Final
Coastal Virginia Offshore Wind Commercial Project Essential Fish Habitat Assessment

For the National Marine Fisheries Service
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U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

Contents

List of Figures

List of Tables

Acronyms and Abbreviations

˚C	degrees Celsius
˚F	degrees Fahrenheit
AC	alternating current
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
bsb	below seabed
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CPT	cone penetration test
CTD	conductivity-temperature-depth
CVOW-C	Coastal Virginia Offshore Wind Commercial Project
dB	decibels
DBBC	double big bubble curtain
DC	direct current
DNODS	Dam Neck Ocean Disposal Site
DOI	U.S. Department of the Interior
DP	dynamic positioning
DSPT	direct steerable pipe thrusting
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	environmental impact statement
EMF	electromagnetic force
FAD	fish aggregating device
FMMP	Fisheries Monitoring and Mitigation Plan
FMP	fishery management plan
GARFO	Greater Atlantic Regional Fisheries Office
GIS	geographic information system
HAPC	habitat area of particular concern
HDD	horizontal directional drill
HRG	high-resolution geophysical
HVAC	high-voltage alternating current
IACC	inter-array cable corridor
IPF	impact-producing factor
JUV	jack-up vessel
kJ	kilojoule
kV	kilovolt
$L_{e,24h}$	sound exposure level over 24 hours
$L_{p,pk}$	peak sound pressure level
MAB	Mid-Atlantic Bight
MAG/TVG	magnetometer/transverse gradiometer

MBES	multibeam echosounder
MCS	multi-channel seismic
MLLW	mean lower low water
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1976
MW	megawatt
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
O&M	operations and maintenance
OCS	Outer Continental Shelf
OECC	offshore export cable corridor
OSS	offshore substation
PDE	project design envelope
PJM	Pennsylvania, New Jersey, Maryland
POI	point of interconnection
ppt	parts per thousand
re	referenced to
ROSA	Responsible Offshore Science Alliance
ROW	right-of-way
SAB	South Atlantic Bight
SAFMC	South Atlantic Fishery Management Council
SBP	sub-bottom profiler
SCADA	supervisory control and data acquisition
Schnabel	Schnabel Engineering LLC
SCS	single-channel seismic
SMR	state military reservation
SSS	side-scan sonar
TOC	total organic carbon
UHRS	ultra-high-resolution seismic
µpa	micropascal
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCG	U.S. Coast Guard
UXO	unexploded ordnance
VMRC	Virginia Marine Resources Commission
WEA	wind energy area
WTG	wind turbine generator

1. Introduction and Project Background

In the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Congress recognized that one of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine, and other aquatic habitats. Congress also determined that habitat considerations should receive increased attention for the conservation and management of fishery resources of the United States. As a result, one of the purposes of the MSA is to promote the protection of essential fish habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat.

The MSA requires federal agencies to consult with the Secretary of Commerce, through the National Marine Fisheries Service (NMFS), with respect to "any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH identified under this Act" (16 United States Code [U.S.C.] 1855(b)(2)). This process is guided by the requirements of the EFH regulation at 50 Code of Federal Regulations (CFR) 600.905. The Bureau of Ocean Energy Management (BOEM) will be the lead federal agency for the consultation and will coordinate with any other federal agencies that may be issuing permits or authorizations for this Project, as necessary, for one consultation that considers the effects of all relevant federal actions, including in offshore and inshore coastal environments (e.g., issuance of permits by the U.S. Army Corps of Engineers [USACE]).

Pursuant to the MSA, each Fishery Management Plan (FMP) must identify and describe EFH for the managed fishery, and the statute defines EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity" 16 U.S.C. 1853(a)(7) and 1802(10). The National Oceanic and Atmospheric Administration's (NOAA's) regulations further define EFH, adding that "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hardbottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

The EFH final rule published in the *Federal Register* on January 17, 2002, defines an adverse effect as: "any impact which reduces the quality and/or quantity of EFH." The rule further states that:

> An adverse effect may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat and other ecosystems components, if such modifications reduce the quality and/or quantity of EFH. The EFH final rule also states that the loss of prey may have an adverse effect on EFH and managed species. As a result, actions that reduce the availability of prey species, either through direct harm or capture, or through adverse impacts on the prey species' habitat may also be considered adverse effects on EFH. Adverse effects on EFH may result from action occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

The Energy Policy Act of 2005, Public Law No. 109-58, added Section 8(p)(1)(C) to the Outer Continental Shelf Lands Act, which grants the Secretary of the Interior the authority to issue leases, easements, or rights-of-way on the Outer Continental Shelf (OCS) for the purpose of renewable energy development (43 U.S.C. 1337(p)(1)(C)). The Secretary delegated this authority to the former Minerals Management Service, now BOEM. On April 22, 2009, BOEM (formerly the Bureau of Ocean Energy Management, Regulation, and Enforcement) promulgated final regulations implementing this authority at 30 CFR 585. Relevant regulations regarding EFH include the MSA.

This EFH assessment has been prepared pursuant to the MSA, as amended by the Sustainable Fisheries Act of 2007 (16 U.S.C. 1801-1884) to evaluate the potential effects of the Coastal Virginia Offshore Wind Commercial Project (CVOW-C) described herein on EFH and EFH species under the jurisdiction of the NMFS.

On December 17, 2020, Dominion Energy submitted a Construction and Operations Plan (COP) to BOEM for the construction, operations, maintenance, and eventual decommissioning of the Project within the Lease Area (the Proposed Action). An updated COP was submitted on June 17, 2021. On July 1, 2021, BOEM published in the *Federal Register* (86 *FR* 35329) a Notice of Intent to prepare an environmental impact statement (EIS) for CVOW-C. A 30-day public comment period ended on August 2, 2021, during which three public, virtual scoping meetings were held. Additional updates to the COP were submitted on October 30, 2021, December 3, 2021, May 6, 2022, and February 28, 2023. The CVOW-C Project COP and appendices can be accessed on BOEM's website at https://www.boem.gov/CVOW-C.

2. Description of the Proposed Action

As detailed in Section 2.1 of the Draft EIS, the Proposed Action would allow Dominion Energy to construct, operate, maintain, and eventually decommission a wind energy facility up to 3,000 megawatts (MW) in scale on the OCS offshore Virginia within the range of design parameters outlined in Section 1 of the COP (Dominion Energy 2023). The Offshore Project components in the Proposed Action include wind turbine generators (WTGs) with their foundations, offshore substations (OSSs) with their foundations, scour protection for foundations, inter-array cables, and offshore export cables (these elements collectively compose the Offshore Project area). The Offshore Project components would be located in the Virginia Wind Energy Area (WEA). The WEA is situated within federal waters in the Lease Area, while the offshore export cable corridor (OECC) would traverse both federal and state territorial waters of Virginia. The offshore trenchless installation punch-out location will be in Virginia state waters. The onshore components of the Project, including the onshore substation, interconnection cables, switching station, onshore export cables, and the cable landing location, would be located in Virginia Beach, Virginia. The construction stage of the Project would include a temporary construction laydown area(s) and construction port(s). The operations and maintenance (O&M) stage of the Project would include an onshore O&M facility with an associated base port. The onshore substation is an existing substation currently owned by Dominion Energy called the Fentress Substation. Onshore export cables are anticipated to be constructed as underground transmission lines from the cable landing location to a common location, while the interconnection cables are expected to be constructed as overhead transmission lines or as a combination of overhead and underground (hybrid) transmission lines from the common location to the onshore substation. The key components of the Project are summarized in Table 2-1. A schematic of the Project components is depicted in Figure 2-2. Further description of the Action Area is provided below in Section 3, *Description of the Affected Environment*.

Table 2-1 Summary of Project components

Parameter	Project Component Design Details	Rationale
Construction		
Wind Turbine Generators (WTGs)	14- to 16-MW WTGs characterized as “minimum” and “maximum” capacity 14.7 MW with power boost technology has been selected by Dominion Energy (further referred to as 14 MW)	Representative of the smallest-sized WTG and energy produced and carried through the structures in the Offshore Project area.
WTG Layout	202 potential WTGs with monopile foundation sites for the Maximum Layout, with a Preferred Layout of 176 WTGs. Spacing in either layout: 0.75 to 0.93 nautical miles (1.4 to 1.7 kilometers) offset grid pattern (east–west by northwest by southeast gridded layout)	Representative of the spacing of WTG structures in the Offshore Project area.
Offshore Substations (OSSs)	Three OSSs, each with four jacket pin piles for a total of 12 jacket pin piles Up to 900 MW each	Representative of the number of structures in the Lease Area that will be the base for all inter-array cables, and the beginning of the offshore export cables.

Parameter	Project Component Design Details	Rationale
Foundations (WTGs and OSSs)	31-foot (9.5-meter) monopiles (WTG), 9.2-foot (2.8-meter) jacket pin piles (OSS)	Representative of the maximum area of softbottom benthic habitat loss due to foundation and scour protection installation that would result in the greatest surface area of hardbottom introduced to the Offshore Project area for a single WTG monopile or OSS jacket pin pile foundation.
Softbottom Habitat Loss: WTG Foundations and Scour Protection	Maximum base area including scour protection: 191.9 acres (77.7 hectares); Preferred Layout: 103.8 acres (42.0 hectares)	Representative of the maximum area of softbottom benthic habitat loss due to foundation and scour protection installation, as well as the Preferred Layout. This acreage would result in the greatest total surface area of hardbottom introduced to the Offshore Project area.
Softbottom Habitat Loss: Offshore Substation Foundations and Scour Protection	Maximum number of piles per jacket foundation: 4 Maximum base area including scour protection: 11.4 acres (4.6 hectares)	Representative of the maximum area of softbottom benthic habitat loss due to foundation and scour protection installation, which would result in the greatest surface area of hardbottom introduced to the Offshore Project area for all three OSSs.
Inter-array Cables	66-kilovolt (kV) inter-array cables Maximum total length per cable: 31,804 feet (9,694 meters), total cable length: 300.7 miles (484 kilometers) Preferred Layout total length per cable: 4,588 feet (1,392 meters) – 28,367 feet (8,646 meters), varies by location Target burial depth 2.6–9.8 feet (0.8–9 meters), depth will not exceed 9.8 feet (3 meters) Temporary trench width: 16–65.62 feet (5–20 meters) Maximum duration of installation: 15 months	Representative of the installation length per cable, burial depth, temporary trench width, and temporary seafloor footprint for the inter-array cables in the Offshore Project area in the Maximum Layout and the Preferred Layout.

Parameter	Project Component Design Details	Rationale
Offshore Export Cables	Up to nine high voltage alternating current (HVAC) cables located along the offshore export cable corridor (OECC). 230-kV offshore export cables Maximum burial depth: 16.4 feet (5 meters) The corridor width will vary based on the spacing between the cables of 164 to 2,716 feet (50–828 meters) and environmental constraints along the corridor. The trenching for offshore export cables would fall within the maximum corridor. Maximum OECC length: 49 miles (79 kilometers) Maximum duration of installation: 30 months	Representative of the temporary seafloor footprint for the offshore export cables, and maximum burial depth.
Underwater Noise: Foundation Installation Method	Pile driving Maximum projected blow energy: 4,000 kilojoules (kJ) Maximum duration: 45 blows per minute for 87 minutes per monopile	Representative of the installation method that would introduce the loudest underwater noise for the longest installation duration.
Underwater Noise: Pile Driving	Method: 100% pile driving monopile Pile diameter: 36 feet (11 meters) Maximum penetration: 197 feet (60 meters) Maximum hammer energy: 4,000 kJ Maximum number of hammer blows at maximum energy: 3,915 Soft-start hammer energy: 800–3,200 kJ Maximum number of hammer blows at soft-start energy: 540 Total pile-driving time including soft-start procedures: 1.65 hours	Representative of the maximum design scenario per monopile and therefore the largest impact footprint and potential acoustic stress to benthic and pelagic resources. 3,915 is considered the maximum number of hammer blows per monopile at maximum hammer energy, plus an additional 540 hammer blows at soft-start hammer energy.
Underwater Noise: Project-Related Vessels	Based on 14 MW WTGs corresponding to the maximum number of structures in the Offshore Project area (202 potential WTG foundation sites, with a Preferred Layout of 176 WTGs installed 3 OSSs, 230 inter-array cables, and 9 offshore export cables) and maximum number of associated construction vessels.	Representative of the maximum predicted Project-related construction vessels for underwater vessel noise.
Operations		
Underwater Noise: Project-Related Vessels	Based on 14 MW WTGs corresponding to the maximum number of structures in the Offshore Project area (202 potential WTG foundation sites, with a Preferred Layout of 176 WTGs installed, 3 OSSs, 230 inter-array cables, and 9 offshore export cables) and maximum number of associated operations and maintenance vessels.	Representative of the maximum predicted Project-related construction vessels.

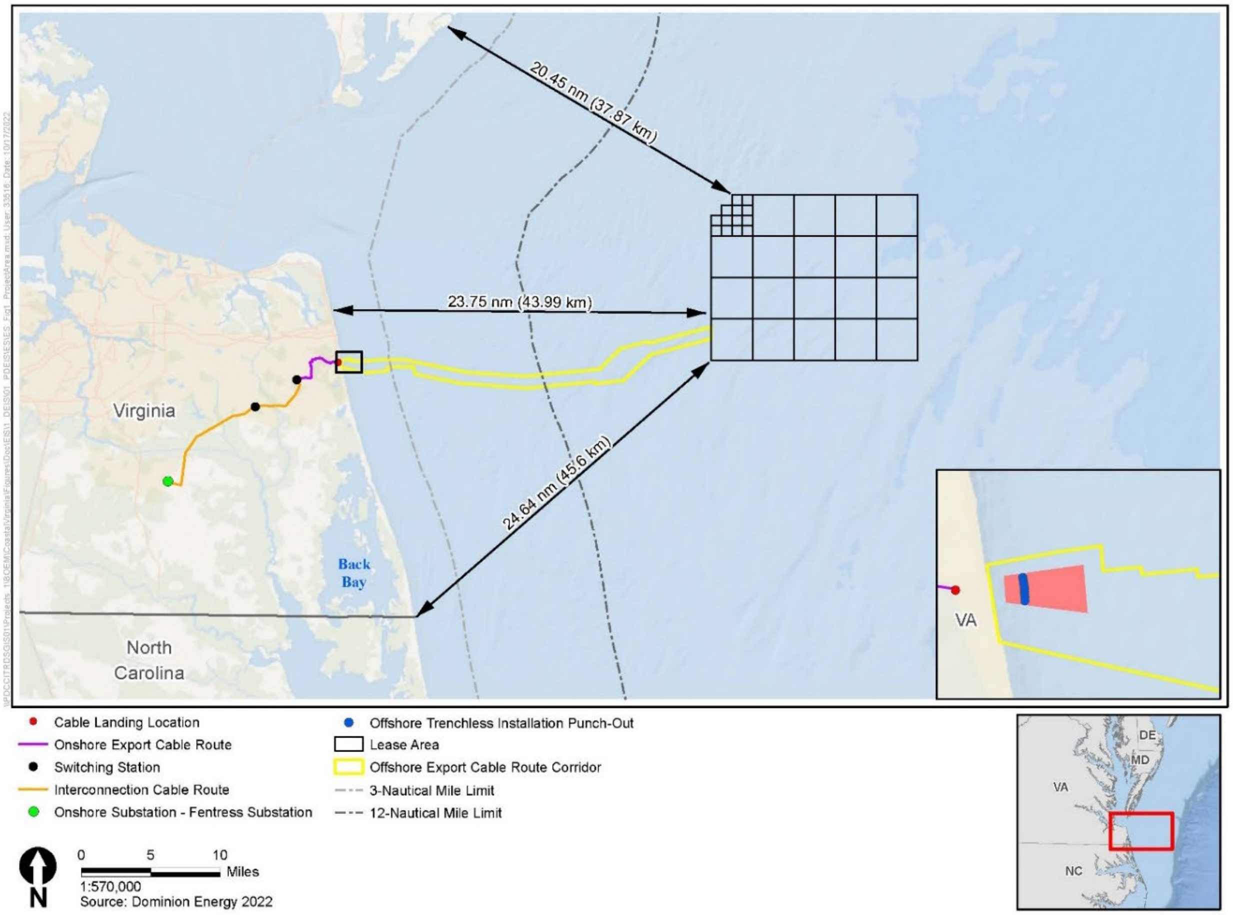
Parameter	Project Component Design Details	Rationale
Electric and Magnetic Fields (EMF): Inter-array Cables	Based on 14 MW WTGs for the maximum number of offshore structures (202 potential WTG foundation sites, with a Preferred Layout of 176 WTGs installed and 3 OSSs) to be connected. Maximum number of cables: 230 Maximum operating voltage: 66 kV Maximum cable diameter: 7.9 inches (200 millimeters) Maximum length per cable: 31,804 feet (9,694 meters) Maximum total length of cables: 265.3 miles (427 kilometers)	Representative of the maximum number, voltage, diameter, and length of inter-array cables, which would result in the maximum exposure of marine life to EMF within the Offshore Project area.
EMF: Offshore Export Cables	Number of cables: 9 Maximum operating voltage: 230 kV Maximum cable diameter: 11.4 inches (290 millimeters) Maximum total length of cables: 49 miles (79 kilometers)	Representative of the maximum number, voltage, diameter, and length of offshore export cables, which would result in the maximum exposure of marine life to EMF within the Offshore Project area.

