impacts would continue from visible vessel activity related to O&M of offshore wind facilities. Based on the estimates for the Proposed Action, O&M of two offshore wind projects (including the Proposed Action) would generate an estimated 4 vessel trips per week within the geographic analysis area. Vessel traffic during O&M would result in long-term, intermittent contrasts to open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during decommissioning at the end of the assumed operating period of each project, with impacts similar to those described for construction. Maintenance activities would cause minor effects on seascape character and open ocean character due to increased O&M vessel traffic to and from the offshore wind lease areas. Increases in these vessel movements would be noticeable to onshore and offshore viewers but are likely to have a minor effect.

Land disturbance: Future offshore wind development including the Proposed Action would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M.

Accidental releases: Accidental releases during construction, O&M, and decommissioning of future offshore wind projects including the Proposed Action could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning of offshore wind projects, and would be lower but continuous during O&M.

3.20.5.1 Cumulative Impacts of the Proposed Action

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

Presence of structures: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute 205 of a combined total of 395 WTGs (considering both Kitty Hawk North and Kitty Hawk South) that would be installed in the geographic analysis area between 2024 and 2030. The total number of WTGs that would be visible from any single KOP would be fewer than the 274 WTGs considered under the planned activities scenario in combination with the Proposed Action. For example, approximately 270 WTGs would be theoretically visible from KOP-26 Marriott Virginia Beach Oceanfront Hotel and approximately 95 WTGs would be theoretically visible from KOP-49g Whale Head Bay Albacore Street Entrance (BOEM 2021d). Appendix M, Attachment M-2 provides simulations of the Proposed Action in combination with other future offshore wind projects that would be theoretically visible within the same viewshed as the Project, including Kitty Hawk Wind North. The presence of structures associated with future offshore wind development in combination with the Proposed Action would have moderate seascape character, open ocean character, landscape character, and viewer experience impacts, as simulated from sensitive onshore receptors (see simulations Appendix M, Attachment M-2). The open ocean character would reach a moderate level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030.

Light: In context of reasonably foreseeable environmental trends, vessel lights could be active during nighttime hours for up to two offshore wind projects including the Proposed Action. Nighttime vessel lighting for the Proposed Action in combination with other future offshore wind development would **moderately** affect seascape character, open ocean character, nighttime viewer experience, and valued scenery. This impact would be localized and short term during construction and decommissioning and intermittent and long term during O&M.

In context of reasonably foreseeable environmental trends, FAA hazard lighting systems would be in use for the duration of O&M for up to 274 WTGs including the Proposed Action and other future offshore wind development. The cumulative effect of these WTGs and associated FAA hazard lighting would have long-term impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The extent to which other future offshore wind projects would implement ADLS is unknown. Cumulative impacts from lighting would be reduced if ADLS is implemented across all future offshore wind projects in the geographic analysis area and would be more adverse if other projects do not commit to using ADLS. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations. Each future offshore wind project would also have at least one OSS that would be lit and marked in accordance with USCG and Occupational Safety and Health Administration lighting standards.

Due to variable distances from visually sensitive viewing locations and unknown adoption of ADLS, other reasonably foreseeable offshore wind projects in combination with the Proposed Action would have moderate to major long-term cumulative effects on visually sensitive viewing areas.

Traffic (vessel): In context of reasonably foreseeable environmental trends, future offshore wind project construction, O&M, and decommissioning would increase vessel traffic in the geographic analysis area beyond what the Proposed Action would generate in isolation.

Land Disturbance: The exact extent of impacts would depend on the locations of project infrastructure for future offshore wind energy projects; however, the Proposed Action in combination with other future offshore wind development would generally have localized, short-term impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases: The Proposed Action would contribute to the combined impacts on scenic and visual resources from ongoing and planned activities, including offshore wind, which would be moderate.

3.20.5.2 Conclusions

Impacts of the Proposed Action. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected during construction, O&M, and decommissioning by the Project's features, applicable distances, horizontal and vertical FOV extents, view framing or intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence. These assessments are documented in Appendix M. Project decommissioning effects would be similar to construction effects. Due to distance, extensive FOVs, strong contrasts, large scale of change, and visual prominence and predominantly undeveloped ocean views, the Proposed Action would have **major** effects on the open ocean character unit and viewer boating and cruise ship experiences. Due to view distances (effects ranges discussion in Appendix M), moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, Proposed Action effects on high- and moderate-sensitivity seascape and landscape character units, and viewer experience would be **moderate** to **negligible**. The daytime presence of offshore WTGs and OSSs, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSSs. In clear weather, the WTGs would be an unavoidable presence in views from the coastline, with **moderate** to **minor** effects on seascape character and landscape character.

Onshore, temporary **moderate** effects would occur during construction and decommissioning of the landfalls and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**. The context of the onshore substation sites surrounding industrial elements, strong visual contrast between the sites and the surrounding landscape, and the scale of change would be **major** to **moderate** as viewed from the KOPs. The transmission lines collocated with existing transmission corridors would have a **moderate** impact, whereas new corridors would have a **major** impact on scenic and visual resources. Impacts of the onshore components on scenic and visual resources would be **moderate**.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would be **moderate**. The Proposed Action would comprise approximately 65 percent of the affected viewshed because of the distance and obtuse angle of reasonably foreseeable projects. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.20.6 Impacts of Alternatives B and C on Scenic and Visual Resources

Impacts of Alternatives B and C. Alternative B involves revised layout of WTGs and OSSs to accommodate navigation and the Fish Haven area located along the northern boundary of the Lease Area and would result in 29 fewer WTGs than the Proposed Action. Alternative C, in addition to the accommodations in Alternative B, would also avoid sand ridge habitat through micrositing components and removal and relocation of WTGs and associated infrastructure in priority sand ridge habitats. As a result, Alternative C would consist of 33 fewer WTGs than the Proposed Action. Therefore, the types of impacts under Alternatives B and C on scenic and visual resources would be the same as described for the Proposed Action but slightly reduced since fewer WTGs would be installed. Impacts of Alternatives B and C related to the primary IPFs (presence of structures, lighting, vessel traffic, and accidental releases) would also be similar to the impacts described for the Proposed Action.

Cumulative Impacts of Alternatives B and C. The contribution of Alternatives B and C to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action.

3.20.6.1 Conclusions

Impacts of Alternatives B and C. The effects of Alternatives B and C on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternatives B and C would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternatives B and C on high- and moderate-sensitivity seascape and landscape character units would be **moderate** to **minor**. The OSSs are not visible from shore. The daytime presence of offshore WTGs, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs. In clear weather, the WTGs would be an unavoidable presence in views from the coastline, with **moderate** to **minor** effects on seascape and landscape character. landscape character.

Considering all the IPFs together, BOEM anticipates that the contribution of Alternatives B and C to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

Cumulative Impacts of Alternatives B and C. In context of other reasonably foreseeable environmental trends in the area, the contribution of Alternatives B and C to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action. Considering all the IPFs together, BOEM anticipates that the contribution of Alternatives B and C to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.20.7 Impacts of Alternative D on Scenic and Visual Resources

Impacts of Alternative D. Under Alternative D, including sub-alternatives D-1 and D-2, the construction, O&M, and eventual decommissioning of a wind energy facility would include the same offshore layout of Project components as described under the Proposed Action. Unlike the Proposed Action and Alternatives B and C, the construction of interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid

Route). Both routes are approximately 14.2 miles (22.9 kilometers) from the cable landing location to the Fentress Substation. The onshore export cables from the proposed cable landing location to the Harpers Switching Station (4.4 miles [7.1 kilometers]) would be underground.

Alternative D-2 would involve the use of Interconnection Cable Route Option 6 (Hybrid Route). This interconnection cable route option would be approximately 14.2 miles (22.9 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. A proposed Chicory Switching Station would be built and used under this sub-alternative. No aboveground switching station would be built at Harpers Road (KOP-3 HF Route 1), instead the Chicory Switching Station would be constructed north of Princess Anne Road on a parcel that is currently forested and adjacent to a transportation corridor (Princess Anne Road) and a small residential subdivision (KOP-18). The Chicory Switching Station is only associated with the Interconnection Cable Route Option 6 (Hybrid Route). From the Chicory Switching Station, Interconnection Cable Route 6 would continue as an overhead transmission line, aligned with Cable Route Option 1 for the remaining 9.7 miles to the Fentress Substation. Approximately 80 percent, or 7.8 miles (12.6 kilometers), of the aboveground transmission lines are co-located with existing transmission lines.

Under sub-alternative D-1, Interconnection Cable Route 1 would be constructed using an entirely overhead cable from the proposed Harpers Switching Station north of Harpers Road to the Fentress Substation. Approximately 68 percent, or 9.6 miles (15.4 kilometers), of the aboveground transmission lines are co-located with existing transmission lines.

Cumulative Impacts of Alternative D. The contribution of Alternative D to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action.

3.20.7.1 Conclusions

Impacts of Alternative D. The effects of Alternative D, including sub-alternatives D-1 and D-2, on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternative D would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternative D on high- and moderate-sensitivity seascape and landscape character units would be **moderate** to **minor**. The daytime presence of offshore WTGs, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs. The OSSs are not visible from shore. In clear weather, the WTGs would be an unavoidable presence in views from the coastline, with **moderate** to **minor** effects on seascape and landscape character.

Onshore, temporary **moderate** effects would occur during construction and decommissioning of the landfall and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**.

The onshore Chicory Switching Station associated with the sub-alternative D-2 site context of surrounding forest and transportation corridor elements, visual contrast between the site and the surrounding landscape, and the scale of change would be **major** to **moderate.** The Chicory Switching Station is not visible in the current KOPs; however, it would be visible in winter and from the surrounding homes. The buried transmission lines would avoid visual impacts on an area of suburban residential development (Castleton and Pine Ridge) at the eastern end of the route. The existing utility ROW would need to be expanded, but no new structures would be built in this area. The buried lines would have **moderate** temporary impact during construction and decommissioning and **negligible** impact during O&M. Transmission lines collocated with existing transmission corridors would have a **moderate** impact. Impacts of the onshore components on scenic and visual resources would be **moderate**.

The onshore components of sub-alternative D-1 include the Harpers Switching Station and 14.3 miles of overhead transmission lines context of agriculture, rural and suburban residential, and recreation land uses; visual contrast, and scale of change would be **major** to **moderate**. The Harpers Switching Station is in a semi-industrial area, but across from high density residential housing and would replace a wooded area adjacent to a golf course. Transmission lines collocated with existing transmission corridors would have a **moderate** impact. Impacts of the onshore components on scenic and visual resources would be **moderate**.

Considering all the IPFs together, BOEM anticipates that the contribution of Alternative D to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

Cumulative Impacts of Alternative D. In context of other reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative D to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.21. Water Quality

This section discusses potential impacts on water quality from the proposed Project, alternatives, and ongoing and planned activities in the water quality geographic analysis area. The water quality geographic analysis area, as described in Appendix F, *Planned Activities Scenario,* Table F-1 and shown on Figure 3.21-1, includes the coastal and marine waters within a 10-mile (16-kilometer) buffer around the Offshore Project area and a 15.5-mile (25-kilometer) buffer around the ports that may be used by the Project. In addition, the geographic analysis area includes an onshore component that includes any subwatershed that is intersected by the Onshore Project area.

3.21.1 Description of the Affected Environment for Water Quality

The geographic analysis area includes onshore waterbodies, such as ponds, streams, and rivers, including, for example, Owl's Creek, Oceana Pond, North Landing River, and Ashville Bridge Creek; it also includes coastal waters, such as estuaries, the Atlantic Ocean, and the MAB.

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

- **Water temperature:** Water temperature heavily affects species distribution in the ocean. Large-scale changes to water temperature may affect seasonal phytoplankton blooms.
- **Salinity:** Salinity, or salt concentration, also affects species distribution. In general, seasonal variation in the region is smaller than year-to-year variation and less predictable than temperature changes (Kaplan 2011).
- **Dissolved oxygen:** The amount of DO in water determines the amount of oxygen that is available for marine life to use. Temperature strongly influences DO content, which is further influenced by local biological processes. For a marine system to maintain a healthy environment, DO concentrations should be above 5 milligrams per liter (mg/L); lower levels may affect sensitive organisms (USEPA 2000).
- **Chlorophyll *a*:** Chlorophyll *a* is a measure of how much photosynthetic life is present. Chlorophyll *a* levels are sensitive to changes in other water parameters, making it a good indicator of ecosystem health. USEPA considers estuarine and marine levels of chlorophyll *a* under 5 micrograms per liter (µg/L) to be good, 5 to 20 µg/L to be fair, and over 20 µg/L to be poor (USEPA 2015).
- **Turbidity:** Turbidity is a measure of water clarity, which is typically expressed as a concentration of TSS in the water column, but can also be expressed as nephelometric turbidity units. Turbid water lets less light reach the seafloor, which may be detrimental to photosynthetic marine life (CCS 2017). In estuaries, a turbidity level of 0 to 10 nephelometric turbidity units is healthy while a turbidity level over 15 nephelometric turbidity units is detrimental (NOAA 2018). Marine waters generally have less turbidity than estuaries.
- **Nutrients:** Key ocean nutrients include nitrogen and phosphorous. Photosynthetic marine organisms need nutrients to thrive (with nitrogen being the primary limiting nutrient), but excess nutrients can cause problematic algal blooms. Algal blooms can significantly lower DO concentration, and toxic algal blooms can contaminate human food sources. Both natural and human-derived sources of pollutants contribute to nutrient excess.