Source: Dominion Energy 2023

2.1. Project Area

The Virginia WEA covers approximately 112,799 acres (45,648 hectares) and its western edge is located 23.75 nautical miles (43.99 kilometers) from the Virginia Beach, Virginia, coastline, and 20.45 nautical miles (37.87 kilometers) from the northwest corner of the Eastern Shore Peninsula. On November 1, 2013, the commercial wind energy lease with Dominion Virginia Power went into effect. Lease OCS-A 0483 (Dominion) comprises 19 whole and 1 partial lease block (Figure 2-1). The Project area comprises the WEA, OECC, and cable landing area offshore Virginia Beach; Virginia, which consists of ocean habitats in the Virginia WEA, adjacent state waters of Virginia, and coastal habitats. The proposed Offshore Project elements would be located on the OCS, as defined in the Outer Continental Shelf Lands Act, with the exception of a portion of the export cables within state waters (Figure 2-1).

As detailed in the COP (Dominion Energy 2023), the Proposed Action would include the construction activities, O&M, and eventual decommissioning of an up to 3,000-MW offshore wind energy facility, and associated submarine and upland cable interconnecting the wind facility to one cable landing location in Virginia Beach, Virginia (Figure 2-1). The Proposed Action would include 202 WTGs in the BOEM Renewable Energy Lease Area OCS-A 0483 (Lease Area), within the Virginia WEA, located on the OCS approximately 27 miles (24 nautical miles, 44 kilometers) east off the Virginia Beach, Virginia coastline. The Preferred Layout would be to install 176 WTGs within the 202 potential sites. Up to 202 WTGs would produce a maximum capacity of 16 MW, while the Preferred Layout of 176 WTGs would produce a maximum capacity of 14.7 MW and would identify seven locations as spare positions. Accordingly, the Joint Permit Application requests authorization from USACE and the Virginia Marine Resources Commission (VMRC) to construct 176 offshore WTGs, scour protection around the base of the WTGs, three OSSs, inter-array cables connecting the WTGs to the OSSs, and offshore export cables. The cable route(s) would originate from the OSSs and would connect to the electric grid in Virginia Beach, Virginia.



Source: Dominion Energy 2023

Figure 2-1 Coastal Virginia Offshore Wind Commercial Project location

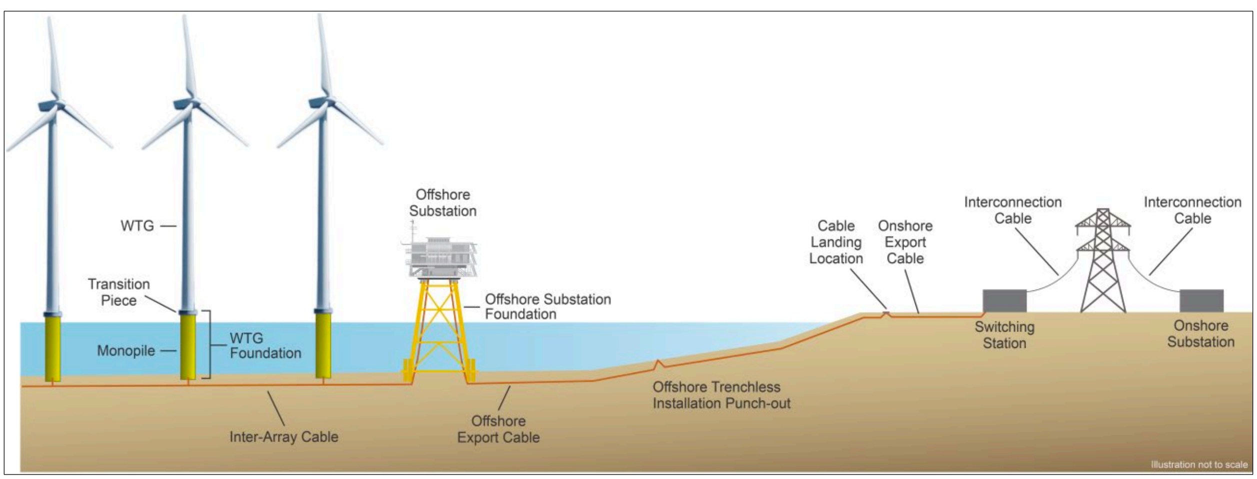
2.2. Construction and Installation

The proposed Project 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 upgrade construction) in the third quarter of 2023 and finishing in 2025. Construction of the offshore components would begin in the fourth quarter of 2023 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 OSS 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, August), and part of fall (September through October) annually. Dominion Energy anticipates that all WTG and OSS foundations will be installed by October 31, 2025. However, as a contingency to account for the potential for delays due to weather, and/or other unanticipated events, Dominion Energy has proposed installation of up to 15 foundations in 2026. If required to accommodate delays in the installation schedule, the 15 installations would occur between May 1 and September 30, 2026. 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. An indicative Project schedule is included in the COP (Section 1, Table 1.1-3; Dominion Energy 2023).

Dominion Energy adopted many lessons learned from the CVOW Pilot Project. Lessons learned from the CVOW Pilot Project that have informed the CVOW Commercial Project include but are not limited to cable burial methodologies, cable crossing design, acquisition of site-specific wind and wave data to inform design of the Project, foundation installation, nautical charting best practices, document requirements to enter commercial operations, and criticality of Jones Act-compliant vessel use (Dominion Wind RFI Response 4/6/2023).

2.2.1 Onshore Activities and Facilities

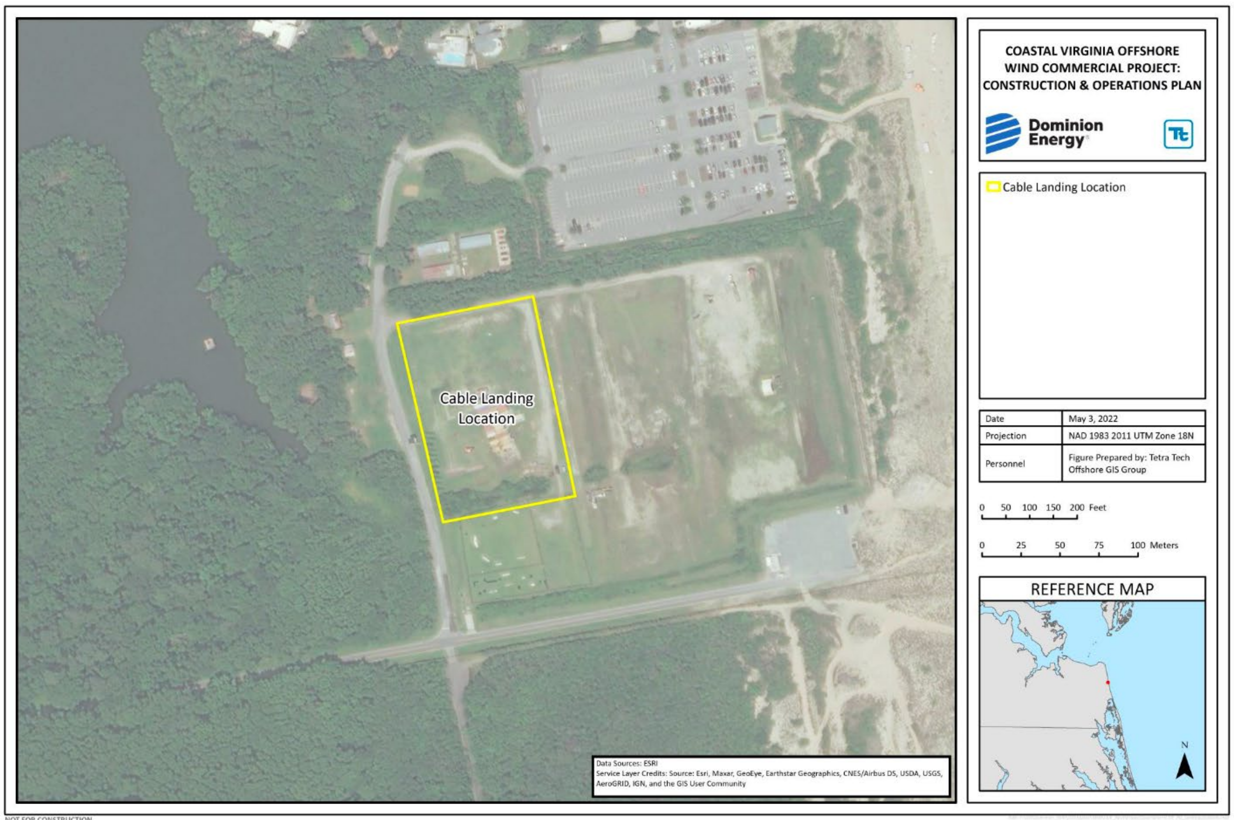
Proposed Onshore Project elements include the cable landing location, the onshore export cable route, the switching station, the onshore interconnection cable routes, and expansions/upgrades to the onshore substation that connects to the existing grid (Figure 2-2). These elements collectively compose the Onshore Project area. COP Section 3, *Description of Proposed Activity*, provides additional details on construction and installation methods (Dominion Energy 2023).



Source: Dominion Energy 2023
Note: The interconnection cable would begin before the switching station, at a common location north of Harpers Road.

Figure 2-2 Overall Project operational concept

The proposed Project would include a cable landing location in Virginia Beach, Virginia, as shown in Figure 2-3. The cable landing location would be located at the proposed parking lot west of the firing range at the State Military Reservation (SMR). Dominion Energy plans to use trenchless installation, horizontal directional drilling (HDD) or 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. HDD and DSPT are both trenchless methods of installing cables. 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. DSPT is similar, though the bore is created and expanded simultaneously. Upon exiting the conduits, the nine 230-kilovolt (kV) offshore export cables would be spliced in a series of nine separate single circuit vaults laid in a single right-of-way (ROW) and transition to the onshore export cables at the cable landing location. Dominion Energy is currently pursuing a DSPT installation solution, which has been determined to be the most appropriate installation technology that would avoid impacting a forested area on the SMR. The onshore export cables would be installed via open trench and HDD. The operational footprint for the cable landing location is anticipated to be 2.8 acres (1.1 hectares).

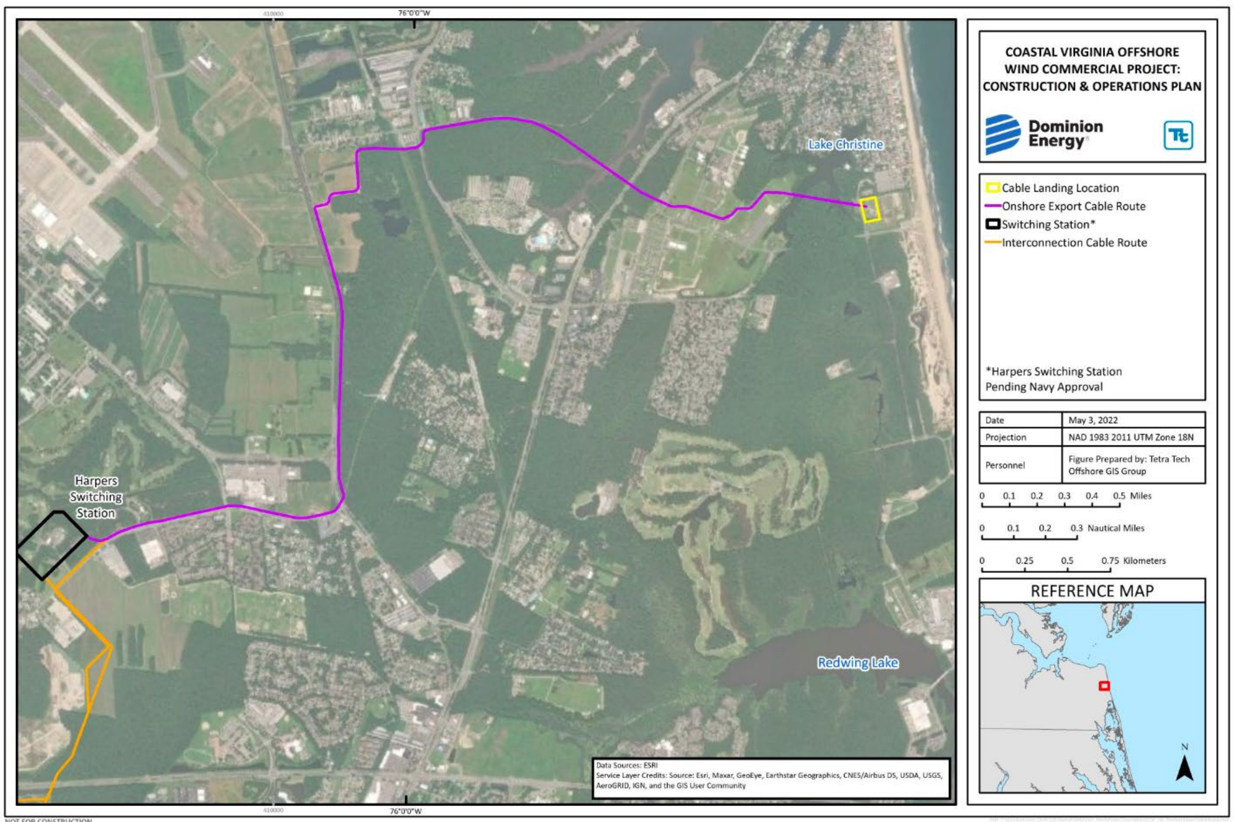


Source: Dominion Energy 2023.

Figure 2-3 Onshore Project components—cable landing location

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. The onshore export cable route (Figure 2-4) 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). 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 total footprint of the Harpers Switching Station would be 45.4 acres (18.4 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.



Source: Dominion Energy 2023

Figure 2-4 Onshore Project components—onshore export cable route

A triple-circuit 230-kV transmission line would be constructed from Harpers Road along an interconnection cable route corridor to the upgraded Fentress Substation onshore. The interconnection cable (Interconnection Cable Route Option 1) would be installed as all overhead transmission facilities, and 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. For overhead interconnection cables, the height would vary from 75 feet (22.9 meters) to 170 feet (51.8 meters), depending on the terrain within the route.