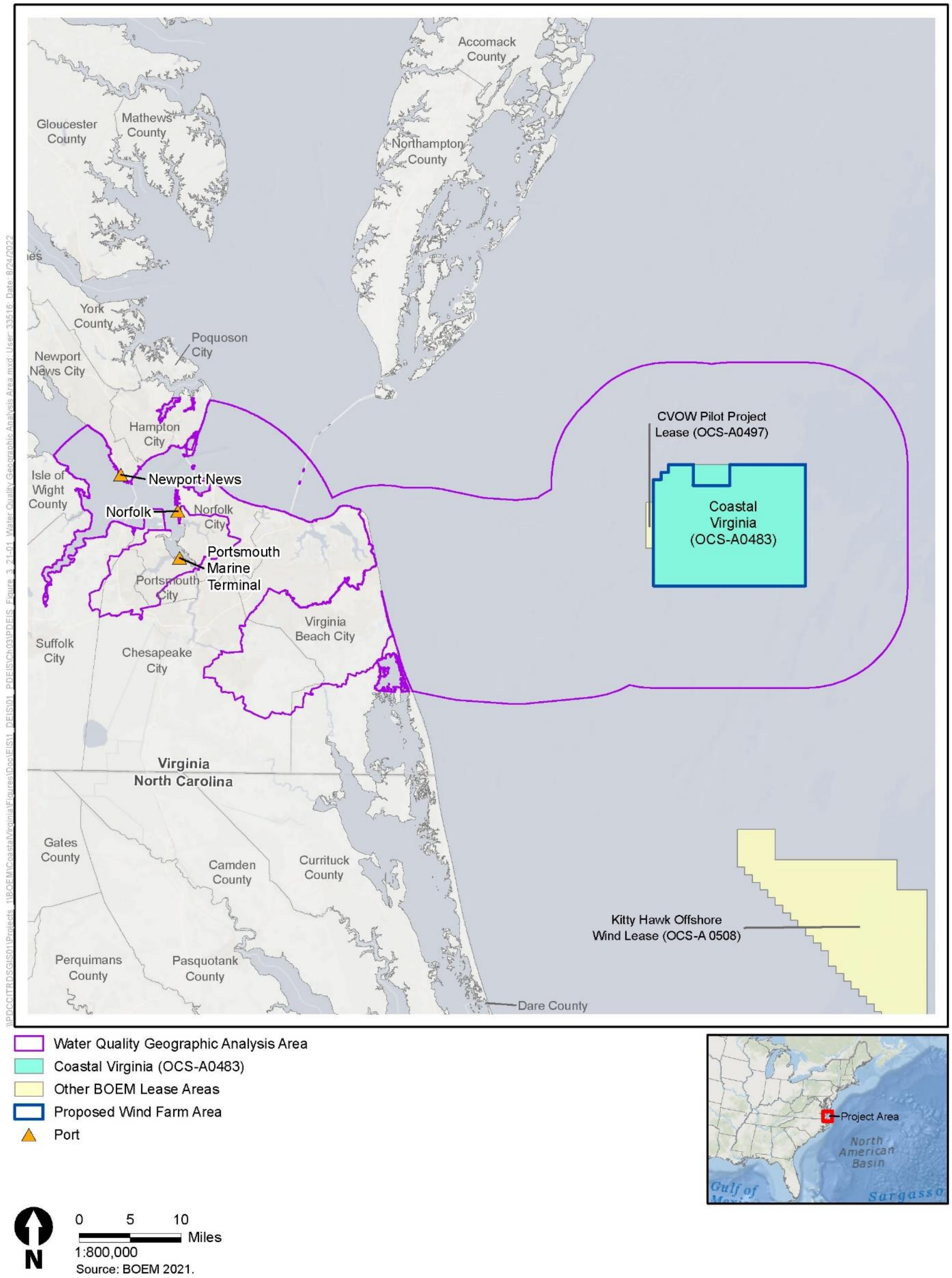

Figure 3.21-1 Water Quality Geographic Analysis Area

The Offshore Project area is located within the Atlantic Ocean (nearshore and offshore waters) and Virginia State Coastal Waters. The Offshore Project components are located in the area of the Atlantic Ocean referred to as the MAB. The Offshore Export Cable Route Corridor crosses Virginia State Coastal Waters to make landfall at Virginia Beach, Virginia.

3.21.1.1 Mid-Atlantic Bight

In 2012, USEPA released the National Coastal Condition Report IV, which assessed dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorous (DIP), chlorophyll *a*, water clarity, and DO for the Northeast Coastal Region ocean waters (Dominion Energy 2022 citing USEPA 2012). For coastal waters, USEPA used measured values and determined thresholds to develop water quality index ratings as "good," "fair," or "poor" for various components. However, USEPA did not develop specific water quality index ratings for the MAB ocean waters as a whole because index rating thresholds for ocean waters did not exist for DIN, DIP, chlorophyll *a*, TSS, and DO (Dominion Energy 2022 citing USEPA 2012).

For the MAB, USEPA reported average DIN concentrations in ocean surface waters of 0.04 mg/L, and near-bottom DIN concentrations averaged 0.13 mg/L. Average DIP concentrations were reported as 0.04 mg/L. Chlorophyll *a* surface concentrations averaged 0.23 µg/L, and near-bottom concentrations averaged 0.30 µg/L. Ocean water clarity was assessed using measurements of TSS concentrations. TSS averaged 5.6 mg/L, and near-bottom concentrations averaged 6.9 mg/L. DO surface concentrations averaged 8.9 mg/L, and near-bottom concentrations averaged 9.1 mg/L (COP, Section 4.1.2.1; Dominion Energy 2022).

Water temperatures were taken at the sea surface, although water temperatures typically remain the same or decrease with depth. Sea surface temperatures ranged from 32 to 88°F (0 to 31°C). The depth-averaged annual water temperature is 56.39°F (13.55°C) (Dominion Energy 2022 citing NOAA n.d.). COP Section 4.1.1, *Physical and Oceanographic Conditions*, provides additional information on water temperatures. NOAA's NEFSC maintains a database of conductivity, temperature, and depth records taken at depth intervals of 3.3 feet (1 meter), collected during various NEFSC cruises within the Offshore Project area. This data was summarized by season within the Lease Area between 2003 and 2006 in Dominion Energy 2022 citing Guida et al. 2017). Water temperatures during this period exhibited approximately 36°F (20°C) seasonal range swings at the surface and 27°F (15°C) seasonal range swings at the bottom, with thermal stratification between April and August during most years (Dominion Energy 2022 citing Guida et al. 2017).

A persistent cross-shelf salinity gradient exists in the MAB because of freshwater runoff from the Hudson-Raritan Estuary System, Delaware Bay, and Chesapeake Bay (Dominion Energy 2022 citing Castelao et.al. 2010). Following periods of high runoff, a strong vertical salinity gradient has been observed across much of the 62- mile-wide (100-kilometer-wide) shelf (Dominion Energy 2022 citing Wilkin and Hunter 2013). Stratification starts in early June and often lasts until October (Dominion Energy 2022 citing Stevenson et al. 2004). NOAA reports mean surface salinity in 2019 as 32.6 Practical Salinity Unity (PSU) and mean bottom salinity as 33.2 PSU (2020). Seasonal variations in salinity are smaller than variations in temperature (Dominion Energy 2022 citing Castelao et.al. 2010). At the shelf edge, strong horizontal gradients in salinity occur separating the shelf water from the warmer saltier sea water (Dominion Energy 2022 citing Csanady and Hamilton 1988). NOAA's NEFSC conductivity, temperature, and depth database showed a median salinity of 32.1 PSU (ranging from 29.8 to 33.9 PSU) in the Lease Area between 2003 and 2016, as summarized in Guida et al. (2017 [COP Section 4.1.2.1]).

3.21.1.2 Virginia State Coastal Waters

Virginia State Coastal Waters include coastal estuaries, intertidal zones, and coastal ocean waters. The USEPA National Coastal Condition Report IV rated the coastal waters of the Northeast Coastal Region as “fair” for water quality (Dominion Energy 2022 citing USEPA 2012). The Northeast Coastal Region includes the Virginia State Coastal Waters. Site water quality indices are rated as “fair” for data points near the offshore cable landing locations (Dominion Energy 2022 citing USEPA 2012). Water quality ratings were based on measurements of DIN, DIP, chlorophyll *a*, water clarity, and DO. An assessment of the National Aquatic Resource Survey’s 2010 water quality data for 23 stations along Virginia coastal estuaries show that DIN concentrations averaged 0.05 mg/L, DIP concentrations averaged 0.02 mg/L, chlorophyll *a* concentrations averaged 13.4 µg/L, and DO concentrations averaged 5.6 mg/L (Dominion Energy 2022 citing USEPA 2016). Light transmissivity was measured to assess water clarity and reported as percent of incident light transmitted through 3.3 feet (1 meter) of water. Light transmissivity ranged from 60.6 percent to 3.52 percent at a depth of 3.3 feet (1 meter), with an average of 32 percent (Dominion Energy 2022 citing USEPA 2016). The USEPA National Coastal Condition Report IV rated Virginia coastal estuaries as “good” for DIN and DO concentrations, and as “fair” for DIP and chlorophyll *a*. Light transmissivity has the largest variability across sampling stations, ranging from “poor” to “good” (Dominion Energy 2022 citing USEPA 2016). From 2016 to 2017, the United States Navy performed water quality sampling in the nearshore and offshore areas of the Naval Air Station Oceana Dam Neck Annex in Virginia Beach, Virginia. The sampling area overlaps a portion of the nearshore HDD area; therefore, water quality measurements collected during the survey are relevant to the Project. Depending on the season that sampling occurred, concentrations of organic nitrogen (i.e., nitrogen bound to organic chemicals [e.g., ammonia]) ranged from 0.50 to 0.51 mg/L, nitrate-nitrite nitrogen ranged from 0 to 0.1 mg/L, total phosphorous ranged from 0.62 mg/L to 1.7 mg/L, and TSS ranged from 0.03 to 0.11 mg/L. COP Table 4.1-4 details the Dam Neck Annex seasonal water chemistry measurement results. Seasonal in-situ water quality data was also collected from spring 2016 to winter 2017 for the Dam Neck Annex (see details in COP Table 4.1-5; Dominion Energy 2022). In-situ water quality parameters measured were found to be significantly influenced by season or location. DO, pH, and temperature were within acceptable levels compared to Commonwealth of Virginia standards (Virginia Administrative Code, Criteria for Surface Water 9VAC25- 260). Virginia has not set numeric nitrogen, phosphorous, or TSS standards for estuaries or open ocean (Virginia Administrative Code, Criteria for Surface Water 9VAC25-260) (COP, Section 4.1.2.1; Dominion Energy 2022).

Virginia Department of Health (VDH) conducts routine *Enterococcus* bacteria water quality sampling at the SMR monitoring station (Station 21VABCH-VA514504), which is also near the preferred cable landing location (Dominion Energy 2022 citing VDH 2020a). Monitoring results are available beginning in 2003 through 2020 through the National Water Quality Monitoring Council (Dominion Energy 2022 citing NWQMC 2020a). For transition and saltwater waterbodies, state water quality standards state that *Enterococci* bacteria shall not exceed a geometric mean of 35 counts/ 100 milliliter (mL) and shall not have greater than a 1-percent excursion frequency of a statistical threshold value of 130 counts/100 mL, both in an assessment period of up to 90 days (Dominion Energy 2022 citing VDEQ 2020b). Samples at Station 21VABCH-VA514504 did not exceed state water quality standards in 2019 (Dominion Energy 2022 citing VDH 2020a).

The VDH Algal Bloom Surveillance Map is updated regularly from May through October to map algal blooms in Virginia (Dominion Energy 2022 citing VDH 2020b). An algal bloom was reported on August 4, 2020, at the 1st Street Jetty, which is approximately 1.0 mile (1.6 kilometers) from the preferred cable landing location. VDH determined the algae to be *Margalefidinium polykrikoides* with a concentration 6,990 cells per milliliter. *Margalefidinium polykrikoides* may contribute to fish kills but are not known to be harmful to humans. Other algal blooms were reported north of the project and primarily in the coastal waters during August and September 2020 (COP, Section 4.1.2.1; Dominion Energy 2022).

3.21.1.3 Onshore Groundwater Quality

The onshore geographic analysis area is underlain by the Northern Atlantic Coastal Plain aquifer, which is a large aquifer that extends from New Jersey through North Carolina, containing multiple aquifer and confining units (Dominion Energy 2022 citing USGS 2020a). The surficial aquifer is the uppermost aquifer in the system and is made up of many small-scale aquifers. In Virginia, the surficial aquifer is used for domestic and agricultural water supplies, and is susceptible to contamination from anthropogenic sources because of its proximity to the surface; therefore, the water quality of the surficial aquifer is variable (Dominion Energy 2022 citing USGS 2020a). The surficial aquifer is used for small-scale irrigation (lawn watering) due to water quality limitations such as high iron content and low pH (causing corrosion), and low well yield potential (Dominion Energy 2022 citing Siudyla et al. 1981).

The regional Chesapeake aquifer lies below the surficial aquifer; the aquifers are separated by a confining layer in most locations. Water supply yield from the Chesapeake aquifer is greatest in the parts of the aquifer near the coast, and most withdrawals are for public water supply, domestic uses, commercial uses, and agricultural uses. The aquifers below the Chesapeake aquifer include the Castle Hayne-Aquia, Peedee-upper Cape Fear, and Potomac aquifers (COP, Section 4.1.2.1; Dominion Energy 2022).

Several USGS groundwater monitoring wells are located around the onshore export cable route, switching station, interconnection cable route, and onshore substation (see COP Table 4.1-6 and Figure 4.1-11). Data collected for the period from September 24, 2019, to September 24, 2020, shows that wells in the surficial aquifer had water depths ranging from 3 to 9.5 feet (0.9 to 2.9 meters) from the surface. Wells in the Chesapeake aquifer measured water depths ranging from 3 to 15 feet (0.9 to 4.6 meters) for this same period. Groundwater quality in the area of the onshore substation has been studied extensively during environmental assessments related to the construction of the Battlefield Golf Club, which is located to the east of the onshore substation across the Centerville Turnpike. Groundwater, surface water, and soil samples from 2001 to 2009 were collected at or near the Battlefield Golf Club (Dominion Energy 2022 citing Tetra Tech 2010). In 2001, Stokes Environmental Associates, Ltd. collected 40 groundwater samples during a baseline surface water quality survey investigation (Dominion Energy 2022 citing Tetra Tech 2010; URS Corporation 2009). Arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, thallium, and zinc were detected in some of the groundwater samples. Two wells produced samples with copper levels above USEPA’s maximum contaminant level (MCL) or action level, and one well had thallium levels above the MCL (Dominion Energy 2022 citing Tetra Tech 2010; URS Corporation 2009). All other inorganic substances were below USEPA’s MCL (COP, Section 4.1.2.1; Dominion Energy 2022).

In 2008, Tetra Tech and USEPA collected groundwater samples from 55 residential wells in the vicinity of the Battlefield Golf Club (Dominion Energy 2022 citing Tetra Tech 2010). Locations of the residential wells were not included in the redacted report. The samples were analyzed for dissolved and total target analyte list metals, boron, and molybdenum. Four of the sampled wells measured lead above USEPA MCL (Dominion Energy 2022 citing Tetra Tech 2010). All other compounds analyzed were below USEPA’s MCL (COP, Section 4.1.2.1; Dominion Energy 2022).

3.21.1.4 Onshore Water Quality and 303(d) Impaired Waters

The overall water quality of Virginia coastal waters in the geographic analysis area is generally impaired, particularly the estuarine waters of or related to the Chesapeake Bay, James River, Nansemond River, Elizabeth River, Lafayette River, Black River, and Harris River (see Appendix I, *Environmental and Physical Setting,* Figure I-5; VDEQ 2021). Impaired non-estuarine surface waters in the geographic analysis area include West Neck Creek and the Pocaty River. The Pocaty River is the only impaired waterbody crossed by the onshore cable routes. The impairment causes of the Pocaty River at this crossing are related to *Escherichia coli* (E. coli), DO, and benthic macroinvertebrate bioassessments;

sources of impairment include non-point source, crop production, agriculture, urban runoff/storm sewers, and unknown (Dominion Energy 2022 citing VDEQ 2020c). Appendix I, Table I-6 contains the full list of 303(d) impaired waters (and reasons for impairment) in the geographic analysis area (VDEQ 2021).

Stormwater runoff from the northern portion of the onshore export cable route discharges to the Atlantic Ocean via Owl's Creek into Rudee Inlet. Oceana Pond was monitored as part of a one-time (June 2014) assessment for the following parameters: DO (7.78 mg/L), temperature (79.3°F [26.3°C]), pH (7.78), and specific conductance (0.172 MilliSiemens per square centimeter) (Dominion Energy 2022 citing Tetra Tech 2015a). The Virginia Aquarium maintains a water quality monitoring station within the estuarine portion of Owl's Creek, with data from 1998 to 2010 for the following parameters (annual mean): DO (7.64 mg/L), temperature (63.1°F [17.3°C]), pH (7.68), salinity (24 PSU), and fecal coliform (37 counts/100 mL) (Dominion Energy 2022 citing Virginia Aquarium [unpublished data], cited in Tetra Tech 2015a). DO, temperature, and pH are within acceptable levels (Virginia Administrative Code 9VAC25-260). Fecal coliform exceeds the state standards for geometric mean for shellfish waters (Virginia Administrative Code 9VAC25-260). Owl Creek is listed on the Draft 2020 303D List of Impaired Waters for dissolved oxygen impairment, fecal coliform impairment and *Enterococcus* impairment (Dominion Energy 2022 citing VDEQ 2020c). Total maximum daily load (TMDL) studies have not been completed by the state (COP, Section 4.1.2.1; Dominion Energy 2022).

Stormwater runoff from the southern portion of the onshore export cable route discharges to Ashville Bridge Creek into the Currituck Sound. Ashville Bridge Creek is listed on the Draft 2020 303D List of Impaired Waters for pH impairment, DO impairment, and *Enterococcus* impairment (Dominion Energy 2022 citing VDEQ 2020c). The state has not completed TMDL studies the DO impairment or *Enterococcus* impairment (COP, Section 4.1.2.1; Dominion Energy 2022).

The interconnection cable routes cross over the North Landing River, the Chesapeake-Albemarle Canal (Intracoastal Waterway), or the Pocaty River (see COP Figure 4.1-13). The alternative switching station sites south of Harpers Road and north of Princess Anne Road are located in the North Landing River watershed. While the Bacterial TMDL implementation plan in the North Landing River watershed is in place, water quality in the North Landing River has either remained the same or declined since publication of that implementation plan (Dominion Energy 2022 citing City of Virginia Beach 2018). Virginia Department of Environmental Quality (VDEQ) has not completed a TMDL study for the pH impairment. The 2020 Annual Water Quality Monitoring Plan includes one Ashville Bridge Creek monitoring station located at latitude 36.7269 and longitude -75.9861 (Dominion Energy 2022 citing VDEQ 2020a). VDEQ Station 5BASH002.20 is an ambient long-term trend monitoring station site for permanent monitoring to detect short-, medium- and long-term water quality trends. Samples at this station are collected six times per year and include measurements of nutrients, bacteria, and suspended solids (COP, Section 4.1.2.1; Dominion Energy 2022).

The onshore substation parcel and a portion of the interconnection cable route is within the Pocaty River subwatershed of the North Landing River (Dominion Energy 2022 citing City of Chesapeake 2007), with the majority of the interconnection cable route occurring within the North Landing River watershed (COP, Figure 4.1-13; Dominion Energy 2022). The Pocaty River is listed on the 2020 303(d) list of impaired waters for DO impairment, E. coli impairment, and for benthic macroinvertebrates bioassessments impairment (Dominion Energy 2022 citing VDEQ 2020c). TMDL studies have been completed for both DO impairment and E. coli impairment. VDEQ has not completed a TMDL study for the benthic macroinvertebrates bioassessments impairment (COP, Section 4.1.2.1; Dominion Energy 2022).

One water quality monitoring station is located at the Blackwater Road Bridge, which is also the location of the interconnection cable route crossing of the Pocaty River. Thirteen different water quality parameters are collected at this station, and averages from data collected in 2019 and 2020 are listed in

COP Table 4.1-8. Of the parameters in COP Table 4.1-8, the state has developed numeric water quality criteria for pH, temperature, and E.coli in freshwater streams. pH and temperature are within acceptable levels (Virginia Administrative Code 9VAC25-260). E. coli exceeds the Commonwealth's standards for geometric mean to protect recreation (Virginia Administrative Code 9VAC25-260) (COP, Section 4.1.2.1; Dominion Energy 2022).

Additional surface water quality data was collected in 2014 and 2015 within the upper portion of the Pocaty River watershed that overlaps the Naval Auxiliary Landing Field Fentress for the following average parameters: DO (7.57 mg/L), temperature (72.1°F [22.3°C]), pH (7.60), and specific conductance (0.406 MilliSiemens per square centimeter) (Dominion Energy 2022 citing Tetra Tech 2015b). DO, temperature, and pH are within acceptable levels (Virginia Administrative Code 9VAC25-260) (COP, Section 4.1.2.1; Dominion Energy 2022).

3.21.2 Environmental Consequences

3.21.2.1 Impact Level Definitions for Water Quality

Definitions of impact levels are provided in Table 3.21-1. There are no beneficial impacts on water quality.

Table 3.21-1 Impact Level Definitions for Water Quality

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

3.21.3 Impacts of the No Action Alternative on Water Quality

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

3.21.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for water quality described in Section 3.21.1, *Description of the Affected Environment for Water Quality,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on water quality generally relate to or include terrestrial runoff, ground disturbance (e.g., construction) and erosion, terrestrial point- and nonpoint-source discharges, and atmospheric deposition. The deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). While water quality impacts may be temporary and localized (e.g., construction) and state and federal statutes, regulations, and permitting requirements (e.g., CWA Section 402) avoid or minimize these impacts, issues with water quality can still persist.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on water quality include:

- Continued O&M of the CVOW project (two WTGs) installed in OCS-A 0497.

Ongoing O&M of the CVOW project would affect water quality through the primary IPFs of accidental releases, anchoring, cable maintenance, port utilization, and discharges. Ongoing offshore wind activities would have the same type of impacts from accidental releases, anchoring, cable maintenance, port utilization, and discharges that are described in detail in Section 3.21.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.21.3.2 Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that affect water quality include onshore development activities (including urbanization, municipal waste discharges, and residential and commercial development); marine transportation-related discharges; dredging and port improvement projects; commercial fishing; military use; new submarine cables and pipelines; and climate change (see Appendix F, Section F.2 for a description of ongoing and planned activities). Water quality impacts from these activities, especially from dredging and harbor, port, and terminal operations, are expected to be localized and temporary to permanent, depending on the nature of the activities and associated IPFs. Similar to under ongoing activities, the deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). State and federal water quality protection requirements and permitting would result in avoiding and minimizing these impacts. See Appendix F, Table F1-22 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for water quality.

The geographic analysis area does not overlap with any other BOEM offshore wind lease areas, and therefore, there would be no future WTGs or OSSs constructed, operated, or decommissioned in the geographic analysis area, and water quality impacts associated with those activities would not occur in the geographic analysis area. Approximately 9 miles (14.5 kilometers) of Kitty Hawk Wind North's (Lease Area OCS-A-0508) proposed offshore cable would travel through the geographic analysis area on its way to landfall in Sandbridge, Virginia. In addition, based on Kitty Hawk Wind North's COP (Kitty Hawk Wind North 2021), the proposed landfall and onshore components (e.g., onshore cable routes) would overlap with the onshore portion of the geographic analysis area. There would also be several years of construction overlap with the Proposed Action and Kitty Hawk (Appendix F, Table F-3).

BOEM expects future offshore wind activities to affect water quality through the following primary IPFs, and include those areas where future offshore wind project components overlap with the geographic analysis area.

Accidental releases: Future offshore wind activities could expose coastal offshore waters to contaminants (such as fuel, solid waste, or chemicals, solvents, oils, or grease from equipment) in the event of a spill or release during routine vessel use. This impact would be primarily limited to vessel use to construct and maintain the 9 miles (14.5 kilometers) of Kitty Hawk Wind North's offshore cable that travels through the geographic analysis area. The Kitty Hawk Wind North project would result in a small incremental increase in vessel traffic in this 9-mile (14.5-kilometer) area, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the Virginia and North Carolina lease areas beginning in 2024 and continuing through 2030 and then lessen to near-baseline levels during operational activities. Increased vessel traffic would be localized near the offshore construction area. Increased vessel traffic associated with construction of the 9 miles (14.5 kilometers) of Kitty Hawk Wind North's offshore export cable could increase the probability of allisions in that area, which could result in oil or chemical spills. However, allisions are not anticipated along the offshore export cable route due to the absence of structures in this area, such as WTGs.

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

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

In summary, due to the limited area of overlap of the Kitty Hawk Wind North project with the geographic analysis area, low likelihood of a spill occurring, and regulatory requirements, the overall impact of accidental releases is anticipated to be short term and localized, resulting in little change to water quality. As such, accidental releases from future offshore wind development in the water quality geographic analysis area would not be expected to contribute appreciably to overall impacts on water quality.

Anchoring: Offshore wind activities would contribute to changes in offshore water quality from resuspension and deposition of sediments from anchoring during construction, installation, maintenance, and decommissioning of offshore components. This impact would be limited to any anchoring that would occur during construction, operations, and decommissioning along the 9 miles (14.5 kilometers) of Kitty Hawk Wind North's offshore cable that travels through the geographic analysis area. If anchoring is required in this area, disturbances to the seabed during anchoring would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to the anchorage area. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement (see the *New cable emplacement and maintenance* IPF discussion) and would, therefore, be unlikely to have an incremental impact beyond the immediate vicinity. If the Kitty Hawk Wind North offshore cable is being constructed during the same period as the Proposed Action in the geographic analysis area, the impacts would be greater than for the Kitty Hawk Wind North project, and multiple areas would experience water quality impacts from anchoring; however, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically. The overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be adverse, localized, and short term, resulting in little change to ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

New cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. This impact would be limited to the 9 miles (14.5 kilometers) of Kitty Hawk Wind North's offshore cable that travels through the geographic analysis area. As described under *Anchoring*, these activities would contribute to changes in offshore water quality from the resuspension and deposition of sediment. Sediment transport modeling was conducted for the Kitty Hawk Wind North offshore cable installation, which determined that the suspended sediment concentration, deposition depth, and area of influence is dependent upon flood and ebb current velocities, burial depth, and the percentage of fine sediments in the sediment sample (Kitty Hawk Wind North 2021). The model also determined that the very fine sediments particles (silt and clay) remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized. During peak flood and ebb tides, the suspended sediment concentrations diminish rapidly away from the release point, and at most stations over 80 percent of the suspended particles deposit within 33 feet (10 meters) of the trench centerline. The typical concentration at 328 feet (100 meters) is about 300 mg/L above background concentration for flood tides and about 50 mg/L above background concentration for ebb tides. Deposition thicknesses were predicted to decrease rapidly away from the trench. Average deposition thicknesses were less than 1.57 inches (4 centimeters) within 82 feet (25 meters) of the trench centerline for flood tides and less than 0.09 inch (0.25 centimeter) within 82 feet (25 meters) of the trench centerline for ebb tides. Deposition thicknesses were less than 0.02 inch (0.05 centimeter) at all stations within 492 feet (150 meters) of the trench centerline. Due to the localized areas of disturbances and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, short term, and adverse, resulting in little change to ambient water quality. New cable emplacement and maintenance activities would not be expected to appreciably contribute to overall impacts on water quality.

Port utilization: Offshore wind development would use nearby ports and could also require port expansion or modification, resulting in increased vessel traffic or increased suspension and turbidity from any in-water work. Several offshore wind projects (e.g., Kitty Hawk Wind North and South, and Ocean Wind 1 and 2) would use ports within, or would have vessels go through, the geographic analysis area to reach ports. For example, Kitty Hawk Wind North and South are considering the use of Newport News, Portsmouth, and Chesapeake, Virginia, as O&M facilities, which are all within the geographic analysis area or would require vessels to transit the geographic analysis area. These activities could also increase the risk of accidental spills or discharge. However, these actions would be localized, and port improvements would comply with all applicable permit requirements to minimize, reduce, or avoid impacts on water quality. As a result, port utilization would not be expected to appreciably contribute to overall impacts on water quality.

Discharges: Future offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. This impact would be primarily limited to vessel use to construct and maintain the 9 miles (14.5 kilometers) of Kitty Hawk Wind North's offshore cable that travels through the geographic analysis area. Vessel activity associated with future offshore wind project construction is expected to occur regularly in the Virginia and North Carolina lease areas beginning in 2024 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Future offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part

162. Furthermore, each project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with future offshore wind projects, BOEM expects impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

Due to the current regulatory requirements administered by USEPA, USACE, USCG, and BSEE, and the restricted allowable discharges, the overall impact of discharges from vessels is anticipated to be localized and short term. The level of impact in the water quality geographic analysis area from future offshore wind development would be similar to existing conditions and would not be expected to appreciably contribute to overall impacts on water quality.

Land disturbance: Future offshore wind development would include Kitty Hawk Wind North onshore components that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during the construction and installation of onshore components (e.g., equipment, substation). With the exception of approximately 0.5 mile (0.8 kilometer) of onshore export cable, all of Kitty Hawk Wind North's onshore project components are located in the geographic analysis area. Construction and installation of onshore components near waterbodies may involve ground disturbance, which could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially erode the soils, resulting in sedimentation of nearby surface waters and subsequent increased turbidity. Kitty Hawk Wind North would prepare a Stormwater Pollution Prevention Plan that will conform with the VDEQ Stormwater Management Program regulations, the construction general permit, and the City of Virginia Beach Erosion and Sediment Control Ordinance (Kitty Hawk Wind North 2021). The erosion and sedimentation controls that will be required as part of the permit requirements and ordinance would minimize impacts, resulting in infrequent and temporary erosion and sedimentation events.

In addition, onshore construction and installation activities would involve the use of fuel and lubricating and hydraulic oils. Use of heavy equipment onshore could result in potential spills during active use or refueling activities. Kitty Hawk Wind North would prepare an Oil Spill Response Plan to address accidental spills or releases of oils and other hazardous wastes during onshore activities (Kitty Hawk Wind North 2021) and would outline spill prevention plans and measures to contain and clean up spills if they were to occur. Additional mitigation and minimization measures (such as refueling away from wetlands, waterbodies, or known private or community potable wells) would be in place to decrease impacts on coastal water quality. Impacts on water quality would be limited to periods of onshore construction and periodic maintenance over the life of each project.