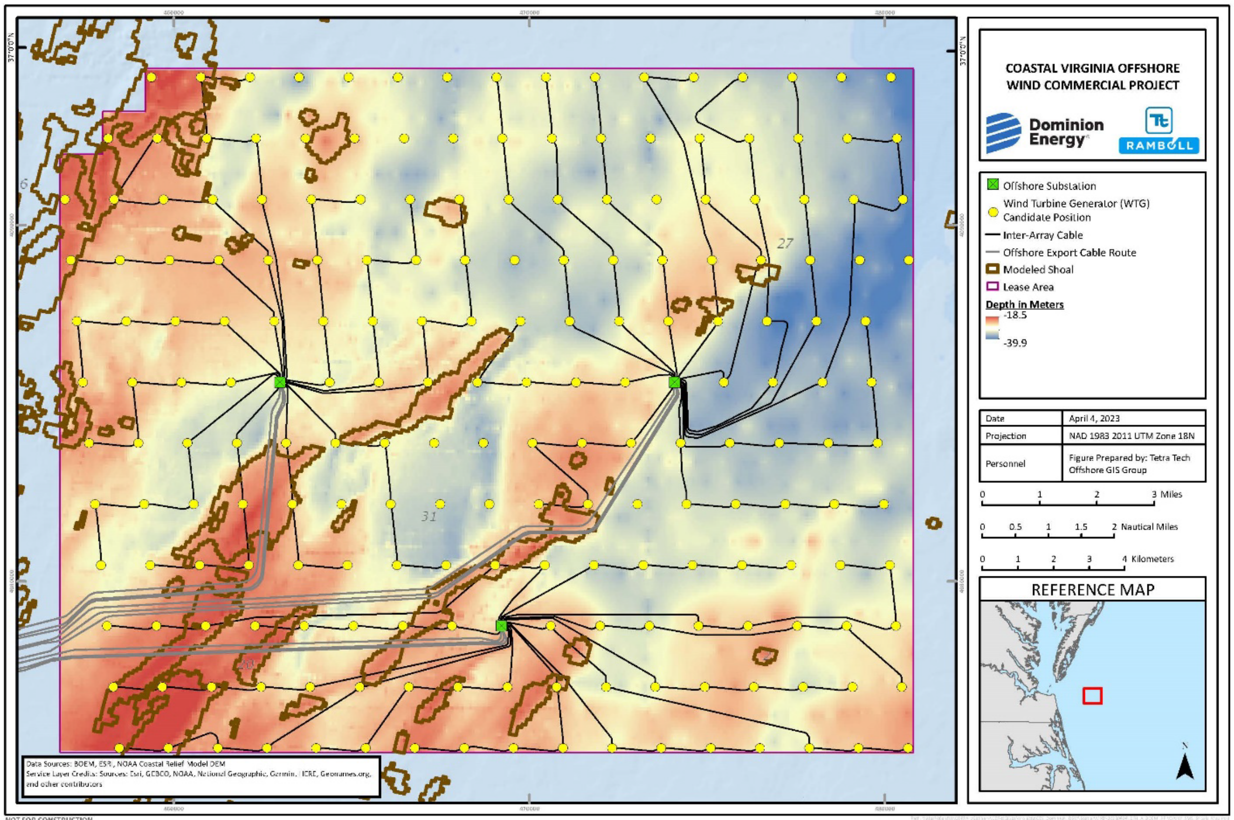
The existing onshore substation (Fentress Substation) that would be expanded/upgraded to accommodate the electricity from the Project is located in Chesapeake, Virginia. The Fentress Substation would serve as the final point of interconnection (POI) for power distribution to the Pennsylvania–New Jersey–Maryland interconnection (PJM) grid. The onshore substation expansions/upgrades would serve as the POI for the three 230/500-kV auto-transformers for connection into the grid. The total footprint for the Fentress Substation is anticipated to be 26.9 acres (10.9 hectares). 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.

2.2.2 Offshore Activities and Facilities

The Offshore Project components under the Proposed Action include WTGs with their foundations, OSSs with their foundations, scour protection for foundations, and inter-array cables. Offshore export cables would be on the OCS, except for a portion of the offshore export cables, which would be within state waters. Project WTGs and OSSs would be, at minimum, 27 miles (24 nautical miles, 44 kilometers) offshore (see Figure 2-1). COP Section 3 provides additional details on construction and installation methods (Dominion Energy 2023).

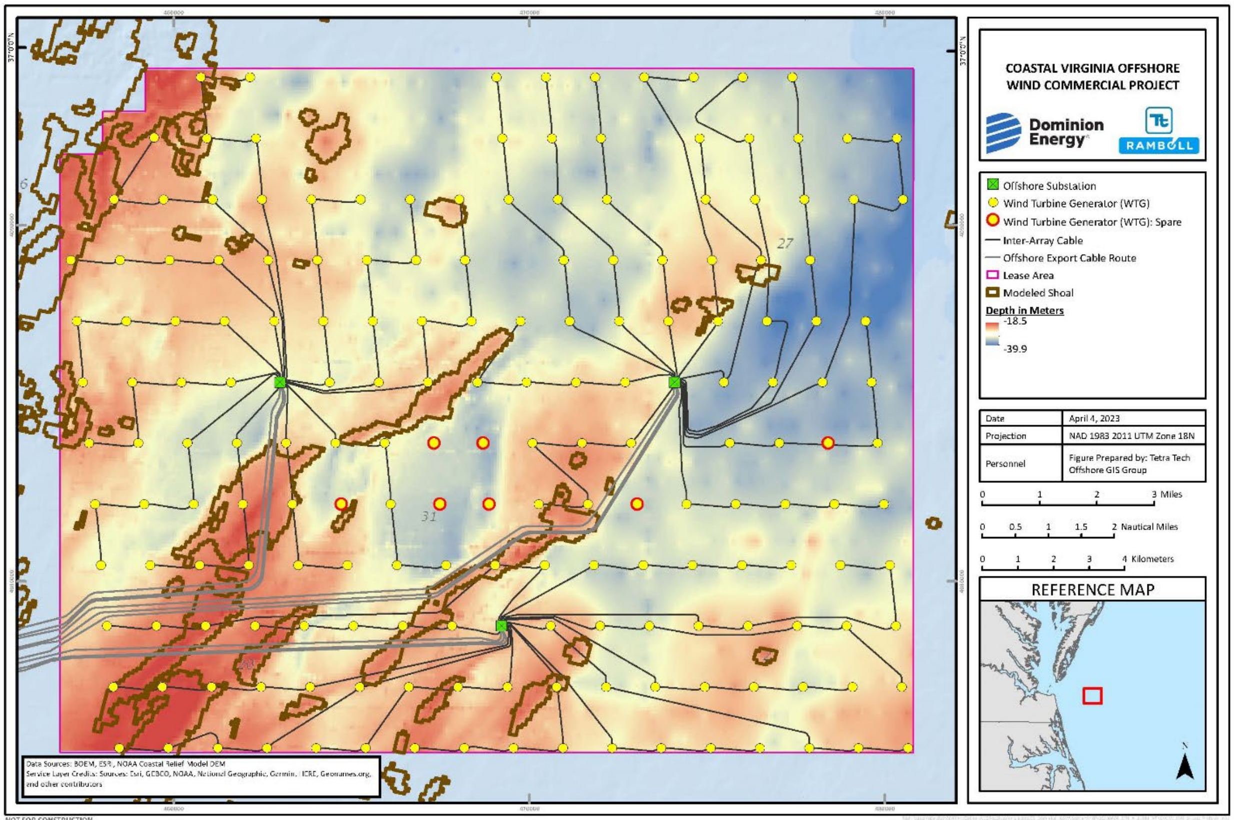
Dominion Energy's Proposed Action includes the construction and installation of up to 202 WTGs. The Maximum Layout includes 202 WTGs (with a WTG capacity of 16 MW) and 3 OSSs, respectively (Figure 2-5). As the Preferred Layout, Dominion Energy proposes to install 176 WTGs, with a WTG capacity of 14.7-MW, with seven locations identified as spare positions (Figure 2-6). For both the Preferred Layout and Maximum Layout, the OSSs will be within the WTG grid pattern oriented at 35 degrees and spaced approximately 0.75 nautical miles (1.39 kilometers) in an east-west direction and 0.93 nautical miles (1.72 kilometers) in a north-south direction.

The final WTG layout, regardless of the number of WTGs, would be arranged in a grid pattern to minimize wake losses within the wind farm. Figure 2-6 shows the planned configuration of the 202 WTGs, 3 OSSs and anticipated inter-array and offshore export cables within the Lease Area. This Maximum Layout is overlayed on the bathymetric map of the Lease Area to draw attention to seabed features, and the modeled sand shoals to be discussed further in Section 3.0. 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 to accommodate for local condition variations. With the Preferred Layout, seven spare positions generally located in the northwestern and northeastern boundaries of the Lease Area have been identified. Aside from those, other spare positions were found to be undesirable, due to foundation technical design risk, shallow gas presence, commercial shipping and navigation risk concerns, erosion risk, or fell within the fish haven area.



Source: Dominion Energy RFI Response 4/6/2023

Figure 2-5 Coastal Virginia Offshore Wind Commercial Project Maximum Layout

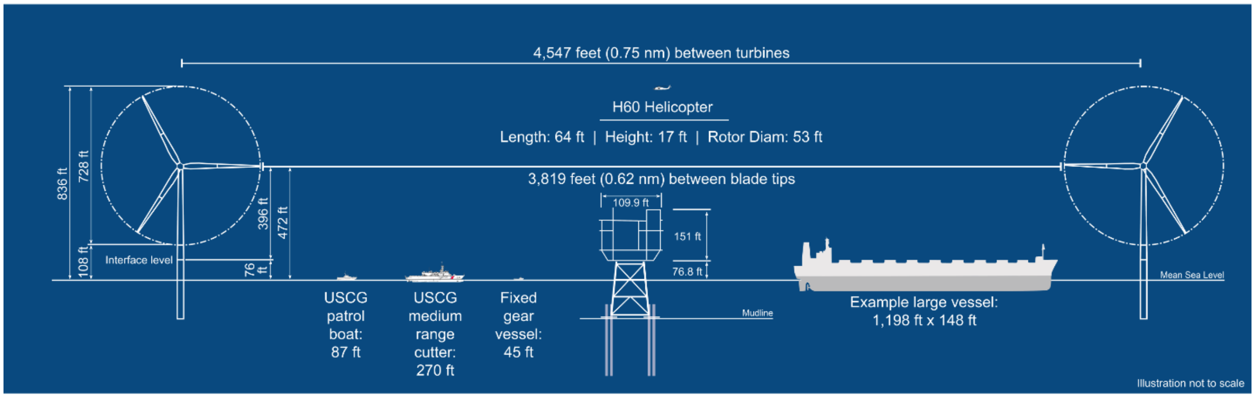


Source: Dominion Energy RFI Response 4/6/2023

Figure 2-6 Coastal Virginia Offshore Wind Commercial Project Preferred Layout

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). Refer to Figure 2-7 for a simplified elevation drawing of Dominion Energy's proposed WTG layout. 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). Scour protection would be installed around the base of the WTG foundations. Monopiles would be installed to the target penetration depth via pile driving. Dominion Energy proposes using near-field noise mitigation systems such as the Hydro Sound Damper, the Noise Mitigation Sleeve, the AdBm Noise Mitigation System, or double big bubble curtains (DBBCs), to reflect and dampen underwater sound waves. The DBBC would be created by two air hoses being placed in concentric circles with a radii of about 591 feet (180 meters), and 755 feet (230 meters) from the monopile installation position. A total of 148.1 acres (59.9 hectares) of seafloor would be temporarily disturbed by the platform supply vessel during DBBC installation, if used (COP Table 3.4-1; Dominion Energy 2023). That impact has not been included on the master benthic impact table in the COP (Table 4.2-17; Dominion Energy 2023). The permanent impacts on benthic habitat from the WTG foundations and scour protection in the Maximum Layout would be 191.9 acres (77.7 hectares). In the Preferred Layout of 176 WTGs 103.8

acres (42.0 hectares) would be permanently impacted, while 3,526.5 acres (1,427.1 hectares) would be temporarily disturbed for the WTG work area, further discussed in Section 5.1.1.



Source: Dominion Energy 2023

Figure 2-7 Scaled representation of offshore Project components and common vessel types relative to Wind Turbine Generator rotor diameter and 0.75 nautical mile turbine spacing for Coastal Virginia Offshore Wind Commercial Project

Dominion Energy proposes to construct three OSSs, each with a rated capacity of up to 900 MW. The OSS 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 topside to each OSS, to support monitoring and maintenance for normal activities and provide emergency access by helicopters, if needed. 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). Dominion Energy is proposing to use pre-installed, pin pile jacket foundations to support the OSS. 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 project design envelope (PDE) to the desired target penetration depth of 230 feet (70 meters) to 269 feet (82 meters). Each OSS jacket foundation is anticipated to take five days to install, for a total of 30 days to complete construction of the three OSSs. The permanent impact on benthic habitat from the OSS foundations and scour protection would be 11.4 acres (4.6 hectares). In the Preferred Layout of 176 WTGs, these values would not change as three OSSs are still planned.

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 OSS would be tied to a WTG string. Dominion Energy anticipates approximately 12 WTG strings would be connected to each OSS, for a total of 36 WTG strings. However, the number of WTGs per string and/or the number of WTG strings connecting to each OSS may be modified given the final layout of WTGs. Overall, installation of the inter-array cables would disturb 2,405.59 acres (973.5 hectares) of benthic habitat in the Maximum Layout. In the Preferred Layout there would be a

309.63 acres (125.30 hectares) reduction, down to roughly 2,095.96 acres (848.2 hectares) of temporary benthic disturbance for cable installation, further discussed in Section 5.1.1.

The offshore export cables would transfer the electricity from the OSS to the cable landing location in Virginia Beach, Virginia. Electricity would be transferred from each of the three OSSs 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. All nine offshore export cables would be within the OECC, which would vary in width upon exiting the Lease Area. The three offshore export cables originating at the OSSs would merge to become one overall OECC containing all nine offshore export cables within the corridor. The total corridor length from the Lease Area to the cable landing would be a maximum of 49.01 miles (79 kilometers). This corridor would range in width from 1,749 feet (533 meters) to 9,400 feet (2,865 meters) between the western edge of the Lease Area and the cable landing location. Variability in the OECC 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 the proposed Atlantic Coast Port Access Study safety fairway to the north; the Dam Neck Ocean Disposal Site (DNODS); other 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 OECC, the nine offshore export cables would generally be spaced approximately 164 feet (50 meters) to 2,716 feet (828 meters) apart and constrained at times to be spaced 164 feet (50 meters) to 328 feet (100 meters) apart. The target burial depth would not be greater than 16.4 feet (5 meters) below grade, except in the portion where the OECC crosses the DNODS and 14.8 feet (4.5 meters) of cover for placement of dredge material would be added, for a total maximum depth of 24.6 feet (7.5 meters). The corridor for OECC installation would temporarily disturb 2,047.87 acres (828.74 hectares) of benthic habitat, which would not change in the Preferred Layout which is further discussed in Section 5.1.1.