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

3.21.3.3 Conclusions

Impacts of the No Action Alternative Under the No Action Alternative, water quality would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent, **minor** impacts on water quality.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and water quality would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on water quality due to increased onshore construction

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have temporary impacts on water quality primarily through accidental releases, increased anchoring, new cable emplacement and maintenance, port utilization, discharges, and land disturbance. BOEM anticipates that the impacts of ongoing activities, such as vessel traffic, military use and survey, commercial activities, recreational activities, and ground disturbance, would be **minor**. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on water quality. Planned activities other than offshore wind include increasing vessel traffic, new submarine cables and pipelines, increasing onshore development, marine surveys, port improvement, and the installation of new offshore structures. BOEM anticipates that the impacts of ongoing and planned activities other than offshore wind would be **minor**. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** impacts on water quality, primarily driven by vessel traffic and associated accidental releases.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area would be **minor** due to cable emplacement and maintenance, port utilization, and discharges. These activities affect offshore water quality through sediment suspension and turbidity or potential spill and marine debris risks. Construction and decommissioning activities associated with future offshore wind activities would lead to increases in sediment suspension and turbidity in the offshore lease areas during the first 6 to 10 years of construction of projects and in the latter part of the 33-year life spans of offshore wind projects due to decommissioning activities. However, sediment suspension and turbidity increases would be temporary and localized.

3.21.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The amount of vessel use during installation, operations, and decommissioning.
- The number of WTGs and OSSs and the amount of cable laid determines the area of seafloor and volume of sediment disturbed by installation. Representing the maximum-case scenario, this would be a maximum of 205 WTGs installed, three OSSs, 300 miles (484 kilometers) of inter-array cable, and 416.9 miles (671 kilometers) of offshore export cable.
- Installation methods chosen and the duration of installation.
- Proximity to sensitive water sources and mitigation measures used for Onshore Project activities.
- In the event of a non-routine event such as a spill, the quantity and type of oil, lubricants, or other chemicals contained in the WTGs, vessels, and other Project equipment.

Variability of the proposed Project design exists as outlined in Appendix E. This includes the exact number of WTGs and OSSs (determining the total area of foundation footprints); the number of monopile foundations (WTGs) and piled jacket foundations (OSSs only); the total length of inter-array cable; the total area of scour protection needed; and the number, type, and frequency of vessels used in each phase of the proposed Project. Changes in the design may affect the magnitude (number of structures and vessels), location (WTG and other Project element layouts), and mechanism (installation method, non-routine event) of water quality impacts.

3.21.5 Impacts of the Proposed Action on Water Quality

The Proposed Action would contribute to impacts through all of the IPFs named in Section 3.21.3.1, *Impacts of the No Action Alternative,* plus the presence of structures IPF. The most impactful IPFs would likely include new cable emplacement and maintenance that could cause noticeable temporary impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredged material disposal.

Accidental releases: The Proposed Action would have a maximum of 855,670 gallons of coolants, 283,860 gallons of oils and lubricants, and 20,409 gallons of diesel stored within WTG foundations or OSSs within the water quality geographic analysis area (COP, Table 3.3-2 and Appendix Q; Dominion Energy 2022). The risk of a spill from any single offshore structure would be low, and any effects would likely be localized. A reduction in the number of WTGs required due to increased capacity would result in a smaller total amount of materials being stored offshore. BOEM has conducted extensive modeling to determine the likelihood and effects of a chemical spill at offshore wind facilities at three locations along the Atlantic Coast, including an area near the proposed Project area (North Carolina Kitty Hawk Call Area, North Carolina; Bejarano et al. 2013). Results of the model indicated a catastrophic, or maximum-case scenario, release of 129,000 gallons (488,318 liters) of oil mixture has a “Very Low” probability of occurring, meaning it could occur one time in 1,000 or more years. In other words, the likelihood of a given spill resulting in a release of the total container volume (such as from a WTG, OSS, or vessel) is low. The modeling effort also revealed the most likely type of spill (i.e., non-routine event) to occur during the life of a project is 90 to 440 gallons (341 to 1,666 liters) at a rate of one time per month, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 10 to 50 years, which would have brief, localized impacts on water quality (Bejarano et al. 2013). The North Carolina Kitty Hawk Call Area is much larger than the CVOW-C Lease Area and would likely contain more WTGs than the 205 under the Proposed Action, which would lead to a decreased likelihood of spill events compared to the Bejarano et al. (2013) model. Overall, the probability of an oil or chemical spill occurring that is large enough to affect water quality is extremely low, and the degree of impact on water quality would depend on the spill volume. The impacts of the Proposed Action alone on water quality from accidental releases would be localized and short term. The risk of spills from offshore structures under Alternative A-1 would be less than under the Proposed Action due to the removal of three WTGs, and, therefore, potential impacts on water quality would be less. However, the difference in potential impacts on water quality from having three fewer WTGs than the Proposed Action’s 205 WTGs is anticipated to be negligible.

Increased vessel traffic in the region associated with the Proposed Action could increase the probability of collisions and allisions, which could possibly result in oil or chemical spills. However, collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Project: USCG requirement for lighting on vessels, NOAA vessel speed restrictions, the proposed spacing of WTGs and OSSs, the lighting and marking plan that would be implemented, and the inclusion of Project components on navigation charts. In the unlikely event an allision or collision involving vessels or components associated with the Proposed Action resulted in a large spill, impacts from the Proposed Action alone on water quality would be short term to long term depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. In addition, Dominion Energy would implement its Oil Spill Response Plan (COP, Appendix Q; Dominion Energy 2022), which would provide for rapid spill response, cleanup, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events. With implementation of the Oil Spill Response Plan, risk of fuel spills and leaks from vessels that could adversely affect water quality would be minimized. The probability of a collision or allision that could result in an oil or chemical spill under Alternative A-1 would be lower than for the Proposed Action because of fewer vessel trips due to three fewer WTGs, and, therefore, potential impacts on water quality would be less. However, the difference in potential impacts on water quality from having three fewer WTGs than the Proposed Action's 205 WTGs is anticipated to be negligible.

Onshore construction activities would require heavy equipment use or HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Dominion Energy would implement a HDD Inadvertent Release Plan with use of non-toxic drilling fluids for review and approval by the appropriate regulatory agencies. Dominion Energy would also develop and implement a Spill Prevention, Control, and Countermeasure Plan to address any ongoing concerns regarding accidental releases to minimize impacts on water quality (which will be provided for agency review and approval, as applicable). In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action alone would result in negligible, temporary, and long-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

Dominion Energy intends to lease a portion of an existing facility to act as the O&M facility. A location for this facility has not yet been finalized, but Dominion Energy is evaluating leasing options in Virginia Port Authority's existing Portsmouth Marine Terminal and Newport News Marine Terminal in the Hampton Roads area of Virginia. The preferred lease location for the O&M facility is Lambert's Point, which is located on a brownfield site in Norfolk, Virginia. This O&M facility will monitor operations and include office, control room, warehouse, shop, and pier space. The O&M plan for both the Project's onshore and offshore infrastructure will be finalized as a component of the Facility Design Report/Fabrication Installation Report review process. Dominion Energy anticipates that they will require a building with an area of up to approximately 0.8 acre (0.3 hectare) to meet the needs of an operation and maintenance facility for an offshore wind farm off the coast of Virginia. In the event that upgrades or a new, build to suit, facility is needed, construction would be undertaken by the lessor and would be separately reviewed and authorized by the USACE and local authorities, as needed. Due to the already developed/disturbed nature of the locations under consideration, BOEM anticipates negligible impacts on water quality if any of the facilities are used for the O&M facility.

Anchoring: There would be increased vessel anchoring during the construction, installation, O&M, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels. Impacts on water quality from the Proposed Action alone due to anchoring would be localized, temporary, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts. During construction Dominion Energy anticipates an average of 46 vessel trips during a typical workday. The number of vessels is anticipated to result in 42 acres (17 hectares) of impact from anchoring, which would be additive with the impact(s) of any and all other anchoring activities, including offshore wind activities that occur within the water quality geographic analysis area during the same timeframe. The amount of anchoring that would occur under Alternative A-1 would be less than under the Proposed Action because of fewer vessel trips due to three fewer WTGs. Therefore, potential impacts on water quality from anchoring would be less when compared to the Proposed Action. However, the difference in potential impacts on water quality from having three fewer WTGs than the Proposed Action's 205 WTGs is anticipated to be negligible.

New cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sandwave clearance, boulder removal) and cable installation via jet plow, jet trenching, chain cutting, trench former, hydroplow (simultaneous lay and burial), mechanical plow (simultaneous lay and burial), pre-trenching (both simultaneous and separate lay and burial), mechanical trenching (simultaneous lay and burial), and other available technologies, which can cause temporary increases in turbidity and sediment resuspension. Other projects using similar installation methods have been characterized as having minor impacts on water quality due to the temporary and localized nature of the disturbance (Latham et al. 2017). To evaluate the impacts of offshore export cable and inter-array cable installation, Dominion Energy developed an analytical sediment transport model to conservatively evaluate potential suspended sediment transport and deposition (see COP Appendix J). The analytical sediment transport model determined that the suspended sediment concentration, deposition depth, and area of influence is dependent upon flood and ebb current velocities, burial depth, and the percentage of fine sediments in the sediment sample. The model also determined that the very fine sediments particles (silt and clay) remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized. During peak flood and ebb tides, the suspended sediment concentrations diminish rapidly away from the release point, and at most stations over 80 percent of the suspended particles deposit within 16 feet (5 meters) of the trench centerline. The typical concentration at 328 feet (100 meters) is about 500 mg/L above background concentration for flood tides and about 50 mg/L above background concentration for ebb tides. Deposition thicknesses were predicted to decrease rapidly away from the trench. Average deposition thicknesses were less than 0.27 inch (0.69 centimeter) within 82 feet (25 meters) of the trench centerline for flood tides and less than 0.09 inch (0.25 centimeter) within 82 feet (25 meters) of the trench centerline for ebb tides. Deposition thicknesses were less than 0.004 inch (0.01 centimeter) at all stations within 1,640 feet (500 meters) of the trench centerline. Results from the model were also consistent with other sediment transport models completed for wind farm installation projects in the mid-Atlantic region. Due to the localized areas of disturbances and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, temporary, and adverse, resulting in little change to ambient water quality. Therefore, given the known hydrodynamic conditions within the area of the Project and the expected BMPs associated with installation methods, no long-term impacts on water quality are anticipated following cable installation activities. Overall, impacts on water quality from the Proposed Action alone due to cable emplacement and resulting suspension of sediment and turbidity would be temporary and minor. The amount of new offshore cable that would be installed under Alternative A-1 would be less than for the Proposed Action because three fewer WTGs would be installed, which would require fewer array cables, and, therefore, potential impacts on water quality would be less. However, the difference in potential impacts on water quality from having slightly fewer array cables than the Proposed Action is anticipated to be negligible.

Port utilization: The current bearing capacity of existing ports was considered suitable for WTGs, requiring no port modifications for supporting offshore wind energy development (DOE 2014). Dominion Energy intends on leasing a portion of an existing facility to act as the O&M facility. A location for this facility has not yet been finalized, but Dominion Energy is evaluating leasing options in Virginia Port Authority's existing Portsmouth Marine Terminal and Newport News Marine Terminal in the Hampton Roads area of Virginia. The preferred lease location for the O&M facility is Lambert's Point, which is located on a brownfield site in Norfolk, Virginia. This O&M facility will monitor operations and include office, control room, warehouse, shop, and pier space. The O&M plan for both the Project's onshore and offshore infrastructure will be finalized as a component of the Facility Design Report/Fabrication Installation Report review process. Dominion Energy anticipates that they will require a building with an area of up to approximately 0.8 acre (0.3 hectare) to meet the needs of an operation and maintenance facility for an offshore wind farm off the coast of Virginia. In the event that upgrades or a new, build to suit, facility is needed, construction would be undertaken by the lessor and would be separately reviewed and authorized by the USACE and local authorities, as needed. The impacts on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in ship traffic at the ports would be small; multiple authorities regulate water quality impacts from these operations (BOEM 2019). Therefore, the impacts of the Proposed Action alone on water quality from port utilization would be negligible. Under Alternative A-1, port use would generally be the same as for the Proposed Action, although there would be slightly less ship traffic at the ports because three fewer WTGs would be constructed, operated, maintained, and decommissioned. Therefore, potential impacts on water quality from port use would be less. However, the difference in potential impacts on water quality at ports related to three fewer WTGs is anticipated to be negligible.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area. Dock facilities and other structures are concentrated along the coastline. The Proposed Action would add up to 205 WTGs, three OSSs, and related Project elements, which would increase seabed disturbance. During operations, scour processes around foundations and submarine export and inter-array cables are a concern due to the potential impacts on water quality through the formation of suspended sediment plumes. The Proposed Action would result in 2.9 acres (1.17 hectares) of permanent seabed impact with scour protection for the three offshore substation foundations, and 196 acres (79 hectares) of permanent seabed impact for WTG foundations and scour protection. Scour around foundations is dependent on water currents, wave action, and water depths, and scour depth can range from 0.3 times the pile diameter to 2.0 times the pile diameter or greater. Water currents are typically the largest indicator of the amount of expected scour (Dominion Energy 2022 citing Tempel et al. 2004). In general, studies have shown the maximum scour depth around most piles is 1.3 times the diameter of the pile (Dominion Energy 2022 citing DNV GL 2016; Whitehouse et al. 2011). The foundations will be located in deeper water depths with lower current speeds (typically 0.7 foot [0.2 meter] per second), and piles located in areas of similar depths and currents have minimal scour (Dominion Energy 2022 citing BOEM 2018; Epsilon 2018; Nielsen et al. 2014; Whitehouse et al. 2011). Several studies have shown that most scour tends to occur within the first month of installation (Dominion Energy 2022 citing Harris et al. 2011; Tempel et al. 2004). However, scouring is a continuous process that can change over a period of years (Dominion Energy 2022 citing Harris et al. 2011; Whitehouse et al. 2011). In addition, large storms with strong currents can temporarily increase the scour rate (Dominion Energy 2022 citing Harris et al. 2011, Whitehouse et al. 2011, Tempel et al. 2004). At some sites, backfilling occurs in the scour hole around the pile when there are changes in current conditions (Dominion Energy 2022 citing Peterson 2014). The magnitude of scour around the edge of scour protection is related to the size of the rock and the depth and tapering of the protection, with smaller rock and shallower protections with more tapering resulting in less edge scour (Dominion Energy 2022 citing Peterson 2014). Edge scour has been shown to be approximately 0.12 times the diameter of the pile (Dominion Energy 2022 citing Whitehouse et al. 2011) and, depending on the scour protection and currents, could be half of that value (Dominion Energy 2022 citing Peterson 2014; Tempel et al. 2004). In some areas, specifically in deep areas and those with small waves, scour is minimal and scour protection can be foregone (Dominion Energy 2022 citing Whitehouse et al. 2011). The relatively low velocities in the Wind Farm Area, combined with scour mitigation, will limit scour potential around foundations (Dominion Energy 2022 citing BOEM 2018). Furthermore, limited scour is anticipated around the cable due to the target cable burial depths. The addition of scour protection would further minimize effects on local sediment transport.