Prior to cable installation, Dominion Energy will complete route clearance, including boulder and sand-wave clearance, pre-lay grapnel runs and relocation of unexploded ordnances (UXOs) that are unable to be avoided through micrositing. Dominion Energy does not anticipate the need for sand wave removal. The intent of the route clearance is to remove any obstructions within the proposed 82 foot (25 meter)- wide corridor for installation of the inter-array cables. Dominion Energy does not foresee the need for boulder removal based on no detection of boulders/rocks in either the extensive survey activities for the CVOW Pilot or Commercial Projects. Pre-lay grapnel runs would be completed to remove seabed debris, such as abandoned fishing gear, wires, etc., from the siting corridor. Three passes of pre-lay grapnel runs would occur, one along the centerline and two parallel to the centerline, to ensure routes are clear. Pre-lay grapnel runs for the IACC are anticipated to impact 2,988.1 acres (1,209.5 hectares), with an additional 3,358.51 acres (1,359.14 hectares) for the offshore export cables (see Section 5.1.1). Combined pre-lay grapnel runs for the Project cable installation would equal temporary benthic impacts to 6,347.31 acres (2,568.67 hectares). Any debris collected within the pre-lay grapnel run will be recovered and disposed of onshore, should it be possible. If debris is considered too large to recover it will be left on the seabed, its position will be logged, and further action shall be taken should it be deemed necessary. Based on recent input from Dominion Energy, sand-wave removal methods are not currently anticipated to occur prior to cable installation (Jabs pers. Comm.; Dominion Energy 2023 COP Section 4.2.4.3). UXO route clearance will require a larger corridor width of 164.04 feet (50 meters) around each section of planned inter-array cable section, and the entire OECC to allow for re-routing and micrositing. Larger corridors are employed in higher risk areas, such as the DNODS, and the telecommunications cable crossings. UXO identification surveys are anticipated to start in spring 2023 to allow for completion prior to construction. If needed, mitigation of each UXO is anticipated to temporarily disturb 161.5 square feet (15 square meters) of the seabed, for an estimated total of 1.58 acres (0.64 hectares) (see Section 5.1.1), and relocation of UXOs is anticipated to involve non-detonation methods (Tetra Tech 2022).

Dominion Energy 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. Areas with sand waves do not require separate burial methods or tools. Cables will be installed in sand waves areas using either hydroplow, or a tracked trencher. For all the proposed installation methods, a narrow temporary trench 16.4 feet (5 meters) wide is created into which the cable is fed while the equipment is towed along the seabed. The cable burial equipment rest on skids or wheels on the seafloor with a width of approximately 23 feet (8 meters). 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. At this time Dominion Energy does not anticipate the need for cable protection along the IACC. The offshore export cables would be buried to a target depth of between 3.3 feet (1 meter) and 16.4 feet (5 meters).

Dominion Energy has identified three in-service telecommunications cables within the OECC 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 post offshore export cable installation) and a potential third layer of protection if stabilization and scour protection is deemed necessary. Dominion Energy anticipates that at the three fiber optic cable crossings additional protection will be needed, including two concrete mattresses, installed using an A-frame lift. One concrete mattress would be countersunk below the offshore export cable to separate it from the existing previously buried fiber optic cable, and one laid over top of the offshore export cable. The bottom mattress will consist of two pieces of tapered edge mattress, each measuring approximately 20 feet (6 meters) in length by 10 feet (3 meters) in width, and 6 inches (0.15 meters) in height. The two pieces would be placed short end to short end. The top mattress would consist of seven pieces of tapered edge mattress, each measuring approximately 20 feet (6 meters) in length by 10 feet (3 meters) in width, and 6 inches (0.15 meters) in height. The top mattresses would also be placed short end to short end. The mattresses will be laid lengthways along the fiber optic cable (bottom) or Offshore Export Cable (top). The export cable will be laid flush with the seafloor; therefore, the mattress placed on top of the cable will result in a total vertical profile increase of 6 inches (0.15 meters). The total area of cable protection would be 684.6 acres (27.7 hectares).

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. COP Section 3, Table 3.4-5, *Preliminary Summary of Offshore Vessels for Construction* (Dominion Energy 2023), provides details and specifications on vessels expected to be used during construction. Vessel trips would average 46 trips per day through the duration of construction activities (assuming January 2023 through August 2027). Daily estimated vessel trips would be dependent on the construction period and activity range from a minimum of three trips per day to a maximum of 95 trips per day. Construction vessels would travel between the Offshore Project area and the third-party port facility where equipment and materials would be staged. Dominion Energy and the Port of Virginia have executed a lease agreement for a portion of the existing Portsmouth Marine Terminal facility in the city of Portsmouth, Virginia, to serve as a construction port. The port would be used to store monopile and transition pieces and to store and preassemble wind turbine generation components. See COP Sections 3.2 and 3.4 for more details about construction and installation strategies, equipment, and timing (Dominion Energy 2023).

2.3. Operations and Maintenance

The Proposed Action is anticipated to have an operating period of 33 years.[1] Dominion Energy intends to lease an existing O&M facility with the preferred location at Lambert's Point, now named Fairwinds, 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 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 (BSEE) (COP Appendices A and Q; Dominion Energy 2023).

2.3.1 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.

2.3.2 Offshore Activities and Facilities

Routine inspection and maintenance are expected for WTGs, foundations, and 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, and 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. Dominion Energy anticipates 365 operating days for

[1] The Dominion Energy lease with BOEM (Lease OCS-A 0483) has an operations term of 25 years that commences on the date of COP approval. Refer to 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 National Environmental Policy Act (NEPA) coverage if BOEM grants such an extension, the Draft EIS analyzes a 33-year operations term.

the service operations vessel, with 26 annual round trips to port and 365 operating days for each crew transfer vessel, with 50 annual round trips to port per vessel.

Dominion Energy anticipates 365 operating days for a single service operations vessel, with 26 annual round trips to the O&M port, and 365 operating days for each of two crew transfer vessels, with 26 annual round trips to the O&M port per vessel. Ports used during O&M would either be located at Lambert's Point in Norfolk, Virginia, or Virginia Port Authority's Portsmouth Marine Terminal and Newport News Marine Terminal near Hampton Roads, Virginia (COP Section 3.5; Dominion Energy 2023). However, conflicting information regarding the number of round trips expected to be completed by crew transfer vessels and/or service operation vessels during O&M is presented in the COP and Draft EIS (BOEM 2022). Additionally, the estimated number does not comport with O&M service trip estimates for other U.S. East Coast wind farm projects with published COPs, which estimate several hundred to thousands of round trips for annual service; however, this is the vessel transit data available for analysis in the EFH.

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.

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. Dominion Energy is developing a lighting, marking, and signal plan for review and concurrence by BOEM and the USCG. The plan is based on consultations with the Fifth Coast Guard District and will conform to applicable federal laws and regulations (COP Section 3.5.3; Dominion Energy 2023).

2.4. Decommissioning

In accordance with 30 CFR 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 O&M activities. 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 2023) for additional details on removal methods and assumptions that would likely be applicable based on the present-day understanding of available decommissioning approaches. Although the Proposed Action has a designated 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 Action for more than the term of the operation.

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 the 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.

2.4.1 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 any remaining cable would be capped off and earthed.

2.4.2 Offshore Activities and Facilities

The decommissioning process for the WTGs and OSSs is anticipated to be the reverse of construction and installation, with turbine components or the OSS 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 OSS 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 to a barge. 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. The steel used in the foundations and towers would be recycled. If used, the scour protection placed around the base of each foundation would be removed unless leaving it in place is deemed appropriate through consultation with the 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.

2.5. Fisheries Monitoring Plans

Dominion Energy is actively working with Virginia Department of Environmental Quality, VMRC, the Virginia Institute of Marine Science, Rutgers University, and commercial fishers to develop a Fisheries Monitoring and Mitigation Plan (FMMP). The proposed plans are expected to begin prior to Project construction. In addition to the whelk (Buccinidae) and black sea bass (*Centropristis striata*) monitoring surveys, Dominion Energy is developing an Atlantic surf clam (*Spisula solidissima*) survey plan that will be provided to BOEM and NMFS when completed. Site-specific fishery characterization and monitoring efforts for the black sea bass and whelk resources are expected to begin in January 2023, and Atlantic surf clam resources in summer 2023. Once fully finalized (expected early 2023), the FMMP will be included as COP Appendix V-1).

This section outlines the proposed surveys that have been developed with consideration of both BOEM's guidelines for providing information on fisheries for offshore wind projects (BOEM 2019) and Responsible Offshore Science Alliance (ROSA) guidance for overarching principals and recommended elements for experimental protocols in the design and implementation of offshore wind monitoring projects (ROSA 2021).

2.5.1 Whelk Surveys

Whelk surveys will occur at roughly 3-day intervals using whelk pots which is a common gear type in the *Busycon* (spp.) fisheries. Sampling will occur twice a month during times of traditionally high fishing activity (November to March) and once a month during times of traditionally low fishing activity (April to October) (21 cruises (4 in year 1 and 17 in year 2). Baited pots are weighted allowing them to remain on the sea floor. Typically, this fishery deploys single pots along the seafloor. At the end of each string, there is a static vertical buoy line that is attached to mark the gear's position at the surface. To reduce the number of vertical lines and reduce entanglement potential, these pots will be deployed in strings (or trawls) of multiple pots along the seafloor, which are connected by groundlines. Pots are deployed and left at the fishing location and are hauled at intervals (approximately 3 days), then re-baited and set again. It is anticipated to construct 8 strings of 12 pots for deployment. The approximate length of each trawl will be 1,800 feet (149 meters) with 150-foot (45-meter) spacing between the pots. Buoy lines will have the required whale release (weak link/swivel) and colored markings (yellow and black marking scheme using paint or woven tracer).

2.5.2 Black Sea Bass Surveys

The proposed monitoring plan will consist of a survey design sampled with fish pots, a common gear type in the black sea bass fishery. Typically, this fishery deploys strings (or trawls) of multiple pots along the seafloor, which are connected by groundlines. At the end of each string, there is a static vertical buoy line that is attached to mark the gear's position at the surface. To mitigate the entanglement potential of a variety of nontarget species (i.e., marine mammals, sharks, and sea turtles) some of the following methods may be used: instead of using a vertical line with a buoy for gear marking, the section of rope between the anchor and the first pot in the string will consist of an elongated section of sinking ground line. To distinguish this gear, the end of sinking ground line (top 12 feet [4 meters]) the rope will be marked in a yellow and black marking scheme using paint or woven tracers. Global positioning system (GPS) locations will be used to mark gear. During year 2 of this project, it is intended to test other on-demand fishing systems as they are available. These fishing methods eliminate the use of vertical lines and should provide equal levels of mitigation.

Pots will be constructed to be consistent with regional efforts with respect to design elements of the gear (i.e., trap material, volume, entrance funnels, escape vent configuration). It is anticipated to construct eight strings of six pots for deployment. The approximate length of each trawl will be 480 feet (146 meters) with 60-foot (18-meter) spacing between the pots and a 180-foot (55-meter) anchor line. To characterize both the underlying population demographics of the sampled black sea bass resource and the catches of the commercial fishery, Dominion Energy will use a combination of ventless and vented (consistent with current regulatory requirements) pots randomly placed within a string.

3. Description of the Affected Environment

The Dominion Energy Wind Lease Area is the offshore area where the Project wind energy generation facilities would be physically located and includes the OECC. The Project Lease Area is located within the Virginia state waters and offshore in the U.S. Exclusive Economic Zone (EEZ). This area contains both demersal and pelagic habitats of coastal Virginia (marine and estuarine). The coastal CVOW-C 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 2023), 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 2015). Additional descriptions of fish and invertebrate species in the Lease Area can be found in BOEM's *Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Final Programmatic Environmental Impact Statement* (BOEM 2014). The Final Programmatic EIS for Alternative Energy Development describes the affected environment for this section of the Atlantic Offshore Continental Shelf in Section 4.2.11 (MMS 2007). The overall oceanography is a mix of the warm Gulf Stream waters, which travel north easterly along the shelf, and the cold waters flowing south westerly from New England. This water combination creates consistent eddies along the shelf and forms the MAB Cold Pool. The Cold Pool develops in the spring and ensures vertical stratification through the summer and fall (Friedland et al. 2021; Miles et al. 2021; Lentz 2017). The MAB finfish fauna is a mix of demersal and pelagic species with boreal and warm temperate, cold temperate, and subtropical affinities. At least 600 finfish species utilize Virginia's coastal and offshore habitats (Robins and Ray 1986). A table listing the predominant demersal species and the biogeographic zones they utilize is found in the Virginia Offshore Technology Revised Environmental Assessment (BOEM 2015). The OECC is the surveyed area identified for routing the offshore export cables. It extends from the Lease Area, along a maximum 49.1-mile (26.5-kilometer) corridor to a landfall site in Virginia Beach, Virginia. Habitat along the OECC and within the Lease Area was evaluated utilizing approximately 12,614 miles (20,300 kilometers) of geophysical trackline data, 74 benthic grab samples, 205 geotechnical deep borings, 31 vibracores, 164 cone penetration tests (CPT), and fifty 1,969-foot (600-meter) towed underwater video transects. This data was collected by the CVOW-C team in summer 2020 (Dominion Energy 2023) and fall 2020 (Schnabel 2021).

As discussed in the Project COP, the seabed characteristics of the Action Area are consistent with the larger MAB region: softbottom sediments characterized by fine sand punctuated by gravel and silt/sand mixes with the primary morphological feature consisting of shoal massifs, sand ridges, and waves. These morphological features are thought to be the result of storm activity and hydrodynamic interactions (Section 4; Dominion Energy 2023). As shown in Table 3-1, water depths in the Lease Area range from 59 to 135 feet (18 to 41 meters) mean lower low water (MLLW) and water depths along the OECC range from 23 to 92 feet (7 to 28 meters) MLLW, assuming the corridor stops at the HDD exit pit (Appendix D; Dominion Energy 2023). The seabed generally slopes west to east toward the OCS edge, with the shallowest waters in the western portion of the Action Area, and the deepest in the eastern portion. The seafloor conditions within the Lease Area and OECC are very homogenous, dominated by sand and silt-sized sediments. These homogenous conditions were identified by multibeam echo sounding and side-scan sonar (SSS) imaging techniques. The geotechnical assessments were ground-truthed via the benthic grab samples, underwater video, borings, and CPTs, and further verified via historical grab sample and still photo data (Guida et al. 2017; Cutter and Diaz 1998). The CVOW-C benthic survey report (Appendix D; Dominion Energy 2023) characterized the Lease Area as sand dominated. Sand dominated all grab samples with a mean of 93.2 percent (primarily fine sand), followed by 3.7 percent gravel and 3.0 percent silt and clay. Surveys conducted for the CVOW Pilot Project (Tetra Tech 2013, 2014) classified the Lease Area as a softbottom mosaic with fine to coarse sands and low organic content.

Northeasterly trending sand ridges of high relief and extent are situated on a broad, shallow shoal complex that dominates the southwestern half of the Lease Area. These shoals are typically megahabitats, and are often composed of different meso, macro, and microhabitats defined by such factors as exposure, sediment texture, depth, and rugosity (Rutecki et al. 2014). Sand ridges are common in the MAB, and found in the northern portions of the Offshore Project area. Sand ridges are generally 1.5- 100 feet (5- 30 meters) in height and spaced apart by kilometers of seafloor (Ashley 1990). Smaller surficial features are superimposed on the more extensive features throughout the Offshore Project area, indicating the potential for sediment transport within the MAB and are often covered with smaller similar forms, such as sand waves, megaripples, and ripples. Sand waves are larger bedforms with wavelengths that exceed 197 feet (60 meters) (BOEM 2020) and average 6.5 to 16.5 feet (2 to 5 meters) in height (Ashley 1990). Megaripples have a wavelength of 16.5 to 197 feet (5 to 60 meters) and a height of 1.5 to 5 feet (0.5 to 1.5 meters) (Ashley 1990; BOEM 2020). Sand ripples are defined as having a wavelength less than 5 meters, and a height less than 1.5 feet (0.5 meters) (BOEM 2020). Substrates are typically fine to medium-grain sand within the OECC, with some gravel and small sand ridges and waves no higher than 8.2 feet (2.5 meters) in the deeper portions. Slopes are consistently less than 5 degrees along the OECC. Closer to the boundaries of the Offshore Project area, ridges and waves increase in width and attain maximum heights of 16.4 feet (5.0 meters) (Tetra Tech 2013). Site-specific geophysical surveys provide a more detailed description of bottom habitat features for the Lease Area and OECC (COP, Appendix E; Dominion Energy 2023).

Reef hardbottom substrates are rare in the MAB and were not observed in the CVOW Pilot Project Research Lease Area surveys or during the benthic surveys and marine site geophysical and geotechnical surveys (Dominion Energy 2023). In the northern portion of the Lease Area, known as the Fish Haven, five large World War II-era tankers and transport ships, cables, tires, and other anthropogenic materials have been placed to form an artificial reef (Triangle Reef) (Lucy 1983). The VMRC continues to expand Triangle Reef by placing scuttled cables, tires, and other materials within the Fish Haven (VMRC 2008).

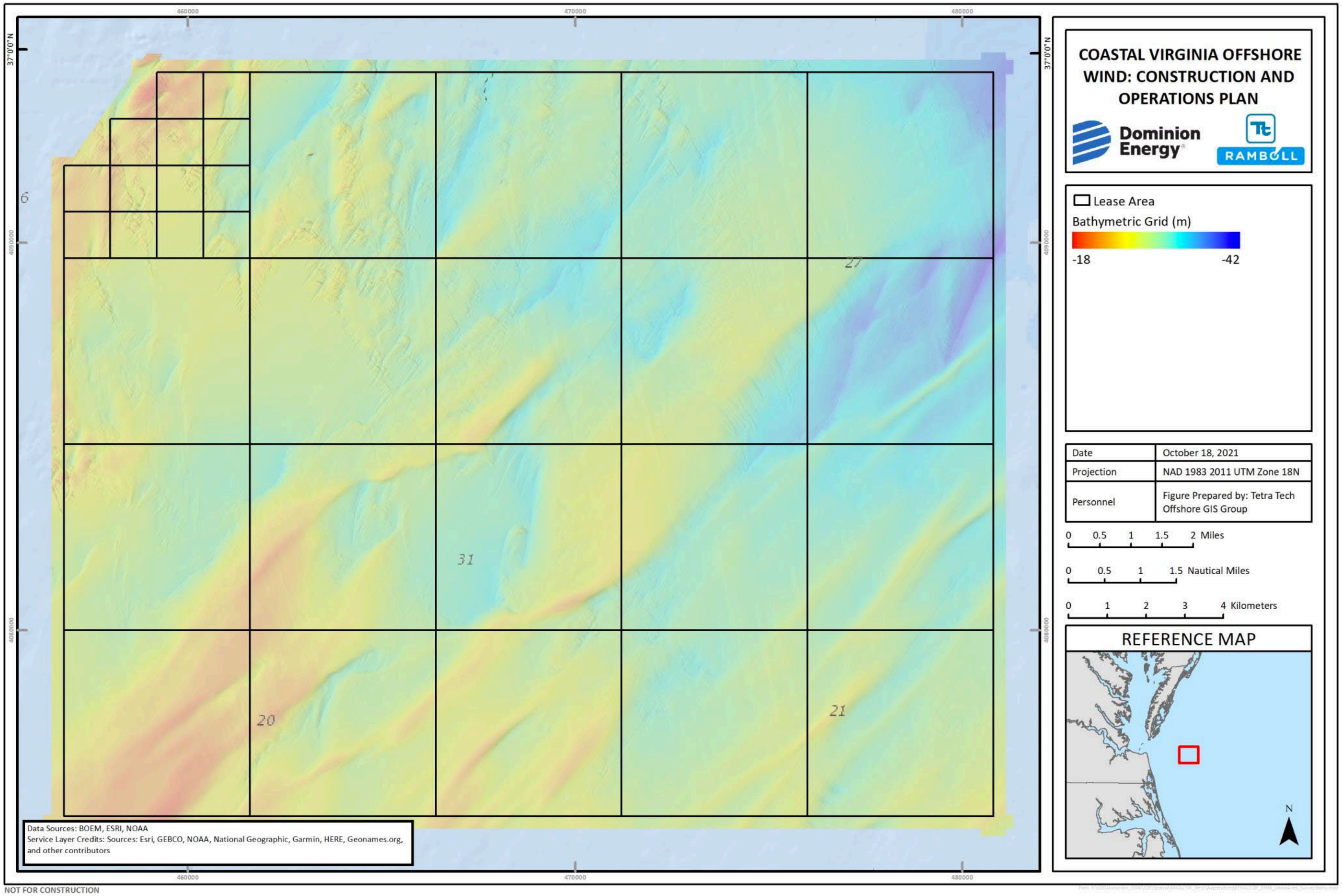
Water temperatures change seasonally in the Offshore Project area, and greatly vary with depth. The seasonal water depth variation can be at ranges of 36 degrees Fahrenheit (˚F) (20 degrees Celsius [˚C]) at the surface and 27˚F (15˚C) at the seafloor (Guida et al. 2017). Thermal stratification begins in April, as surface water ambient temperatures begin to rise above colder bottom temperatures. Maximum surface-to-bottom thermal gradients occur in August with a range of 27˚F (15˚C), followed by vertical turnover occurring within September to October (Guida et al. 2017).

As described in the CVOW-C COP EFH (Dominion Energy 2023) within the MAB and the Lease Area in particular, dynamic water quality parameters such as conductivity, dissolved oxygen, and pH are influenced by broad climactic events, current patterns, local meteorological conditions, and anthropogenic impacts. Temperature and light penetration covary with depth, although the relationships between these water column variables are not always linear. Inner shelf waters (60 to 100 feet [18 to 30 meters]) are influenced by nearshore conditions such as winds and tidal action; intermediate shelf waters (100 to 160 feet [30 to 50 meters]) are mostly wind driven; and shelf edges (160 to 330 feet [50 to 100 meters]) are influenced primarily by the southbound Labrador Current and northwest Gulf Stream (Lee et al. 1981; Atkinson and Targett 1983).

The salinity regime within the MAB is described as having a persistent cross-shelf gradient (Dominion Energy 2023). The major influences on the salient gradient include freshwater runoff from the Hudson-Raritan Estuary System, Delaware Bay, and Chesapeake Bay (Castelao et al. 2010; Dominion Energy 2023). Following periods of high runoff, a strong vertical salinity gradient has been observed across portions of the continental shelf (Wilkin and Hunter 2013). Historical annual mean salinities for the entire MAB range from 32.7 to 34.5 parts per thousand (ppt) (Jossi and Benway 2003). Northeast Fisheries Science Center (NEFSC) seasonal trawl CTD data (conductivity, temperature, and depth data gathered by a sonde instrument) collected from 2003 to 2016 generated water column salinity profiles consistent with these historical values (Guida et al. 2017). Salinity was recorded within the euhaline range (29.8 to 34.0 ppt), indicating relative stability of this pelagic habitat feature (Guida et al. 2017). More specifically, salinity in the Lease Area ranges from 31.9 to 32.8 ppt, and in Virginia state waters near the trenchless punch-out salinity ranged from 23.4 to 36.6 ppt (COP Table 4.1-7; Dominion Energy 2023).

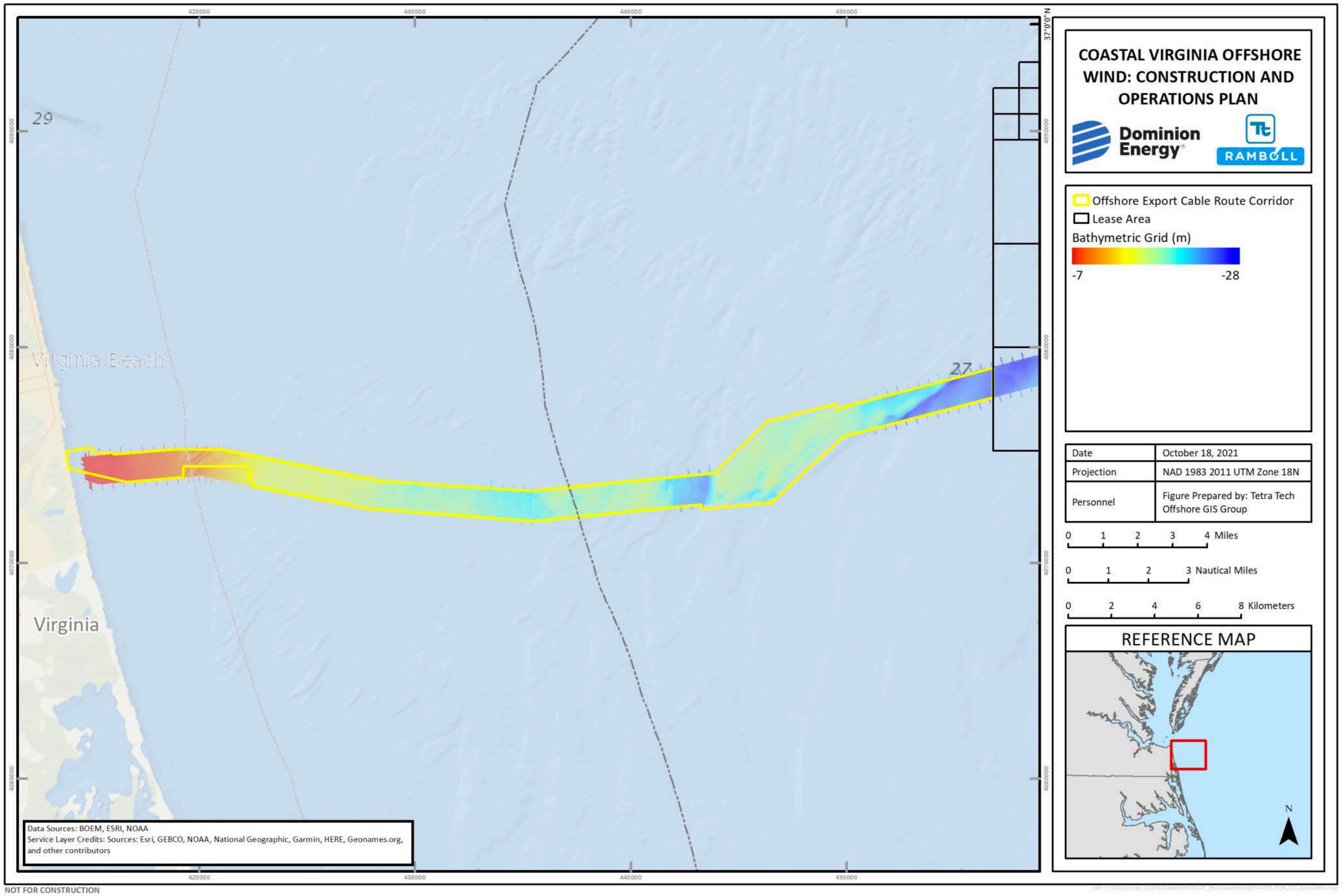
The National Coastal Condition Report IV (EPA 2012) rated the condition of Virginia Beach shoreline waters near the cable landfall location as "poor to fair" and the waters of the Offshore Project area as "fair to good." Wastewater treatment equipment, stormwater runoff, agricultural runoff, and other anthropogenic factors may indirectly influence dissolved oxygen by yielding occasional algal blooms and subsequent hypoxic events in the nearshore regions of the Offshore Project area (VADEQ 2020). Concentrations of dissolved oxygen in offshore waters are expected to consistently exceed safe thresholds for marine organisms (i.e., more than 5 milligrams per liter) (BOEM 2015). Water depth influences surface and bottom temperatures, light penetration, sediment movement, and other physiochemical parameters that define EFH. In the Offshore Project area, charted water depths range from 0 feet (0 meters) to 62 feet (19 meters) in the OECC and 62 feet (19 meters) to 134 feet (41 meters) in the Lease Area (NOAA 2021a). Depths increase seaward along roughly a southwest to northeast gradient, with the shallowest areas in the northwest and southwest corners and deepest areas in the northeast corner (Figure 3-1).

During 2020 and 2021, Dominion Energy completed full-coverage high-resolution geophysical (HRG) and geotechnical surveys in the Lease Area and OECC (TerraSond 2021; Alpine 2021). Relevant findings from those surveys are based on the interpretations of sub-bottom profiler (SBP), ultra-high-resolution seismic (UHRS), SSS, multibeam echosounder (MBES), and magnetometer/transverse gradiometer (MAG/TVG) equipment. MBES data were used to correlate SSS contact positions and prominent features of the seafloor during interpretation. Backscatter data were utilized to generate seafloor interpretations along with the MBES and SSS data, as summarized in Section 3.3.2.2, *Habitat Mapping,* from TerraSond 2021. These surveys included a total of five vessels and approximately 12,427 miles (20,000 kilometers) of survey lines in the Lease Area, and three vessels and approximately 2,051 miles (3,300 kilometers) of survey lines in the OECC. The bathymetry of the entire Offshore Project area (TerraSond 2021; Alpine 2021) is shown with bathymetric contours as an overview in Figure 3-1 and Figure 3-2. Depth profiles and acreages are shown in Table 3-1. Additionally, the full-coverage Offshore Project area bathymetry based on geophysical survey data are available as a webmap tool, located at: https://cvowc.tetratech.com.



Source: Dominion Energy 2023

Figure 3-1 Bathymetry overview in the Lease Area



Source: Dominion Energy 2023

Figure 3-2 Bathymetry overview in the offshore export cable corridor

Table 3-1 Depth profiles in the Offshore Project area

Offshore Project Area	Depth Range (m)	Acres (Hectares) at Depth Range	Percent of Total Acreage
Offshore Export Cable Corridor: State Waters	0 to 5	86 (34.8)	4.7
	5 to 10	1,234 (499.4)	67.4
	10 to 15	449 (181.7)	24.5
Offshore Export Cable Corridor: Federal Waters	10 to 15	810 (327.8)	5.9
	15 to 20	8,957 (3,624.8)	64.9
	20 to 25	3,107 (1,257.4)	22.5
	25 to 30	720 (291.4)	5.2
Lease Area	15 to 20	120 (48.6)	0.1
	20 to 25	13,386 (5,417.1)	11.9
	25 to 30	65,048 (26,324)	57.7
	30 to 35	31,391 (12,703.5)	27.8
	35 to 40	2,777 (1,123.8)	2.5

Source: Dominion Energy 2023

The assemblage of pelagic species in the Offshore Project area varies by season and with distance from shore. Bays and estuaries provide spawning, nursery, and foraging purposes habitats (MAFMC 2017; NEFMC 2017). Pelagic species tolerant of low salinities occur seasonally in bays and estuaries (e.g., Atlantic herring [*Clupea harengus*], Atlantic butterfish [*Peprilus triacanthus*], Atlantic mackerel [*Scomber scombrus*], bluefish [*Pomatomus saltatrix*], scup [*Stenotomus chrysops*]). Inshore habitat uses may be further divided by life stage. For example, Atlantic herring larvae occur in salinities as low as 2.5 ppt; juveniles also tolerate low salinities but exhibit increasing preference for higher salinities (greater than 28 ppt) as they age (Reid et al. 1999a; Stevenson and Scott 2005; NEFMC 2017).