The proposed Project's contribution to impacts on water quality due to the presence of structures would be additive with the impacts of the 9 miles (14.5 kilometers) of Kitty Hawk Wind North's offshore cable that goes through the geographic analysis area, and that would remain for the life of the proposed Project.

These disturbances would be localized but, depending on the hydrologic conditions, have the potential to affect water quality through altering mixing patterns and the formation of sediment plumes for as long as the structures remain in operation. Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). Results from a recent BOEM (2021) hydrodynamic model found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification), via their influence on currents from WTG foundations and by extracting energy from the wind. The results of the hydrodynamic model study show that introduction of the offshore wind structures into the offshore wind energy area modifies the oceanic responses of current magnitude, temperature, and wave heights by (1) reducing the current magnitude through added flow resistance, (2) influencing the temperature stratification by introducing additional mixing, and (3) reducing current magnitude and wave height by extracting of energy from the wind by the offshore wind turbines. Alterations in currents and mixing would affect water quality parameters such as temperature, DO, and salinity, but would vary seasonally and regionally. The impacts from the Proposed Action alone on water quality due to the presence of structures would be negligible during construction, decommissioning, and operations.

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

Under Alternative A-1 there would be three fewer WTGs compared to the Proposed Action's 205 WTGs. Therefore, potential impacts on water quality related to the presence of offshore structures under Alternative A-1 would be less. However, the difference in potential impacts on water quality from having three fewer WTGs is anticipated to be negligible.

Discharges: During construction of the Proposed Action, vessel traffic would increase in and around the Wind Farm Area, leading to potential discharges of uncontaminated water and treated liquid wastes. In accordance with 30 CFR 585.626(b)(9), Dominion Energy has provided a preliminary list of wastes expected to be generated during Project construction (COP, Table 3.5-1; Dominion Energy 2022). Dominion Energy would only be allowed to discharge uncontaminated water (e.g., uncontaminated ballast water and uncontaminated water used for vessel air conditioning) or treated liquid wastes overboard (e.g., treated deck drainage and sumps). Other waste such as sewage and solid waste or chemicals, solvents, oils, and greases from equipment, vessels, or facilities would be stored and properly disposed of on land or incinerated offshore.

Dominion Energy expects substantially less vessel use during routine O&M than during construction. Vessel use would consist of scheduled inspection and maintenance activities, with corrective maintenance as needed. In a year, the Proposed Action would generate a maximum of 26 crew vessel trips, 26 service operation vessel trips, and 50 helicopter trips (COP, Section 3.5.1; Dominion Energy 2022). The proposed Project would require all vessels to comply with regulatory requirements related to the prevention and control of discharges, accidental spills, and nonindigenous species. All vessels would need to comply with waste and water management regulations described in Section 3.21.3.2, *Cumulative Impacts of the No Action Alternative*, including USCG ballast water management requirements and USCG bilge water regulation. The bilge water from the proposed Project would either be retained onboard vessels in a holding tank and discharged to an onshore reception facility or treated onboard with an oily water separator, after which the treated water could be discharged overboard. In addition, bilge water would not be allowed to be discharged into the sea unless the oil content of the bilge water without dilution is less than 15 parts per million. For vessels operating within 3 nautical miles (5.6 kilometers) from shore, bilge water regulations under USEPA's National Pollutant Discharge Elimination System program apply to any of the proposed Project's vessels that are covered by a Vessel General Permit (those that are 79 feet [24 meters] or greater in length). Bilge discharges within 3 nautical miles (5.6 kilometers) from shore are subject to the rules in Section 2.2.2 of the Vessel General Permit and must occur in compliance with 40 CFR Parts 110, 116, and 117, and 33 CFR Part 151.10. Dominion Energy has also committed to developing and implementing an Oil Spill Response Plan for the Project (COP, Appendix Q; Dominion Energy 2022). With implementation of this measure and these regulatory requirements, the temporary impact of routine vessel discharge is expected to be minor.

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

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

The amount of discharges that would occur under Alternative A-1 would be less than under the Proposed Action because there would be three fewer WTGs and fewer vessel trips compared to the Proposed Action; therefore, potential impacts on water quality would be less. However, the difference in potential impacts on water quality from having three fewer WTGs and fewer related vessel trips is anticipated to be negligible.

Land disturbance: Construction and installation of onshore components (e.g., substations, cable installation) would disturb ground and lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Dominion Energy would develop a Stormwater Pollution Prevention Plan for construction activities that would conform with the VDEQ Construction General Permit, Dominion Energy's approved Annual Standards and Specifications for Erosion and Sediment Control and Stormwater Management for Electric Transmission Line Development, and local pollution prevention and spill response procedures. Construction would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. Dominion Energy would routinely inspect and clean onsite stormwater control features to remove debris or excess vegetation that may impede the designed functionality. The Stormwater Management Plan would describe how the stormwater control facilities would be operated and maintained after construction is complete. The incremental increases in land disturbance from the Proposed Action would be small and mitigation measures, such as the use of an SPCCC Plan, would be implemented. As such, impacts from the Proposed Action alone on water quality from land disturbance would be negligible to minor.

The extent of potential water quality impacts from constructing the onshore cable routes would generally depend on the amount of wetlands and streams within the rights-of-way of affected by the interconnection cable route and associated onshore components. Interconnection Cable Route Option 1 (overhead) and associated onshore components would permanently impact approximately 40.95 acres [16.57 hectares] of wetlands and 2.0 miles [3.2 kilometers] of streams (COP, Table 4.2-2; Dominion Energy 2022; BOEM and Dominion Energy 2022).[1] See Section 3.22, *Wetlands*, for additional information related to potential wetland impacts associated with cable routes.

Land disturbance under Alternative A-1 would be the same as for the Proposed Action because the removal of three WTGs under Alternative A-1 would not affect the onshore components of the Project.

3.21.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, and other planned offshore wind activities. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined accidental release impacts on water quality from ongoing and planned activities would likely be short term and minor due to the low risk and localized nature of the most likely spills, and the use of an Oil Spill Response Plan for projects. These impacts would occur primarily during construction but also during operation and decommissioning, to a lesser degree. In the unlikely event that an allision or collision involving Project vessels or components resulted in an oil or chemical spill, it would be expected that a small spill would have negligible temporary impacts, while a larger spill would have potentially increased temporary impacts. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including the Proposed Action or Alternative A-1, to contribute to impacts on water quality resulting from oil and chemical spills.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined anchoring impacts on water quality from ongoing and planned activities are anticipated to be localized, temporary, and minor, primarily during construction and decommissioning. In context of reasonably foreseeable environmental trends, during operations, the contribution of the Proposed Action or Alternative A-1 to the combined anchoring impacts on water quality from ongoing and planned activities would likely be localized, temporary, and negligible.

The contribution from the Proposed Action or Alternative A-1 to increased sediment concentration and turbidity would be additive with the impact(s) of any and all other cable installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended. These activities in the context of reasonably foreseeable environmental trends, including the Proposed Action or Alternative A-1, would likely be temporary and minor to moderate. There could be limited overlap in construction schedules for cable installation for the proposed Project and the 9 miles (14.5 kilometers) of Kitty Hawk Wind North's offshore export cable that travels through the geographic analysis area. These impacts would not occur during operation.

In context of reasonably foreseeable environmental trends and due to the need for minimal port modifications or expansions and the small increase in ship traffic, the contribution of the Proposed Action or Alternative A-1 to the combined port use impact on water quality from ongoing and planned activities would likely be localized, short term, and negligible.

[1] Note that even though Hybrid Interconnection Cable Route Option 6 has the least area of wetland and distance of stream in the study area corridor, Interconnection Cable Route Option 1 is still anticipated to have the least amount of wetland and stream impact because it is an overhead cable route. COP Section 4.2.1.2 (Dominion Energy 2022) states that proposed overhead construction areas will not temporarily or permanently impact wetlands. Hybrid Interconnection Cable Route Option 6 would require trenching within wetland areas for underground segments. The actual proposed impacts will be further refined for the preferred route as a part of the USACE Joint Permit Application. See Section 3.2.2, *Wetlands*, for additional information.

In context of reasonably foreseeable environmental trends, the contributions of the Proposed Action to the combined structure placement impacts on water quality from ongoing and planned activities would likely be constant over the lifespans of the ongoing and planned activities.

Impacts on water quality from the Proposed Action or Alternative A-1 due to discharges would be additive with the impact(s) of any and all discharges, including those of offshore wind activities, that occur within the water quality geographic analysis area during the same timeframe. Vessel traffic (e.g., fisheries use, recreational use, shipping activities, military uses) in the region would overlap with vessel routes, and port cities expected to be used for the Proposed Action or Alternative A-1 and vessel traffic would increase under the Proposed Action or Alternative A-1. Discharge events would mostly be staggered over time and localized, and all vessels would be required to comply with regulatory requirements related to prevention and control of discharges, accidental spills, and nonindigenous species administered by USEPA, USACE, USCG, and BSEE. Therefore, in context of reasonably foreseeable environmental trends, BOEM expects that the contribution of the Proposed Action or Alternative A-1 to the combined discharge impacts on water quality from ongoing and planned activities would likely be short term and localized, primarily during construction and to a lesser extent during decommissioning and operations.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action of Alternative A-1 to the combined land disturbance impacts on water quality from ongoing and planned activities would be localized, short term, and minor due to the low likelihood that construction on onshore components would overland in time or space, and the minimal amount of expected erosion into nearby waterbodies.

3.21.5.2 Conclusions

Impacts of the Proposed Action. BOEM anticipates the impacts on water quality resulting from the Proposed Action or Alternative A-1 would range from **negligible** to **moderate**. Impacts from routine activities—including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; discharges from the WTGs or OSSs during operation; sediment plumes due to scour; and erosion and sedimentation from onshore construction—would be **negligible** to **minor**. Impacts from non-routine activities, such as accidental releases, would be **minor** from small spills, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with the Proposed Action or Alternative A-1 are likely to be temporary or small in proportion to the size of the Atlantic Ocean.

While the significance level of impacts would remain the same, BOEM could further reduce impacts with the following mitigation measure conditioned as part of the COP approval (Appendix H, *Mitigation and Monitoring*): BMPs to minimize sediment suspension during pile driving, cable installation, scour protection installation, and offshore facility removal.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would likely range from **negligible** to **moderate**. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action or Alternative A-1 to these impacts from ongoing and planned activities would be **minor**. The main drivers for this impact rating are the short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures. BOEM has considered the possibility of a **moderate** impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures. Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts from the Proposed Action or Alternative A-1 but would not change the impact ratings. The impact on water quality would be small, and the resource would recover completely after decommissioning.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the combined land disturbance impacts on water quality from ongoing and planned activities would likely be localized, short term, and **minor** due to the low likelihood that construction on onshore components would overlap in time or space, and the minimal amount of expected erosion into nearby waterbodies.

3.21.6 Impacts of Alternatives B and C on Water Quality

Impacts of Alternatives B and C. The impacts resulting from individual IPFs under Alternatives B and C would be slightly less than those described under the Proposed Action due to the removal of WTGs and associated connecting inter-array cables in the Offshore Project area. Under Alternative B, 29 WTGs (for total of up to 176 WTGs) and associated connecting inter-array cables would be removed. Under Alternative C, 33 WTGs (for a total of up to 172 WTGs) and associated connecting inter-array cables would be removed. All other Offshore and Onshore Project components would stay the same. The only IPF that would not be affected under Alternatives B and C compared to the Proposed Action is *land disturbance*. While the decreased number of WTGs under Alternatives B and C may slightly decrease localized water quality impacts during construction and operations, the difference in impacts compared to the Proposed Action would not be notable. Impacts on water quality from cable emplacement would still result in short-term and localized sediment suspension, and mitigation measures, such as the use of a Spill Prevention, Control and Countermeasures Plan and Stormwater Pollution Prevention Plan, would be implemented. In addition, all vessels would need to comply with the regulatory requirements described in Section 3.21.5, *Impacts of the Proposed Action on Water Quality,* to avoid and minimize impacts on water quality. Therefore, while there is a decreased potential for impacts on water quality from reduced WTGs and inter-array cables, BOEM does not anticipate the impacts from Alternatives B and C to be materially different than those described under the Proposed Action.

Cumulative Impacts of Alternatives B and C. The contribution of Alternative B or C to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would be similar to the Proposed Action.

3.21.6.1 Conclusions

Impacts of Alternatives B and C. BOEM anticipates the impacts on water quality resulting from Alternatives B and C to be similar to the Proposed Action and range from **negligible** to **moderate**. Impacts from routine activities—including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; discharges from the WTGs or OSSs during operation; sediment plumes due to scour; and erosion and sedimentation from onshore construction—would be **negligible** to **minor**. Impacts from non-routine activities, such as accidental releases, would be **minor** from small spills, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with Alternative B or C are likely to be temporary or small in proportion to the size of the Atlantic Ocean.

While the significance level of impacts would remain the same, BOEM could further reduce impacts with the following mitigation measure conditioned as part of the COP approval (Appendix H): best management practices to minimize sediment suspension during pile driving, cable installation, scour protection installation, and offshore facility removal.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternative B or C to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would be similar to the Proposed Action and would likely range from **negligible** to **moderate**.

3.21.7 Impacts of Alternative D on Water Quality

Impacts of Alternative D. The impacts resulting from individual IPFs under Alternative D would similar to those described under the Proposed Action. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). Because Alternative D is specific to the Onshore Project component, the only IPF that would be affected under Alternative D compared to the Proposed Action is land disturbance. Interconnection Cable Route Option 1 (Alternative D-1) is the same as the Proposed Action and therefore, potential impacts to water quality from the construction and operation of onshore components of the Project would be the same. Hybrid Interconnection Cable Route Option 6 (Alternative D-2) would permanently impact approximately 53.84 acres (21.79 hectares) of wetlands and 1.94 miles (3.12 kilometers) of streams, which is approximately 12.89 (5.22 hectares) more than Interconnection Cable Route Option 1 (Alternative D-1). Additionally, Hybrid Interconnection Cable Route Option 6 would include underground installation (trenching), which could have a greater temporary impact on wetlands, and therefore water quality, compared to the completely overhead cable under Interconnection Cable Route Option 1 (see Section 3.2.2, *Wetlands*, for details).

Cumulative Impacts of Alternative D. The cumulative impacts on water quality will not be materially difference than those described under the Proposed Action. In the context of reasonably foreseeable environmental trends, the impacts contributed by Alternative D to the cumulative water quality impacts would be similar to those described under the Proposed Action.

3.21.7.1 Conclusions

Impacts of Alternative D. BOEM anticipates the impacts on water quality resulting from Alternative D to be similar to the Proposed Action and range from **negligible** to **moderate**. The water quality impacts from the onshore component from cable installation would have the same **negligible** to **minor** impacts on water quality under Alternative D compared to the Proposed Action. Impacts from routine activities—including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; discharges from the WTGs or OSSs during operation; and sediment plumes due to scour—would be the same as the Proposed Action: **negligible** to **minor**. Impacts from non-routine activities, such as accidental releases, would be **minor** from small spills, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with Alternative D alone are likely to be temporary or small in proportion to the size of the Atlantic Ocean.

In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would be similar to the Proposed Action and likely would range from **negligible** to **moderate**.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action. While there could be slightly less potential for impacts on water quality compared to the Proposed Action, regulatory requirements to avoid and minimize impacts on water quality would still be implemented, and Dominion Energy's proposed mitigation measures to avoid and minimize impacts on water quality under the Proposed Action would still apply under Alternative D.

3.22. Wetlands

This section discusses potential impacts on wetlands from the proposed Project, alternatives, and ongoing and planned activities in the wetlands geographic analysis area. The wetlands geographic analysis area, as described in Appendix F, *Planned Activities Scenario,* Table F-1, and shown on Figure 3.22-1, includes all subwatersheds that intersect the Onshore Project area, which encompasses all wetlands and surface waters that are most likely to experience impacts from the proposed Project. See Section 3.21, *Water Quality*, for a discussion of impacts on water quality.

3.22.1 Description of the Affected Environment for Wetlands

The Project is located in the following watershed areas: Rudee Inlet-Atlantic Ocean (Hydrologic Unit Code [HUC] 020403040501), Asheville Bridge Creek (HUC 030102051301), West Neck Creek (HUC 030102051203), 030102051202—Upper North Landing River, 030102051201—Chesapeake Canal, and 030102051204—Pocaty Creek. Sixty wetlands totaling approximately 78,480 acres (31,759 hectares) were identified in the geographic analysis area based on review of available GIS mapping data, evidence collected during field surveys, and best professional judgment (USFWS 2021; COP Appendix U; Dominion Energy 2022). Notable natural habitats and rare natural communities as defined by the Virginia Department of Conservation and Recreation (VDCR 2022) are located within or adjacent to the Onshore Project components. These include areas of the North Landing River, Pocaty River, and West Neck Creek. Refer to Appendix I for a description of these natural areas. Table 3.22-1 displays the wetland communities within the geographic analysis area based on National Wetland Inventory (NWI) data.

Dominion Energy performed aquatic resources surveys for the onshore components of the Project and submitted an updated Joint Permit Application to the Virginia Marine Resources Commission (VMRC) in August 2022 containing complete wetland delineation survey data for the Onshore Project components and Interconnection Cable Route Option 1. The wetland delineation survey data for Interconnection Cable Route Option 1 is also sufficient for Interconnection Cable Route Option 6 because the route corridors are the same, with the exception of the Switching Station. Therefore, while wetlands within the geographic analysis area are estimated using the NWI, the analysis of alternatives in this DEIS relies on wetland delineation data collected by Dominion Energy for the interconnection cable route options with the exception of the Chicory Switching Station where wetland impacts are estimated based on a recent jurisdictional determination and review of light detection and ranging (LiDAR) data (BOEM and Dominion Energy 2022).

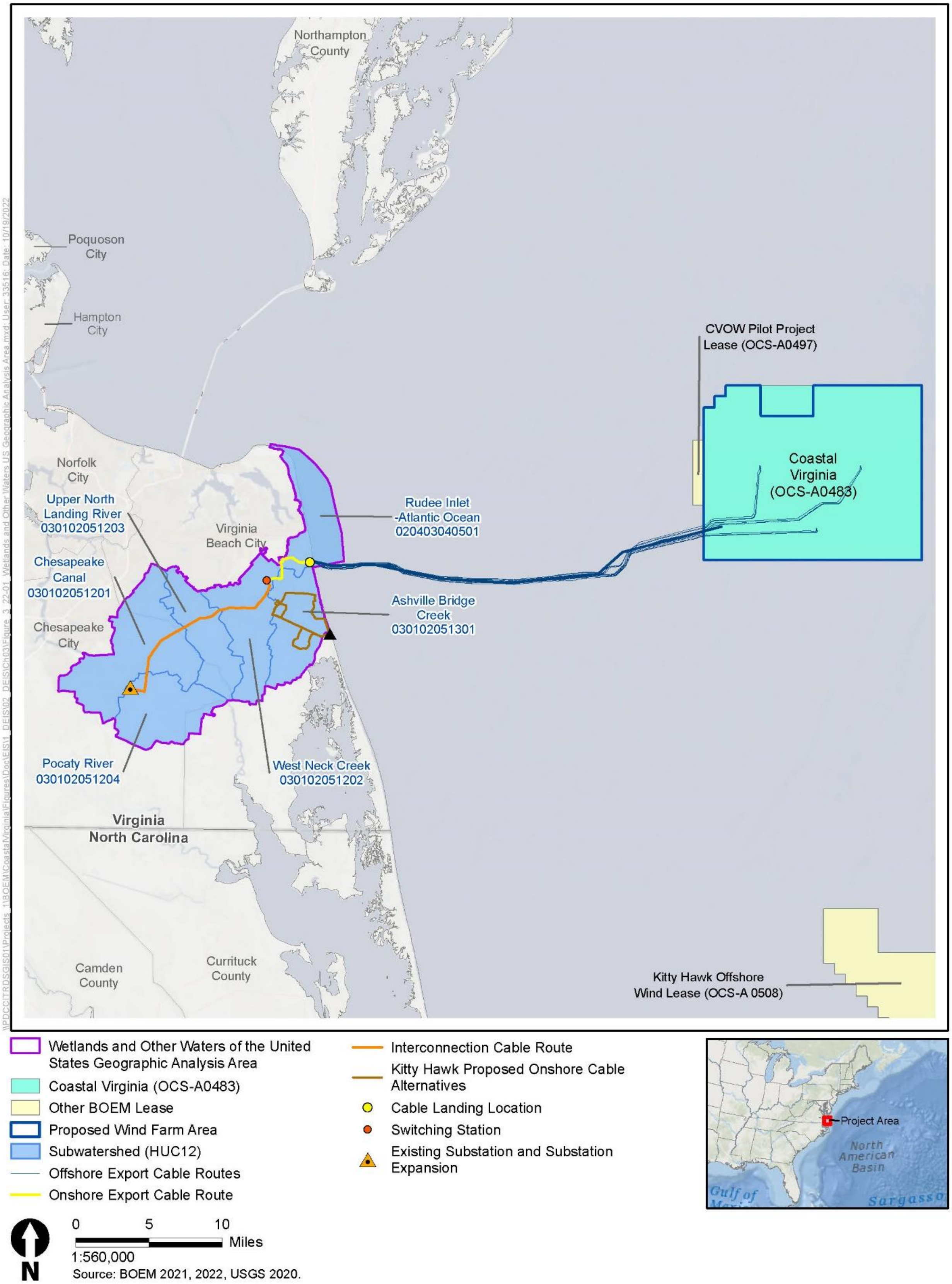

Figure 3.22-1 Wetlands Geographic Analysis Area

Table 3.22-1 Wetland Communities in the Geographic Analysis Area

NWI Feature (Cowardin Classification)	Acres	Percent of Total
Estuarine and Marine Deepwater (E1UBL6)	30,846	39.3%
Estuarine and Marine Wetland (E2EM1)	5,190	6.6%
Freshwater Emergent Wetland (PEM)	1,346	1.7%
Freshwater Forested/Shrub Wetland (PFO/PSS)	35,161	44.8%
Freshwater Pond (PUBx)	1,728	2.2%
Lake (L1UBHx)	1,220	1.6%
Other	0	0.0%
Riverine	2,987	3.8%
Total	**78,480**	**100%**

Source: USFWS 2021; Dominion Energy 2022.

3.22.2 Environmental Consequences

3.22.2.1 Impact Level Definitions for Wetlands

As described in Section 3.3, *Definition of Impact Levels*, this EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. USACE defines wetland impacts differently than BOEM due to requirements under CWA Section 404. The definitions of impact levels are provided in Table 3.22-2. There are no beneficial impacts on wetlands.

Table 3.22-2 Impact Level Definitions for Wetlands

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on wetlands would be so small as to be unmeasurable and impacts would not result in a detectable change in wetland quality and function.
Minor	Adverse	Impacts on wetlands would be minimized and would be relatively small and localized. If impacts occur, wetlands would completely recover.
Moderate	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be unavoidable. Compensatory mitigation required to offset impacts on wetland functions and values and would have a high probability of success.
Major	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be regionally detectable. Extensive compensatory mitigation required to offset impacts on wetland functions and values would have a marginal or unknown probability of success.

USACE defines temporary impacts as those that occur when fill or cut impacts occur in wetlands that are restored to preconstruction contours when construction activities are complete (e.g., stockpile, temporary access). Conversion of a wetland type or permanent placement of fill within wetlands is considered a permanent impact. USACE regulates waters of the U.S. and wetlands under Section 10 of the Rivers and Harbors Act, and Section 404 of the Clean Water Act. VDEQ regulates wetlands under Section 401 of the Clean Water Act. VMRC acts as the clearinghouse for distribution of Joint Permit Applications to the appropriate agencies and regulates impacts and encroachments to activities in, on, under, or over state-owned submerged lands, tidal wetlands, and dunes/beaches (Code of Virginia Title 28.2 § 1200-1420). Where present, jurisdiction for tidal wetlands from edge to mean low water table is considered under the regulatory purview of the Local Wetland Board (LWB). In this instance, VMRC retains an oversight and appellate role for localities that have adopted these coastal resource ordinances. The City of Virginia Beach coastal resource ordinances are regulated by the LWB. The City of Chesapeake has no LWB and, thus, coastal resource ordinances are under the regulatory purview of VRMC (COP, Section 4.2.1, Dominion Energy 2022).

The City of Virginia Beach LWB is responsible for reviewing requests for permits for the use, alteration, or development of tidal wetlands, coastal primary sand dunes, and beaches (Virginia Beach Code of Ordinances, Appendix A, Article 14). LWB's jurisdiction for non-vegetated wetlands lies between mean low water and mean high water; for vegetated wetlands, it lies from mean low water to an elevation 1.5 times the mean tidal range. The mean tidal range is from approximately 2 feet (0.6 meter) for rivers and bay areas to 3.5 feet (1.1 meters) for ocean areas. Upland of this elevation, LWB does not have jurisdiction.

In accordance with the Virginia Beach Southern Rivers Watershed Management Ordinance (Virginia Beach Code of Ordinances, Appendix G, Ord. No. 2115), land disturbance activities within 50 feet (15.2 meters) of any jurisdictional wetland or shoreline, except where wetlands or shorelines have been established in connection with structural best management practice facilities, are prohibited except by application (permit, exception, or exemption) through the City of Virginia Beach.

All earth disturbances from construction activities would be conducted in compliance with the Virginia Discharge Elimination System General Permit for stormwater discharges associated with construction activities and the approved Stormwater Pollution Prevention Plan for the Project. Any work in wetlands would require a Joint Permit Application for corresponding permits through the USACE, VMRC, VDEQ, and the LWB, and a Section 401 Water Quality Certification from VDEQ; any wetlands permanently lost would require compensatory mitigation.

3.22.3 Impacts of the No Action Alternative on Wetlands

When analyzing the impacts of the No Action Alternative on wetlands, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind activities and ongoing offshore wind activities, for wetlands. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.22.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for wetlands described in Section 3.22.1, *Description of the Affected Environment for Wetlands*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that may contribute to impacts on wetlands are generally associated with onshore development activities and climate change (see Appendix F, Section F.2 for a description of ongoing and planned activities). Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect wetlands through activities that can have permanent (e.g., fill placement) and short-term (e.g., vegetation removal) impacts on wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss. Climate change–induced sea level rise in the geographic analysis area is also anticipated to continue to affect wetlands. Inundation and rising water levels would result in the conversion of vegetated areas into areas of open water, with a consequent loss of wetland functions associated with the loss of vegetated wetlands. Wetlands have very specific water elevation tolerances; if water is not deep enough, it is no longer a wetland. Slowly rising waters on a gentle, continuously rising surface can result in wetlands migrating landward. In areas where slopes are not gradual or where there are other features blocking flow (e.g., bulkhead or surrounding developed landscape), wetland migration would be slowed or impeded. Rising coastal waters would also continue to cause saltwater intrusion, which occurs when saltwater starts to move farther inland and creeps into freshwater/non-tidal areas. Saltwater intrusion would continue to change wetland plant communities and habitat (i.e., freshwater species to saltwater species) and overall wetland functions. See Appendix F, Table F1-23 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for wetlands.

Other planned non-offshore wind activities that may affect wetlands would primarily include increasing onshore construction (Appendix F, Table F-9). These activities may permanently (e.g., fill placement) and temporarily (e.g., vegetation removal) affect wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss.

There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on wetlands.

3.22.3.2 Cumulative Impacts of the No Action Alternative

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

Impacts on wetlands from future offshore wind projects may occur if onshore activity from these projects overlaps with the geographic analysis area. Based on review of the Kitty Hawk Wind North and South projects (Lease Area OCS A-0508) COP (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022), proposed landfall and onshore components (e.g., onshore cable routes) would intersect the geographic analysis area in Virginia (Figure 3.22-1). Specifically, onshore components (onshore export cables and substation) for the Kitty Hawk Wind North project would occur within two watersheds of the CVOW-C Project geographic analysis area for wetlands: the Asheville Bridge Creek (HUC 030102051301) and West Neck Creek (HUC 030102051203) watersheds. However, the construction corridors for onshore components of the CVOW-C Project and those associated with the Kitty Hawk North and South projects are not anticipated to overlap.