In offshore waters over the continental shelf, the photic zone supports phytoplankton (e.g., diatoms, dinoflagellates), particularly in areas with high nutrient content, such as coastal zones enriched by runoff or shelf-break zones enriched by upwelling. Current dynamics provide a dispersal mechanism for planktonic eggs and larvae of managed species. The continental shelf of the MAB receives Labrador Current cold-water influxes from the north and Gulf Stream warm-water influxes from the south. To the south of the Offshore Project area, Cape Hatteras demarcates a dynamic ichthyoplankton faunal transition zone between two broad eco-regions: the MAB, which extends from Delaware Bay to Cape Hatteras, and the South Atlantic Bight (SAB), which extends from Cape Hatteras to Cape Canaveral (Grothues and Cowen 1999; Hare et al. 2001; Hare et al. 2002). Ichthyoplankton from this transition zone are carried to the Offshore Project area by prevailing currents.

As a result, larvae of species distributed throughout the U.S. Atlantic Coast occur in the Offshore Project area (BOEM 2014). Buoyant eggs and larvae are widely dispersed by currents during the weeks or months they remain in the plankton (Hare et al. 2001; Hare et al. 2002; Walsh et al. 2015). For example, the 4- to 8-month planktonic larval stage of the Atlantic herring allows ample time for individuals to be distributed across the U.S. Atlantic Coast (NEFMC 2017). Such widespread phytoplankton and ichthyoplankton assemblages support some short-lived, highly fecund managed species (e.g., Atlantic mackerel) that serve as a forage base for longer-lived, highly migratory managed species (e.g., tunas, pelagic sharks) (NEFMC 2017; NMFS 2017).

3.1. Benthic Habitat – Softbottom EFH

3.1.1 Seabed Characterization

A detailed analysis of the seabed, resulting from the HRG surveys, is included in COP, Appendix C, *Marine Site Investigation Report* and Appendix CC (2021), *Seabed Morphology Study*[2] (Dominion Energy 2023), and is summarized in this section. The Offshore Project area is bordered by a shallow nearshore plateau to the west and sand ridges deeper to the east. The Lease Area spans across a variety of geological features based on water depth and seafloor features that include: a shallower water depth (typically less than 92 feet [28 meters]) area in the northwestern and western section, with a highly irregular seafloor consisting of sand ridges and superimposed bedforms; an intermediate water depth (typically 92 to 112 feet [28 to 34 meters]) area in the northern section, which consists of lower relief seafloor features; a deeper water depth (greater than 112 feet [34 meters]) area in the eastern section; and a shallower water depth (typically less than 92 feet [28 meters]) area associated with the regional sand ridge massif in the central and southern sections (Appendix CC; Dominion Energy 2023). This larger geologic feature is further subdivided into three larger ridges. The height of the ridges lies between 9 and 33 feet (3 and 10 meters), for the highest ridge, at depths between 66 to 131 feet (20 to 40 meters) (Appendix CC; Dominion Energy 2023). These areas consist of seafloor features that are related to geologic features, surficial sediments, and the hydrodynamic environment. Overall, the Lease Area can be divided by seabed morphology into two areas where the seabed is mostly immobile in the northeast, and mobile in the northwest and southern areas (Figure 3-4) (Appendix CC; Dominion Energy 2023).

The three ridges are composed of coarse sand (d50>0.5/0.6 mm), with finer sediments trapped in the trough areas (Appendix CC; Dominion Energy 2023). These ridges can be several kilometers in length, a few kilometers wide and several meters high (Appendix CC; Dominion Energy 2023). The spaces between the sand ridges consist of deeper flat areas that are mostly immobile with occasional signs of bed erosion where the bathymetry is slightly channelized. The ridges in shallower water depths are shorter in length and width when compared to the larger geologic features. Within the Lease Area and OECC the sand ridges are moving 3 to 7 feet per year (1 to 2 meters per year) southwest (Appendix CC; Dominion Energy 2023).

No large sand wave fields were detected in the Lease Area (Appendix CC; Dominion Energy 2023). The sand waves present on the slopes of sand ridges in the northwest area have fairly low heights and are not very dynamic. Their amplitudes range from 2 to 5 feet (0.5 to 1.5 meters) and wavelengths up to 984 feet (300 meters), which classifies them as mega ripples, though they will be considered along with the sand waves further mentioned (Appendix CC; Dominion Energy 2023). They occur at a higher frequency and display a lower bathymetric relief. The sand waves within the Lease Area have relatively low migration rates of 3 to 10 feet per year (1 to 3 meters per year), compared to the sand waves in the OECC with rates up to 59 feet per year (18 meters per year) within the DNODS (Appendix CC; Dominion Energy 2023). The DNODS overlaps with the OECC and contains dredged sediment from the Chesapeake Bay access

[2] The Seabed Morphology Study was compiled from various data sources, including bathymetry data from 2010, 2011, 2012, 2013, and 2020. The findings were reported in May 2021 for the original COP, with no changes made for consecutive COP versions.

channels. These fine sediments may contribute to the high sediment migration values at that site. If the disposal area site is removed, then the maximum migration would be 19 feet per year (5.9 meters per year), with an average of 11 feet per year (3.3 meters per year).

Softbottom habitats are characterized by soft, unconsolidated sediments, including silt, mud, clay, sand, gravel, pebbles, cobbles, and shell fragments. The softbottom sediments offshore of Virginia are typical of the rest of the MAB and are characterized by fine sand and punctuated by gravel and silt/sand mixes (Milliman 1972; Steimle and Zetlin 2000). Offshore Project area substrates are consistent with this regional pattern and include unconsolidated sediments composed of gravel (larger than 2,000 micrometers), sand (62.5 to 2,000 micrometers), silt (4 to 62.5 micrometers), clay (smaller than 4 micrometers), and shell debris (Williams et al. 2006).

Extensive HRG surveys have been performed in the Offshore Project area (including the Lease Area) as part of BOEM's site Environmental Assessment (McNeilan et al. 2013) and leading up to the CVOW-Pilot Project (Tetra Tech 2013; Tetra Tech 2014). These data are included in publicly available databases, technical literature, and site-specific reports that provide useful data collected in the Offshore Project area. Numerous sources characterize the Offshore Project area and vicinity as predominately fine to coarse-grained sand (Cutter and Diaz 1998; Diaz et al. 2004; Diaz et al. 2006; USACE 2009; Greene et al. 2010; McNeilan et al. 2013; Guida et al. 2017; MARCO 2021). Bottom topography in the offshore survey 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 (Guida et al. 2017). The slopes in the offshore survey area generally fall within 1.2 degrees and rugosity is virtually nonexistent with a ratio value close to 1 throughout the area (Guida et al. 2017). U.S. Fish and Wildlife Service benthic sampling programs determined that the most abundant taxa in Virginia nearshore habitats (in descending order) were polychaetes, bivalves, and amphipods (USACE 2009; Brooks et al. 2006). Cutter and Diaz (1998) noted these taxa as well as decapods, sand dollars, and lancelets. Infaunal assemblages in grab samples collected in the Lease Area were characterized as highly diverse (Guida et al. 2017).

During 2020 and 2021, Dominion Energy completed full-coverage geophysical and geotechnical surveys in the Lease Area and OECC, which characterized the entire Offshore Project area as softbottom habitat (TerraSond 2021; Alpine 2021). Seabed characterization and morphology features (e.g., sediment type, sand-waves, ridges, depressions) were also interpreted from the SBP, UHRS, SSS, MBES, MAG/TVG, and backscatter data. Sediment type and seabed morphology are features that define EFH for some species. Coastal and Marine Ecological Classification Standard (CMECS) softbottom habitat types interpreted from the HRG data account for the entirety of the Offshore Project area and range from muddy sand to coarse sand in the OECC and fine sand to coarse sand in the Lease Area (TerraSond 2021; Alpine 2021). Grain size roughly increases along a west to east gradient along the OECC. Fine sand was identified as the dominant sediment type in the northwest portion of the Lease Area and coarse sand in the southeast portion of the Lease Area, varying with seabed morphology within the Lease Area. CMECS sediment types in the Offshore Project area were interpreted from MBES, SSS, and backscatter data processed at 0.1- to 0.5-square meter resolution, as listed in Table 3-2.

Table 3-2 Sediment types in the Offshore Project area, interpreted from MBES, SSS, and backscatter data processed at 0.1- to 0.5-square meter resolution

Offshore Project Area	Sediment Type (CMECS)	Acres	Percent of Total Acreage (%)
Offshore Export Cable Corridor: Federal Waters	Construction hash	76.89	0.5
	Gravel mixes	2.80	0.02
	Gravelly	1,691.22	10.6
	Mud	11.52	0.1
	Muddy sand	1,324.40	8.3
	Sand	10,598.67	66.7
	Unsurveyed	530.51	3.3
Offshore Export Cable Corridor: State Waters	Muddy sand	1,381.22	8.7
	Sand	45.96	0.3
	Unsurveyed	225.32	1.4
Lease Area	Coarse sand/very coarse sand	62,180.10	55.1
	Fine sand/very fine sand	22,725.62	20.1
	Medium sand	27,893.18	24.7

CMECS = Coastal and Marine Ecological Classification Standard; MBES = multibeam echosounder; SSS = side-scan sonar

3.1.2 Habitat Mapping

NMFS Greater Atlantic Regional Fisheries Office (GARFO) has developed habitat mapping recommendations in coordination with BOEM to ensure that adequate data and information are included as part of EFH assessments associated with offshore wind projects (NMFS-GARFO 2021 [March]). The primary goal of interpreting and mapping seabed features is to quantify and differentiate between complex (hardbottom, gravel mixes, shell, and vegetation) and non-complex sand/silt/mud habitats (grain sizes less than 2 millimeters) in accordance with the CMECS modifiers provided by NMFS-GARFO (2021). CMECS sediment types in the Offshore Project area were interpreted from MBES, SSS, and backscatter data processed at 0.1- to 0.5-square meter resolution, and displayed on maps at a scale of 1:10,000 throughout the Project area, as shown in the COP (Appendix E; Dominion Energy 2023) and the webmap tool, located at: https://cvowc.tetratech.com. Benthic features defined as sand-waves, megaripples, ripples, and biogenic habitats are also important to delineate to characterize and quantify EFH types present in the Project area (NMFS-GARFO 2021).

All acquisition, processing, and interpretation of data was consistent with the BOEM guidelines and NMFS-GARFO recommendations (BOEM 2020; NMFS-GARFO 2021). In addition to providing data to support the overall Project design, the HRG surveys provide ultra-high-resolution data on the seafloor to support accurate interpretation of habitat features in the Offshore Project area. To that end, the following data were collected within the survey area:

- MBES bathymetry and backscatter: gridded at 0.5-meter resolution;
- SSS imagery: collected at 200 percent coverage submitted at 0.25-meter resolution;
- Multi-channel seismic (MCS): 150-meter depth below seabed (bsb), 1-meter resolution;
- Single-channel seismic (SCS): 25-meter depth bsb, 0.4-meter resolution;
- SBP: 12-meter depth bsb, 0.2-meter resolution;

- TVG: gridded at 1-meter resolution; and
- Geotechnical and benthic samples (grab samples and imagery).

Benthic sampling (grab samples, still images, video images) was conducted during summer 2020 (Dominion Energy 2023) and fall 2020 (Schnabel 2021) to provide information on benthic habitats and organisms. Specifically, a portion of the Schnabel Engineering LLC (Schnabel) survey was to “ground-truth” the seabed interpretations from the HRG survey data. A total of 120 grab samples were collected within the Lease Area by TerraSond subcontractor, Schnabel. Of the 120 sites, 80 were positioned based on a regular pattern (60 percent on even corridors, 40 percent on odd), and 40 sites were selected as areas of interest. The first 80 sites were selected by referencing the turbine layout. The remaining 40 sites were selected by reviewing the SSS and backscatter data and selecting areas where the acoustic signature suggested a more variable surficial sediment or appeared to have significant intensity difference from areas already sampled. The sampling locations are fully represented on the maps included in the COP (Appendix E; Dominion Energy 2023) and the webmap tool, located at: https://cvowc.tetratech.com. In addition to Schnabel’s grab sampling, benthic sampling results from previous work conducted by Tetra Tech were provided and used during subsequent interpretation to supplement the available data.

Habitat mapping recommendations were incorporated into the processes and methods used to interpret seabed habitats from the HRG survey data, as detailed in the COP (Appendix C; Dominion Energy 2023), the Marine Site Investigation Report, and the HRG survey reports (TerraSond 2021; Alpine 2021). Backscatter data and sediment sample locations were imported into Blue Marble Geographics Global Mapper v20.0. A correlation of grain sizes in each grab sample with the backscatter amplitude was used to generate contours consistent with backscatter intensity. The generated contours were then adjusted on the basis of the bathymetry and SSS data. The resulting interpreted boundaries were classified using the CMECS Substrate Component and ASTM D2488 to describe the surficial sediments. The digitized regions were then imported into a geographic information system (GIS) project using ESRI ArcCatalog and ESRI ArcMap 10.7.1. Metadata were generated for the sediment boundaries in ESRI ArcCatalog 10.7.1.

Methods used to interpret seabed habitats are summarized from TerraSond (2021) and Alpine (2021) below:

- Grain size sample location point coordinates were imported on the MBES backscatter mosaic in GIS software and the amplitude of the backscatter at each sampling location was measured.
- A plot of sediment size correlated to the backscatter was made to visualize and analyze their relationship and sampling results were ordered by increasing value of grain size (millimeters) and correlated with the backscatter intensity at the sampling location.
- The moving average with a window of 10 samples and a linear interpolation resulted in a general increase of the backscatter reflectivity with the increase of the grain size.
- Laboratory grain size data from the 202 grab samples resulted in CMECS classifications of 97 percent very coarse sand or finer, and 3 percent granule/pebble, with each of the granule/pebble samples located within the CMECS coarse sand mapped areas.
    - Muddy sand (1 sample)
    - Fine/very fine sand (41 samples)
    - Medium sand (62 samples)
    - Coarse sand (91 samples)

  - Very coarse sand (2 samples)
  - Granule (1 sample)
  - Pebble (4 samples)
- The samples were then ordered using CMECS classification, showing the backscatter amplitude for coarse sand, fine/very fine sand, and medium sand. The average backscatter amplitude was calculated for all the classes, and the midpoint between the average values of the various classes was used as backscatter amplitude threshold between the classes: Fine: -70.000 to -28.456, Medium: -28.456 to -24.611, Coarse: -24.611 to 0.000; see Figure 3-3.
- These limits between classes were used in GIS software to generate contours of the backscatter values, and the resulting areas represent a first approximation of the distribution of seabed sediments grainsize on the Lease Area and OECC, using the CMECS classification.
- A certain amount of variation is observed in the backscatter amplitude for each grain size class. This observed variation is due to the accuracy of the sample positioning coordinates and to the variability in the backscatter ranges across the Lease Area and OECC. This difference in backscatter is expected in large surveys when thousands of survey lines from different vessels are merged for the creation of a single mosaic covering the whole study area.
- Additional corrections in the backscatter class limits were performed in a few portions of the area, showing a general positive or negative variation in the backscatter amplitude. The values were selected to obtain the maximum possible continuity of the sediment class areas previously generated using the average values.
- Additional manual editing of the mapped areas was performed on the basis of the sample grain sizes, the low frequency SSS mosaic, and the geomorphology observed in bathymetric data. This manual editing was done to remove spikes and artifacts, as well as to improve the general interpretation of the class areas.