While a wetland delineation has not yet been completed for the Kitty Hawk Wind North and South projects, approximately 294 acres (119 hectares) of wetlands are mapped by NWI data within the limits of the Kitty Hawk North and South onshore project component study area (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022). The majority of these wetlands occur in the Asheville Bridge Creek watershed and within wetlands geographic analysis area for the CVOW-C Project; however, potential impacts on wetlands are not anticipated to overlap between the CVOW-C and Kitty Hawk Wind projects. The impacts of other offshore wind activities on wetlands would be of the same type and in the same geographic area as those of the Proposed Action, including impacts related to land disturbance. There would also be several years of construction overlap with the Proposed Action and the Kitty Hawk Wind North project (Appendix F, Table F-3). These activities may permanently (e.g., fill placement) and temporarily (e.g., vegetation removal) affect wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss.

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

Land disturbance: Construction of onshore components (e.g., export cables, substation) for Kitty Hawk Wind North in Virginia is anticipated to require clearing, excavating, trenching, fill, and grading, which could result in the loss or alteration of wetlands in the geographic analysis area. Although BOEM expects future offshore wind projects would be designed to avoid wetlands to the extent feasible, in areas where wetlands cannot be avoided, loss of wetland habitat could occur if permanent placement of fill is required in wetlands. Temporary wetland impacts may occur from construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands. The extent of wetland impacts would depend on specific construction activities and their proximity to wetlands. These impacts would occur primarily during construction and decommissioning; impacts during O&M would only occur if new ground disturbance was required, such as to repair a buried component. All projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. This would include compliance with the Virginia Pollutant Discharge Elimination System General Permit for Stormwater Discharges associated with Construction Activities and implementation of sediment controls and a Stormwater Pollution Prevention Plan to avoid and minimize water quality impacts during onshore construction. Any in-wetland work in wetlands would require a Joint Permit Application and a Section 401 Water Quality Certification from the VDEQ. If impacts would not be avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands.

Refer to Section 3.21, *Water Quality*, for a discussion of accidental releases (activities that could expose wetlands to contaminants such as fuel, solid waste, chemicals, solvents, oils, drilling mud, or grease from equipment).

3.22.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, wetlands would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on wetlands. These effects are primarily driven by onshore construction impacts. There, the No Action Alternative would result in **moderate** impacts on wetlands.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and wetlands would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on wetlands due to habitat loss from increased onshore construction.

Kitty Hawk Wind North and South and their impacts would go forward as cumulative projects under the cumulative impacts of the No Action Alternative, and land disturbance from onshore construction activities could cause temporary and permanent loss of wetlands in portions of approximately 294 acres (119 hectares) of wetlands within the onshore project component study area for Kitty Hawk Wind North and Kitty Hawk Wind South. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands. Ongoing activities, especially land disturbance, would likely result in **moderate** impacts on wetlands. Planned activities other than offshore wind may also contribute to impacts on wetlands. Planned activities other than offshore wind primarily include increasing onshore construction; BOEM anticipates that the impacts of planned activities other than offshore wind would be **moderate** given that an activity could result in permanent wetland impacts that require compensatory mitigation. BOEM expects the combination of ongoing activities and planned activities other than offshore wind to result in **moderate** impacts on wetlands, primarily driven by land disturbance.

Other offshore wind activities could cause impacts that would be similar to the impacts of the proposed Project. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands, thereby avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated for projects that would allow wetlands to recover to the extent possible.

Under the No Action Alternative, existing environmental trends and activities would continue, and wetlands would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on wetlands. Considering the IPFs and regulatory requirements for avoiding, minimizing, and mitigating impacts on wetlands, BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts, primarily through land disturbance. Other offshore wind activities are expected to contribute to the impacts through land disturbance, although the majority of this IPF would be attributable to ongoing activities.

3.22.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below.

Dominion Energy has committed to measures to minimize impacts on wetland resources, including the collocation of Onshore Project components in existing rights-of-way, existing roads, previously disturbed areas, and otherwise urbanized locations to the extent practicable. Dominion Energy would also use a combination of HDD and overhead routing to the best extent practicable and restrict access during construction to avoid alteration of soil properties from compaction. Additional avoidance, minimization, and mitigation measures for wetlands are provided in Appendix H, *Mitigation and Monitoring*.

3.22.5 Impacts of the Proposed Action on Wetlands

The Proposed Action could affect wetlands through the following primary IPF. Refer to Section 3.21, *Water Quality*, for a discussion of accidental releases (activities that could expose wetlands to contaminants such as fuel, solid waste, chemicals, solvents, oils, drilling mud, or grease from equipment).

Land disturbance: The Onshore Project area includes the cable landing location, onshore export cable route corridor, the proposed Harpers Switching Station, interconnection cable route corridor, and Fentress Substation. The route for the approximately 4.4-mile (7.1-kilometer) underground 230 kV onshore export cable circuits between the cable landing location on the State Military Reservation (SMR) and the proposed Harpers Switching Station located north of Harpers Road was developed in close coordination with SMR and NAS Oceana in order to avoid conflicts with the operation and future development of these military installations, as well as avoid and minimize impacts on wetlands. This was achieved by avoiding impacts on Lake Christine and Owls Creek by utilizing HDD installation methodology. In addition, wetland impacts on NAS Oceana property were minimized by siting the proposed Harpers Road Switching Station within the boundaries of the existing Aeropines Golf Club. Interconnection Cable Route Option 1 would be constructed to provide transmission from the common location north of Harpers Road to the onshore substation. Interconnection Cable Route Option 1 would be entirely overhead and use existing corridors to the greatest extent possible. The Onshore Project area for the Proposed Action and NWI-mapped wetlands in the geographic analysis area are shown on Figure 3.22-2.

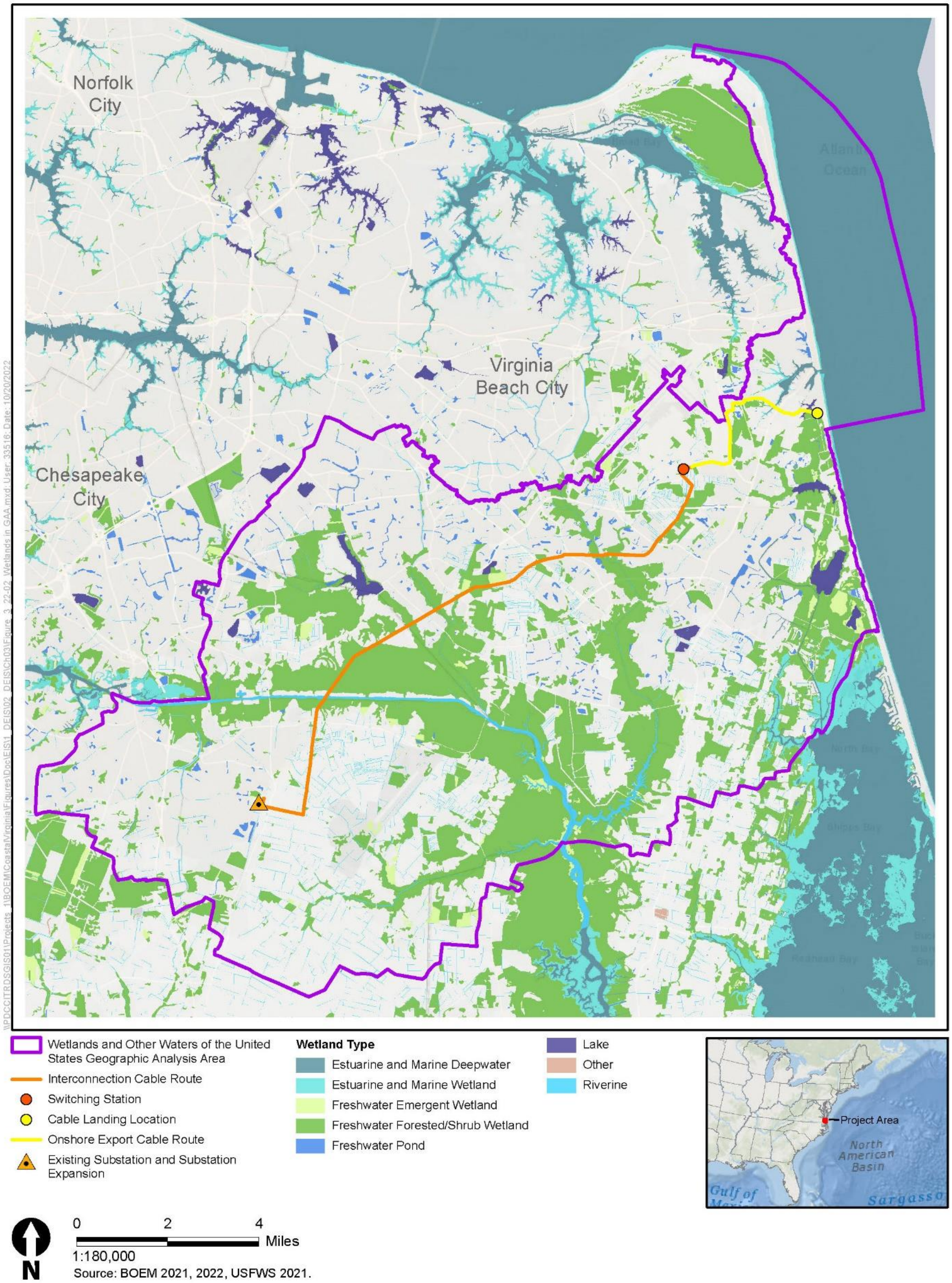

Figure 3.22-2 Proposed Action Onshore Project Area and NWI Wetlands in the Geographic Analysis Area

Construction of the Onshore Project components would result in permanent wetland impacts consisting of concrete manholes, overhead structure foundations, permanent fill from the substation expansion, and associated stormwater management facilities. Conversion impacts would consist of new ROW for the onshore export cable route corridor and various areas of new ROW and ROW expansion for Interconnection Cable Route Option 1. Temporary impacts would consist of open trench installation of underground cables and access and construction matting.

Within wetlands, the primary impacts would be excavation, rutting, compaction, mixing of topsoil and subsoil, and the potential alteration of habitat due to clearing at HDD entry pit locations. Loss of wetland habitat could occur if permanent placement of fill is required in wetlands and through installation of permanent structures within wetlands, wetland transition areas, riparian areas, and protected watersheds. The onshore substation and switching station would include associated construction practices as defined by the final design and is assumed to include permanent construction practices such as reinforced concrete foundations, permeable gravel lots, and associated security fencing (COP, Section 4.2.1.3; Dominion Energy 2022). Construction activities would also have the potential to result in conversion of palustrine forested wetlands to palustrine emergent wetlands and conversion of palustrine shrub-shrub wetlands to palustrine emergent wetlands, resulting in permanent impacts.

The Project would require the permitting of an underground crossing of Owl's Creek and aerial crossings over West Neck Creek, North Landing River, an unnamed tributary of the North Landing River, and the Chesapeake and Albemarle Canal (Intracoastal Waterway). These crossings will require authorization from VMRC and the USACE under Section 10 of the Rivers and Harbors Act of 1899. Royalties for the VMRC jurisdictional crossings are expected to be based on the crossing lengths identified in Dominion Energy's Joint Permit Application. Impacts on higher quality forest corridors in the vicinity of the North Landing River crossing were minimized in coordination with The Nature Conservancy by using existing corridors and selectively identifying the areas needed for expansion of the ROW where expansion is needed. Permanent fill impacts on wetlands associated with the overheard transmission infrastructure would be limited to the foundations of the new transmission structures. Except for the foundations, there would be no new permanent structures proposed, including no new permanent access roads. Access roads for construction are limited to existing ROW, state roads, private roads, existing maintenance paths, and temporary access features.

Table 3.22-3 quantifies the estimated temporary and permanent wetland impacts under the Proposed Action based on wetland delineation survey data. Permanent impacts estimated in Table 3.22-3 for overhead construction under Interconnection Cable Route Option 1 include both permanent loss and permanent conversion (i.e., palustrine forested/scrub-shrub to palustrine emergent). The onshore export cable route would result in 0.16 acre (0.06 hectare) of temporary impacts and 4.02 acres (1.63 hectares) of permanent wetland impacts. Interconnection Cable Route Option 1 would not result in temporary wetland impacts but would convert 27.37 acres (11.08 hectares) of wetlands, resulting in permanent impacts. The Harpers Switching Station and onshore substation would not result in temporary wetland impacts but would permanently impact 1.06 acres (0.43 hectares) and 8.50 acres (3.44 hectares) of wetlands, respectively. In total, the Proposed Action would result in 1.23 acres (0.50 hectare) of temporary wetland impacts, and 40.95 acres (16.57 hectares) of permanent wetland impacts (Table 3.22-3). Wetland impacts are further defined as part of Dominion's USACE Joint Permit Application (COP, Section 4.2.1.2; Dominion Energy 2022).

The placement of permanent features within wetlands, protected watershed buffer areas, and flood hazard areas would be avoided to the maximum extent practicable, and where appropriate, regulatory requirements as stipulated by regional and local permitting authorities would be followed. This compliance would include adherence to stormwater, erosion, and sediment control requirements (COP, Section 4.2.1.3; Dominion Energy 2022). Onshore Project components would be collocated in existing

ROW, existing roads, previously disturbed areas, and otherwise urbanized locations to the maximum extent practicable. To reduce land disturbance and to minimize impacts, Dominion Energy would utilize timber mats to cross wetlands and streams. All mats would be removed upon completion, and site restoration would consist of restoring the area to preconstruction contours and re-seeding with approved seed mixes. Compensation for the proposed wetland impacts would be required as part of the Project. Compensation for impacts on wetlands is determined by multiplying the amount of impact in acres by the mitigation compensation ratio designated for each Cowardin classification and impact type. Dominion Energy is proposing fulfilment of compensation requirements through the purchase of wetland mitigation credits from an approved mitigation bank(s) and in lieu fee in areas where credits are not available. The mitigation plan would be further refined as a component of the USACE permitting package (COP, Section 4.2.1.3; Dominion Energy 2022). A complete listing of measures proposed by Dominion Energy to avoid, minimize, and mitigate impacts on wetlands is provided in COP Section 4.2.1.4, Table 4.2-5 (Dominion Energy 2022).

BOEM would not expect normal O&M activities to involve further wetland alteration. The Onshore Project components generally have no maintenance needs unless a fault or failure occurs; therefore, O&M is not expected to affect wetlands. In the event of a fault or failure, impacts would be expected to be short term and negligible. All activities would utilize existing access roads and entry points, approved via agency review. Decommissioning of the Onshore Project components would have similar impacts as construction.

Land disturbance under Alternative A-1 would be the same as the Proposed Action because the relocation of three offshore substations and the removal of three WTGs under Alternative A-1 would not affect the onshore components of the Project. Therefore, potential impacts on wetlands under Alternative A-1 would be the same as under the Proposed Action.

Table 3.22-3 Wetland Impacts in Onshore Project Area – Proposed Action

Onshore Project Component	Wetland Classification [1]	Acres Within Onshore Project Area	Temporary Impact (acres)	Permanent Impact (acres)	Percent Permanent Impacts Relative to Wetlands in Geographic Analysis Area
Offshore Export Cable Route Landing Location					
Proposed Parking Lot, West of the Firing Range at State Military Reservation (SMR), Located East of Regulus Avenue and North of Rifle Range Road	PEM	1.07	1.07	0.00	0.08
	Total:	**1.07**	**1.07**	**0.00**	**0.08**
Switching Station					
Harpers Switching Station (Interconnection Cable Route Option 1)	PEM	0.38	0.00	0.38	0.03
	PSS	0.68	0.00	0.68	<0.01
	Total:	**1.06**	**0.00**	**1.06**	**<0.01**
Onshore Substation					
Fentress Expanded Substation	PEM	1.65	0.00	1.65	0.12
	PFO	6.85	0.00	6.85	0.02
	Total:	**8.50**	**0.00**	**8.50**	**0.02**

Onshore Project Component	Wetland Classification [1]	Acres Within Onshore Project Area	Temporary Impact (acres)	Permanent Impact (acres)	Percent Permanent Impacts Relative to Wetlands in Geographic Analysis Area
Onshore Export Cable Route					
Onshore Export Cable Route Construction ROW	PEM	0.16	0.16	0.00	<0.01
	PFO	4.02	0.00	4.02	0.01
	Total:	**4.18**	**0.16**	**4.02**	**0.01**
Laydown Area (South of Common Location)					
Laydown Area	No Wetland Impacts Within the Laydown Area				
Interconnection Cable Route Option 1					
Overhead Interconnection Cable Route Option 1 Construction ROW	PEM	0.12	0.00	0.12	0.01
	PFO	27.25	0.00	27.25	0.08
	Total:	**27.37**	**0.00**	**27.37**	**0.07**
Grand Total – Proposed Action					
Onshore Project Components	**N/A**	**42.18**	**1.23**	**40.95**	**0.05**

Source: BOEM and Dominion Energy 2022.
[1] Wetland classifications use the following Cowardin classifications: PFO = Palustrine Forested; PSS = Palustrine Scrub-Shrub; PEM = Palustrine Emergent.

3.22.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, and other planned offshore wind activities. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on wetlands through the primary IPF of land disturbance.

In context of reasonably foreseeable environmental trends, the impacts on wetlands under the Proposed Action or Alternative A-1 may add to the impacts of ongoing and future land disturbance. Impacts due to onshore land use changes are expected to include a gradually increasing amount of wetland alteration and loss. The future extent of land disturbance from ongoing activities and future non-offshore wind activities over the next 33 years is not known with as much certainty as the extent of land disturbance that would be caused by the Proposed Action or Alternative A-1 but based on regional trends is anticipated to be similar to or greater than that of the Proposed Action. If a future project were to overlap the geographic analysis area or even be collocated (partly or completely) within the same right-of-way corridor that the Proposed Action or Alternative A-1 would use, then the impacts of that future project on wetlands would be of the same type as those of the Proposed Action or Alternative A-1; the degree of impacts may increase, although the location and timing of future activities would influence this. For example, repeated construction in a single right-of-way corridor would be expected to have less impact on wetlands than construction in an equivalent area of undisturbed wetland. All earth disturbances from construction activities would be conducted in compliance with the Virginia Pollutant Discharge Elimination System General Permit for Stormwater Discharges associated with Construction Activities and the approved Stormwater Pollution Prevention Plan for the Project. Any work in wetlands would require a Joint Permit

Application and associated permits, and a Section 401 Water Quality Certification from VDEQ; any wetlands permanently lost would require compensatory mitigation.

3.22.5.2 Conclusions

Impacts of the Proposed Action. The Proposed Action or Alternative A-1 may affect wetlands through temporary or permanent disturbance from activities within or adjacent to these resources. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), construction of the Proposed Action or Alternative A-1 alone would likely have **moderate** to **major** impacts on wetlands.

Cumulative Impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends, the contribution of the Proposed Action or Alternative A-1 to the impacts of individual IPFs resulting from ongoing and planned activities would be **moderate** to **major**. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action or Alternative A-1 to the impacts on wetlands from ongoing and planned activities would likely be **moderate** to **major**. The Proposed Action or Alternative A-1 would contribute to the overall impact rating primarily through temporary and permanent impacts on wetlands from onshore construction activities in and adjacent to these resources. Measurable impacts would be small, and the resource would likely recover completely when the affecting agent (e.g., temporary construction activity) is gone and remedial or mitigating action is taken.

3.22.6 Impacts of Alternatives B and C on Wetlands

Impacts of Alternatives B and C. The impacts resulting from individual IPFs under Alternatives B and C would be the same as those described under the Proposed Action because the onshore components would stay the same.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be different from those described under the Proposed Action. As described under Section 3.22.5, *Impacts of the Proposed Action on Wetlands*, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts from Alternatives B and C but would not change the impact ratings.

3.22.6.1 Conclusions

Impacts of Alternatives B and C. The expected **moderate** to **major** impacts associated with the Proposed Action alone would not change under Alternatives B and C because the alternatives only differ in offshore components, and offshore components would not contribute to impacts on wetlands; the same construction, O&M, and decommissioning activities would still occur.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action: **moderate** to **major**. Offshore wind projects would contribute to wetland impacts in the geographic analysis area but the overall scale of impacts is expected to be small, and compliance with mitigation measures and regulations would minimize these impacts.

3.22.7 Impacts of Alternative D on Wetlands

Impacts of Alternative D. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same. The Onshore Project area for Alternative D and NWI-mapped wetlands in the geographic analysis area are shown on Figure 3.22-2.

The impacts resulting from *land disturbance* under Alternative D would generally be similar to the Proposed Action; however, Hybrid Interconnection Cable Route Option 6 under sub-alternative D-2 would require more trenching and clearing in wetlands (including forested wetlands) when compared to the Proposed Action. Additionally, Dominion Energy's routing study determined that Alternative D-1 (Interconnection Cable Route Option 1) would result in fewer impacts on wetlands than Hybrid Interconnection Cable Route Option 6 due to the amount of trenching and backfilling Hybrid Interconnection Cable Route Option 6 would require within wetlands (COP, Section 4.2.1.2; Dominion Energy 2022). Trenching required for underground installation of portions the interconnection cable route under Alternative D-2 is anticipated to result in greater permanent fill impacts on wetlands compared to the conversion of forested wetlands to emergent wetlands impacts associated with installation of the overhead interconnection cable route considered under Alternative D-1 (COP, Section 4.2.1.2; Dominion Energy 2022). Table 3.22-4 quantifies the estimated temporary and permanent wetland impacts under Alternative D-2 based on wetland delineation survey data, with the exception of the Chicory Switching Station where wetland impacts were estimated through a combination of a jurisdictional determination of the adjacent property and review of LiDAR data. In total, Alternative D-2 would result in 4.58 acres (1.85 hectares) of temporary wetland impacts and 53.84 acres (21.79 hectares) of permanent wetland impacts. Compared to the Proposed Action and Alternative D-1, temporary and permanent wetland impacts would be increased respectively by 3.35 acres (1.36 hectares) and 12.89 acres (5.22 hectares) under Alternative D-2 (BOEM and Dominion Energy 2022).

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of sub-alternatives D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action. While Alternative D-2 would result in a greater amount (12.89 acres [5.22 hectares]) of wetlands permanently lost when compared to the Proposed Action or Alternative D-2, the same regulatory requirements to avoid and minimize impacts on wetlands would be implemented, and Dominion Energy's proposed mitigation measures to avoid and minimize impacts on wetlands under the Proposed Action would still apply.

Table 3.22-4 Wetland Impacts in Onshore Project Area – Alternative D-2

Onshore Project Component	Wetland Classification [1]	Acres Within Onshore Project Area	Temporary Impact (acres)	Permanent Impact (acres)	Percent Permanent Impacts Relative to Wetlands in Geographic Analysis Area
Offshore Export Cable Route Landing Location					
Proposed Parking Lot, West of the Firing Range at State Military Reservation (SMR), Located East of Regulus Avenue and North of Rifle Range Road	PEM	0.00	1.07	0.00	0.08
	Total:	**1.07**	**1.07**	**0.00**	**0.08**
Switching Station					
Chicory Switching Station	PEM	0.21	0.00	0.21	0.02

Onshore Project Component	Wetland Classification [1]	Acres Within Onshore Project Area	Temporary Impact (acres)	Permanent Impact (acres)	Percent Permanent Impacts Relative to Wetlands in Geographic Analysis Area
(Interconnection Cable Route Option 6)	PFO	20.38	0.00	20.38	0.06
	Total:	**20.59 [2]**	**0.00**	**20.59 [2]**	**0.06**
Onshore Substation					
Fentress Expanded Substation	PEM	1.65	0.00	1.65	0.12
	PFO	6.85	0.00	6.85	0.02
	Total:	**8.50**	**0.00**	**8.50**	**0.02**
Onshore Export Cable Route					
Onshore Export Cable Route Construction ROW	PEM	0.16	0.16	0.00	0.01
	PFO	4.02	0.00	4.02	0.01
	Total:	**4.18**	**0.16**	**4.02**	**0.01**
Laydown Area (South of Common Location)					
Laydown Area	No Wetlands Within the Laydown Area				
Interconnection Cable Route Option 6					
Overhead Interconnection Cable Route Option 6 Construction ROW	PEM	3.98	3.35	0.63	0.05
	PFO	20.10	0.00	20.10	0.06
	Total:	**24.08**	**3.35**	**20.73**	**0.06**
Grand Total – Alternative D2					
Onshore Project Components	**N/A**	**58.42**	**4.58**	**53.84**	**0.07**

Source: BOEM and Dominion Energy 2022.
[1] Wetland classifications use the following Cowardin classifications: PFO = Palustrine Forested; PSS = Palustrine Scrub-Shrub; PEM = Palustrine Emergent.
[2] Wetland impacts for the Chicory Switching Station are estimated based on a recent jurisdictional determination of the adjacent property, in-depth review of LiDAR, and the revised LOD for the Station.

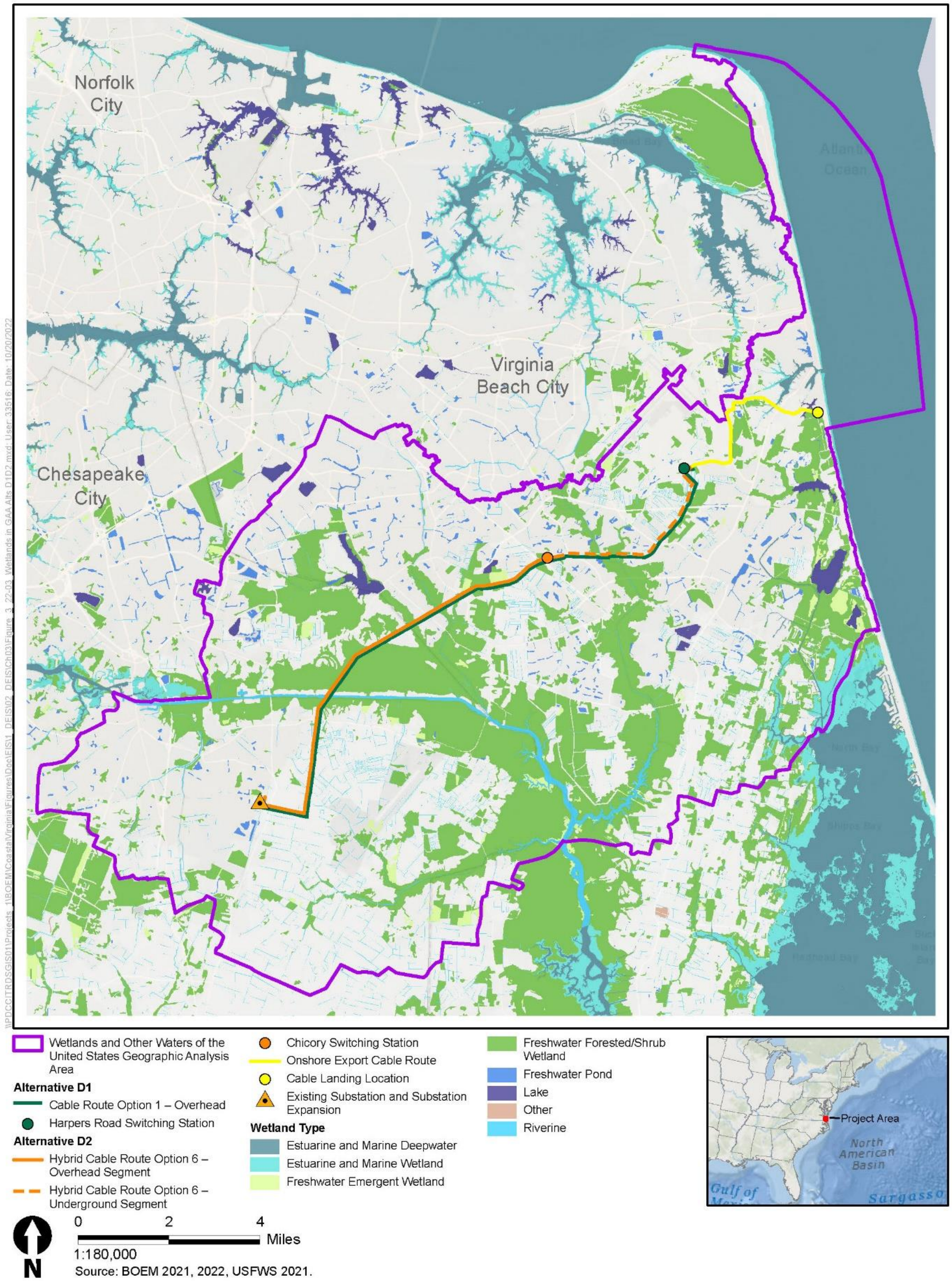

Figure 3.22-3 Alternative D Onshore Project Area and NWI Wetlands in the Geographic Analysis Area

3.22.7.1 Conclusions

Impacts of Alternative D. BOEM anticipates the impacts on wetlands resulting from Alternatives D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be greater than under the Proposed Action due to the amount of trenching and backfilling Hybrid Interconnection Cable Route Option 6 would require within wetlands. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), the wetland impacts from the onshore component from cable installation would have the same, or similar **moderate** to **major** impacts on wetlands under Alternatives D-1 or D-2 compared to the Proposed Action.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the combined impacts from individual IPFs on wetlands resulting from ongoing and planned activities would be similar to the Proposed Action and likely would range from **moderate** to **major**.