Resulting seabed morphology and sediment types are shown as overview maps (for informational purposes only) in Figure 3-4 through Figure 3-7, with additional detailed panels shown at a 1:10,000 scale in the COP (Appendix E; Dominion Energy 2023). Additionally, the full-coverage and full-resolution Offshore Project area seabed CMECS habitat interpretations based on geophysical survey data are available to BOEM and NMFS as a webmap tool, located at: https://cvowc.tetratech.com. This tool can be used to generate custom-view data-based habitat maps that display the characterized delineations and complex/non-complex or heterogeneous complex benthic features, provided at user-defined scales appropriate to habitat features, consistent with the NMFS-GARFO habitat mapping and minimum mapping unit recommendations (NMFS-GARFO 2021). As part of the benthic resource assessment, the sediment characteristics were crossed-walked into CMECS biotic subclasses and provided in Table 3-3 with supporting habitat group refences in Tables 3-4 to 3-6.

Table 3-3 Table of habitat types by project component

Habitat Types	Project Component Area					
	Lease Area	Offshore/Onshore Export Cable: Export cable route	Offshore/Onshore Export Cable: Landing area	Offshore/Onshore Export Cable: Interior coastal	Port Modifications	Operation and Maintenance (O&M) Facility
Rocky (total area that is 5% or greater of all: granule-pebble, cobble, boulder, ledge/bedrock)	0 acres	1,694.02 acres consisting of the following substrate groups: (see notes) • 2.80 acres of "gravel mixes" • 1,691.22 acres of "gravelly"	0 acres (see notes)	0 acres	N/A	N/A
Softbottom Mud (intertidal, shallow-water, and deep)	0 acres	11.52 acres	0 acres (see notes)	0 acres	N/A	N/A
Softbottom Sand (with and without sand ripple, shoals, waves/ridges)	112,798.90 acres	13,350.25 acres consisting of the following substrate groups: • 2,705.62 acres of "muddy sand" • 10,644.63 acres of "sand"	0 acres (see notes)	0 acres	N/A	N/A
Submerged Aquatic Vegetation	0 acres	0 acres	0 acres (see notes)	0 acres	N/A	N/A
Tidal Marsh (e.g., saltmarsh and brackish marsh)	0 acres	0 acres	0 acres (see notes)	0 acres	N/A	N/A
Shellfish Reefs and Beds (e.g., hard clams, Atlantic surfclam, mussels, oysters)	0 acres	0 acres	0 acres (see notes)	0 acres	N/A	N/A
Shell Accumulations	0 acres (see notes)	0 acres (see notes)	0 acres (see notes)	0 acres	N/A	N/A

Habitat Types	Project Component Area					
	Lease Area	Offshore/Onshore Export Cable: Export cable route	Offshore/Onshore Export Cable: Landing area	Offshore/Onshore Export Cable: Interior coastal	Port Modifications	Operation and Maintenance (O&M) Facility
Other Biogenic (e.g., cerianthids, corals, emergent tubes – polychaetes)	0 acres	0 acres	0 acres (see notes)	0 acres	N/A	N/A
Pelagic (offshore and estuarine)	112,798.90 acres	15,886.48 acres	0 acres (see notes)	0 acres	N/A	N/A
Habitat for Sensitive Life Stages (i.e., demersal eggs, spawning activity-discrete areas)	0 acres	0 acres	0 acres (see notes)	0 acres	N/A	N/A
Habitat Areas of Particular Concern (HAPC)	0 acres	0 acres	0 acres	0 acres	N/A	N/A

Notes: Though not typically considered “rocky,” this habitat type includes gravels, gravel mixes, and gravelly sand.
All values based on GIS-calculated areas of seabed interpretation data, available in Appendix E (Table E-5) of the Construction and Operations Plan (COP) (Dominion Energy 2023), and in more detail in the Project-specific Essential Fish Habitat (EFH) webmapper: https://cvowc.tetratech.com/efha.
The offshore export cable landings would occur via trenchless installation, approximately 10 to 125 feet (3 to 38 meters) below the seafloor and would not impact the seafloor habitats within 1,000 to 1,800 feet (305 to 549 meters) of the shoreline.
A portion of the export cable route corridor runs through the Dam Neck Offshore Disposal Site, a portion of which (76.89 acres [31 hectares) is classified as “construction hash.”
Unsurveyed portion of the offshore export cable route corridor = 755.83 acres (306 hectares). Approximately 225 acres (91 hectares) of that is immediately adjacent to the cable landing, extending out to approximately 2,427 feet (740 meters) from the shoreline, which was too shallow for survey vessels to acquire data.
There are no HAPC overlapping or adjacent to the Project area.
Pelagic habitat is inclusive of all water column habitat, therefore, the full acreage of the Lease Area and export cable corridor.
Shell accumulations were not specifically characterized or quantified across the entire Lease Area or export cable corridor. However, shell hash and shell rubble were noted where present in benthic grab sample data (see Appendix D of the COP; Dominion Energy 2023).
Habitat for sensitive life stages was not specifically characterized or surveyed across the entire Lease Area or export cable corridor. However, the presence of EFH in the Project area by species and life stage was quantified for each species with EFH in the Project area (see Appendix E, Attachment E-1 of the COP [Dominion Energy 2023] for acreages for applicable species and life stages).
Port and O&M facilities are not included as part of the Project footprint as these facilities would be leased, and any required upgrades would be undertaken by the lessor to support broader domestic offshore wind development.

Table 3-4 Habitat table group referenced against CMECS (class, subclass and groups)

Habitat Table Group	Class	Subclass	Group(s)
Rocky (general, to include all: granule-pebble, cobble, boulder, ledge/bedrock) Note that CMECS Biotic Subclasses Benthic Macroalgae and Attached Fauna should be addressed in the characterization of rocky habitats.	Substrate Class: Rock Substrate	Substrate Subclass: Bedrock	N/A
		Substrate Subclass: Megaclast	N/A
	Substrate Class: Unconsolidated Mineral Substrate – with 5% or greater of particles 2 millimeter (mm) to <4,096 mm	Substrate Subclass: Coarse Unconsolidated Substrate	Substrate Group: Gravels
			Substrate Group: Gravel Mixes
			Substrate Group: Gravelly
Softbottom Mud (intertidal, shallow-water, and deep) Note that CMECS Biotic Subclasses Soft Sediment Fauna and Inferred Fauna should be addressed in the characterization of mud habitats	Substrate Class: Unconsolidated Mineral Substrate – with <5% or greater of particles 2 mm to <4,096 mm	Substrate Subclass: Fine Unconsolidated Substrate – with >50% of particles <0.625 mm	Substrate Group: Slightly Gravelly (Note: this CMECS category label is not used in the Recommendations for Mapping Fish Habitat, but it is incorporated into the classification of the Fine Unconsolidated Substrate substrates)
			Substrate Group: Sandy Mud
			Substrate Group: Mud
Softbottom Sand (with and without sand ripple, shoals, waves/ridges) Note that CMECS Biotic Subclasses Soft Sediment Fauna and Inferred Fauna should be addressed in the characterization of sand habitats	Substrate Class: Unconsolidated Mineral Substrate – with <5% or greater of particles 2 mm to <4,096 mm	Substrate Subclass: Fine Unconsolidated Substrate – with ≥50% of particles 0.625 mm to <2 mm	Substrate Group: Slightly Gravelly (Note: this CMECS category label is not used in the Recommendations for Mapping Fish Habitat, but it is incorporated into the classification of the Fine Unconsolidated Substrate substrates)
			Substrate Group: Sand
			Substrate Group: Muddy Sand
Submerged Aquatic Vegetation	Biotic Class: Aquatic Vegetation Bed	Biotic Subclass: Aquatic Vascular Vegetation	Biotic Group: Seagrass Bed
			Biotic Group: Freshwater and Brackish Tidal Aquatic Vegetation

Habitat Table Group	Class	Subclass	Group(s)
Tidal Marsh (i.e., saltmarsh and brackish marsh)	Biotic Class: Emergent Wetland	Biotic Subclass: Emergent Tidal Marsh	Biotic Group: Brackish Marsh
			Biotic Group: Freshwater Tidal Marsh
			Biotic Group: High Salt Marsh
			Biotic Group: Low and Intermediate Salt Marsh
		Biotic Subclass: Vegetated Tidal Flats	Biotic Group: Vegetated Freshwater Tidal Mudflat
			Biotic Group: Vegetated Salt Flat and Panne
	Biotic Class: Scrub-Shrub Wetland	Biotic Subclass: Tidal Scrub-Shrub Wetland	Biotic Group: Brackish Tidal Scrub-Shrub
			Biotic Group: Freshwater Tidal Scrub-Shrub
			Biotic Group: Saltwater Tidal Scrub-Shrub
			Biotic Group: Tidal Mangrove Shrubland
	Biotic Class: Forested Wetland	Biotic Subclass: Tidal Forest/Woodland	Biotic Group: Brackish Tidal Forest/Woodland
			Biotic Group: Freshwater Tidal Forest/Woodland
			Biotic Group: Saltwater Tidal Forest/Woodland
			Biotic Group: Tidal Mangrove Forest
Shellfish Reefs and Beds (e.g., hard clams, Atlantic surfclam, mussels, oysters)	Substrate Class: Shell Substrate	Substrate Subclass: Shell Reef Substrate	Substrate Group: Clam Reef Substrate
			Substrate Group: Crepidula Reef Substrate
			Substrate Group: Mussel Reef Substrate
			Substrate Group: Oyster Reef Substrate
		Substrate Subclass: Shell Rubble if dominated by living shells	Substrate Group: Clam Rubble
			Substrate Group: Crepidula Rubble
			Substrate Group: Mussel Rubble
			Substrate Group: Oyster Rubble

Habitat Table Group	Class	Subclass	Group(s)
Continued from above	Biotic Class: Faunal Bed	Biotic Subclass: Mollusk Reef Biota	Biotic Group: Mussel Reef
			Biotic Group: Oyster Reef
			Biotic Group: Gastropod Reef
		Biotic Subclass: Attached Fauna	Biotic Group: Attached Mussels
			Biotic Group: Attached Oysters
		Biotic Subclass: Soft Sediment Fauna	Biotic Group: Clam Bed
			Biotic Group: Mussel Bed
			Biotic Group: Oyster Bed
			Biotic Group: Scallop Bed
Shell Accumulations	Substrate Class: Shell Substrate	Substrate Subclass: Shell Hash	Substrate Group: Clam Hash
			Substrate Group: Crepidula Hash
			Substrate Group: Mussel Hash
			Substrate Group: Oyster Hash
		Substrate Subclass: Shell Rubble if dominated by non-living shells	Substrate Group: Clam Rubble
			Substrate Group: Crepidula Rubble
			Substrate Group: Mussel Rubble
			Substrate Group: Oyster Rubble
Other Biogenic (e.g., cerianthids, corals, emergent tubes – polychaetes) Areas with corals or dense aggregations of epifauna or emergent infauna should be identified and characterized	Biotic Class: Reef Biota	Biotic Subclass: Deepwater/ Coldwater Coral Reef Biota	Biotic Group: Deepwater/Coldwater Stony Coral Reef
			Biotic Group: Deepwater/Coldwater Stylasterid Coral Reef
			Biotic Group: Colonized Deepwater/Coldwater Reef

Habitat Table Group	Class	Subclass	Group(s)
Continued from above		Biotic Subclass: Shallow/Mesophotic Coral Reef Biota	Biotic Group: Branching Coral Reef
			Biotic Group: Columnar Coral Reef
			Biotic Group: Encrusting Coral Reef
			Biotic Group: Foliose Coral Reef
			Biotic Group: Massive Coral Reef
			Biotic Group: Plate Coral Reef
			Biotic Group: Table Coral Reef
			Biotic Group: Turbinate Coral Reef
			Biotic Group: Mixed Shallow/Mesophotic Coral Reef
			Biotic Group: Colonized Shallow/Mesophotic Reef
	Biotic Class: Faunal Bed	Biotic Subclass: Glass Sponge Reef Biota	Biotic Group: Glass Sponge Reef
		Biotic Subclass: Mollusk Reef Biota	Biotic Group: Gastropod Reef
		Biotic Subclass: Worm Reef Biota	Biotic Group: Sabellariid Reef
			Biotic Group: Serpulid Reef
		Biotic Subclass: Attached Fauna	Biotic Group: Attached Corals
		Biotic Subclass: Soft Sediment Fauna	Biotic Group: Diverse Soft Sediment Epifauna
			Biotic Group: Larger Tube-Building Fauna
			Biotic Group: Small Tube-Building Fauna
			Biotic Group: Burrowing Anemones
			Biotic Group: Brachiopod Bed
			Biotic Group: Soft Sediment Bryozoans
			Biotic Group: Hydroid Bed
			Biotic Group: Pennatulid Bed
			Biotic Group: Sponge Bed
			Biotic Group: Tunicate Bed
Pelagic (offshore and estuarine)			

Habitat Table Group	Class	Subclass	Group(s)
Habitat for Sensitive Life Stages (i.e., demersal eggs, spawning activity-discrete areas)	Not defined by CMECS but by managed spp. that occur in the project area		
Habitat Areas of Particular Concern	Not defined by CMECS but by managed spp. that occur in the project area		

Note the following substrate classes and groups should not be defined as substrate classes and should be addressed as biotic components under appropriate habitat type (see Tables 3-5 and 3-6):

- Substrate Class: Algal Substrate
- Substrate Class: Coral Substrate
- Substrate Subclass: Shell Sand
    - Substrate Subgroup: Coquina Hash
- Substrate Class: Worm Substrate
    - Substrate Subclass: Sabellariid Substrate
        - Substrate group: Sabellariid Reef Substrate
        - Sabellariid Rubble
        - Sabellariid Hash
            - Serpulid Substrate
                - Serpulid Reef Substrate
                - Serpulid Rubble
                - Serpulid Hash

Table 3-5 Table of biotic subclasses that should be addressed in the characterization of rocky habitat [a]

Biotic Subclass	Biotic Group
Benthic Macroalgae	Calcareous Algal Bed
	Canopy-Forming Algal Bed
	Coralline/Crustose Algal Bed
	Filamentous Algal Bed
	Leathery/Leafy Algal Bed
	Mesh/Bubble Algal Bed
	Sheet Algal Bed
	Turf Algal Bed
Attached Fauna	Biotic Group: Attached Sea Urchins
	Biotic Group: Attached Tunicates
	Biotic Group: Attached Starfish
	Biotic Group: Attached Sponges
	Biotic Group: Attached Hydroids
	Biotic Group: Sessile Gastropods
	Biotic Group: Mobile Crustaceans on Hard or Mixed Substrates
	Biotic Group: Attached Crinoids
	Biotic Group: Chitons
	Biotic Group: Attached Bryozoans
	Biotic Group: Brittle Stars on Hard or Mixed Substrates
	Biotic Group: Attached Brachiopods
	Biotic Group: Attached Basket Stars
	Biotic Group: Barnacles

Biotic Subclass	Biotic Group
	Biotic Group: Attached Anemones
Attached Fauna (continued)	Biotic Group: Vent/Seep Communities –
	Biotic Group: Attached Tube-Building Fauna
	Biotic Group: Diverse Colonizers
	Biotic Group: Wood Boring Fauna
	Biotic Group: Mineral Boring Fauna

[a] Total area that is 5% or greater of all: granule-pebble, cobble, boulder, ledge/bedrock.

Table 3-6 Table of biotic subclasses that should be addressed in the characterization of mud and sand habitat [a]

Biotic Subclass	Biotic Group
Soft Sediment Fauna	Larger Deep-Burrowing Fauna
	Small Surface-Burrowing Fauna
	Tunneling Megafauna
	Oligozoic Biota
	Soft Sediment Brittle Stars
	Soft Sediment Crinoids
	Mobile Crustaceans on Soft Sediments
	Echiurid Bed
	Holothurian Bed
	Mobile Mollusks on Soft Sediments
	Sand Dollar Bed
	Starfish Bed
	Burrowing Urchins
	Sea Urchin Bed
	Egg Masses
	Fecal Mounds
	Pelletized, Fluid Surface Layer
	Tracks and Trails

[a] Softbottom Mud: intertidal, shallow-water, and deep; Softbottom Sand: with and without sand ripple, shoals, waves/ridges.

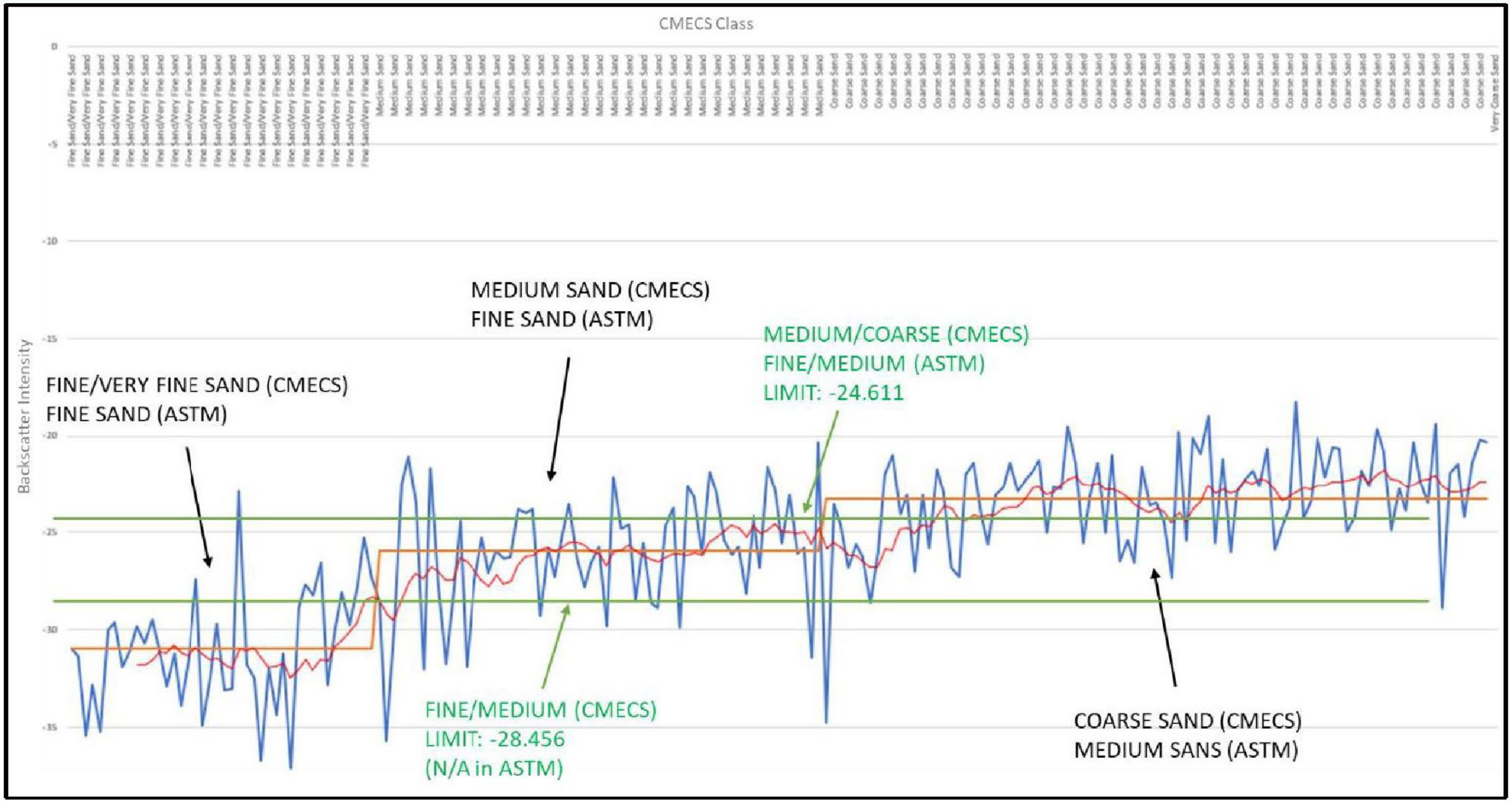
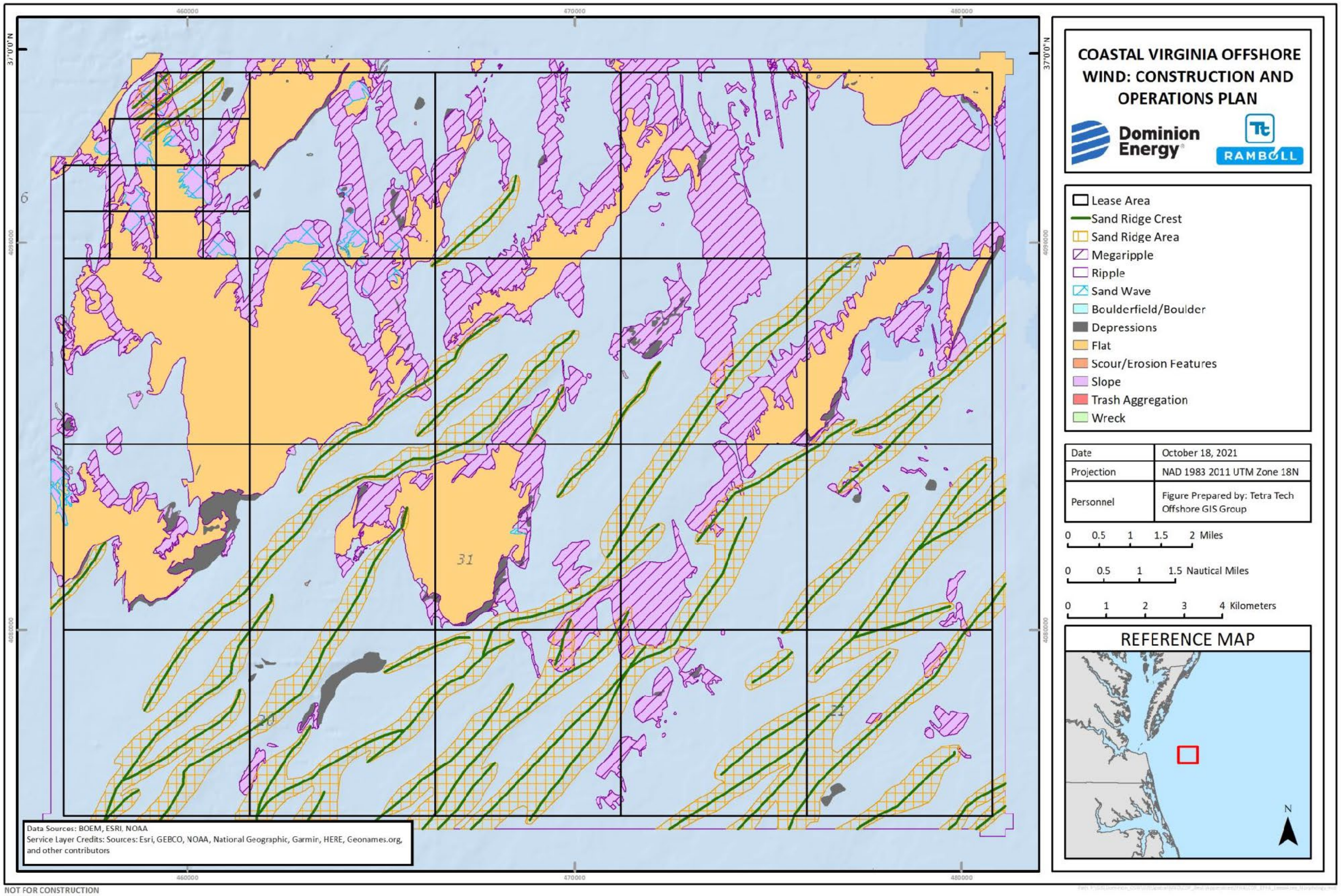
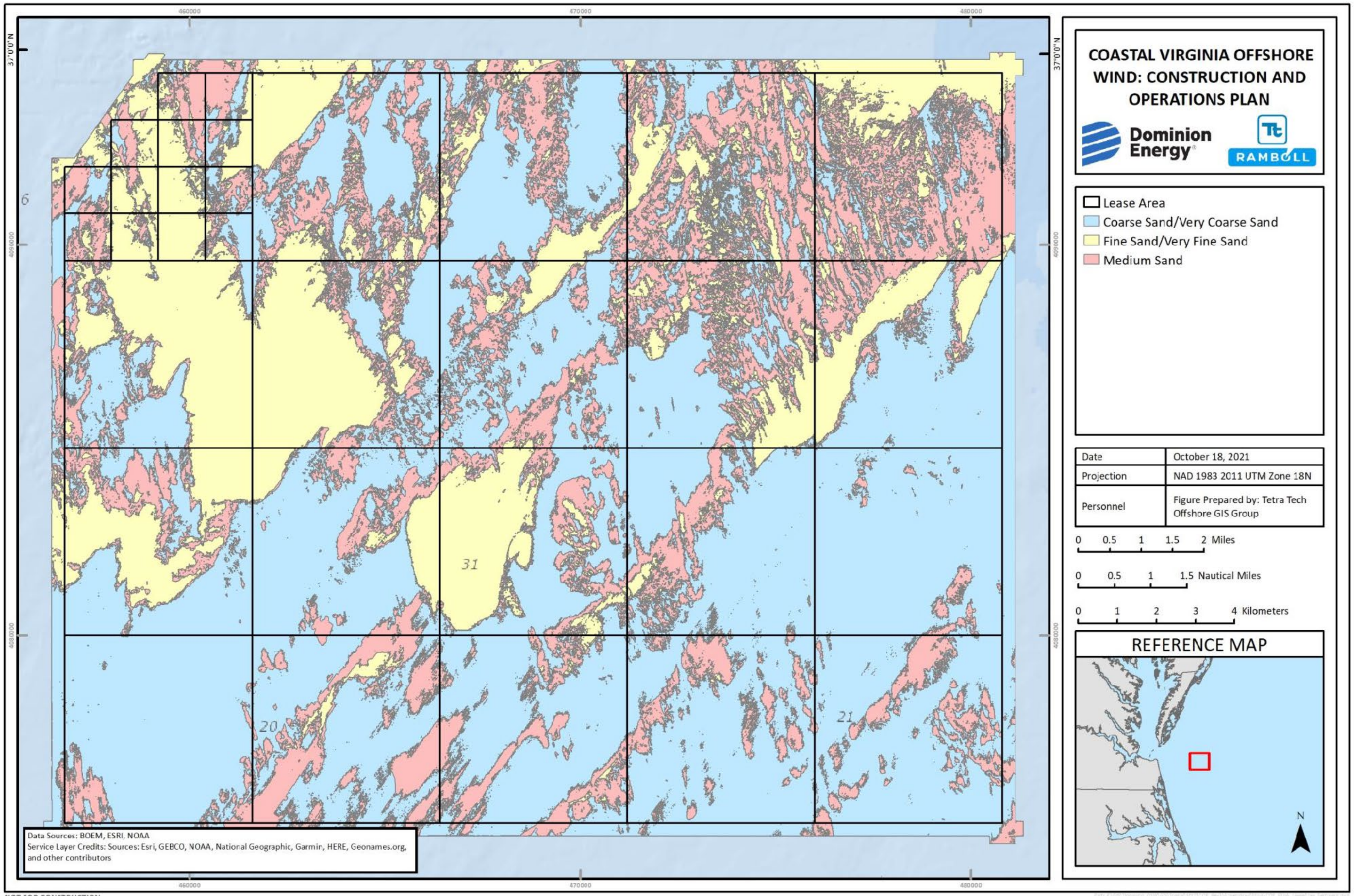


Figure 3-3 Grain size and backscatter correlation based on samples classification



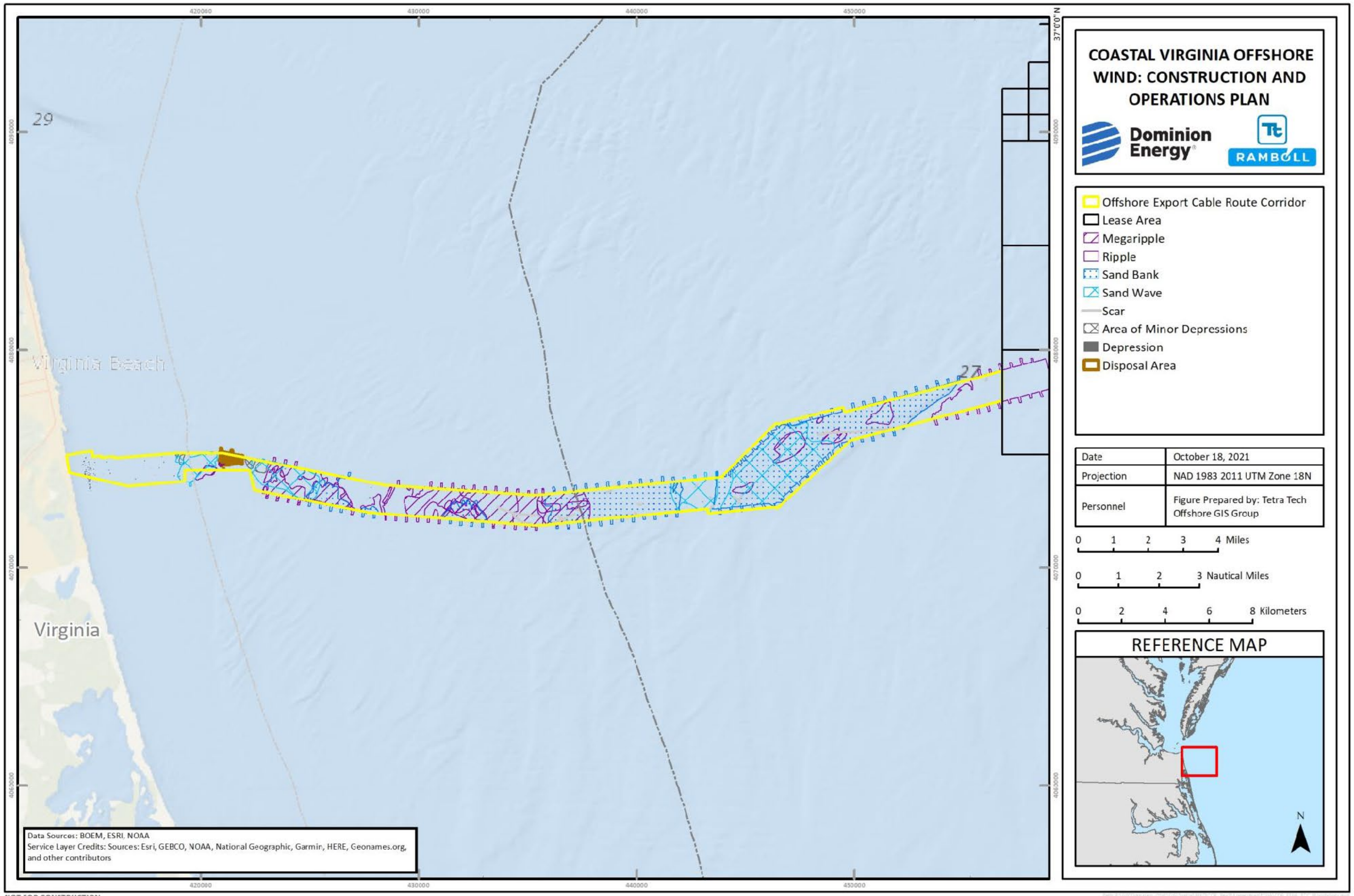
Source: Dominion Energy 2023; see COP, Appendix E for full-scale maps

Figure 3-4 Seabed morphology overview in the Lease Area



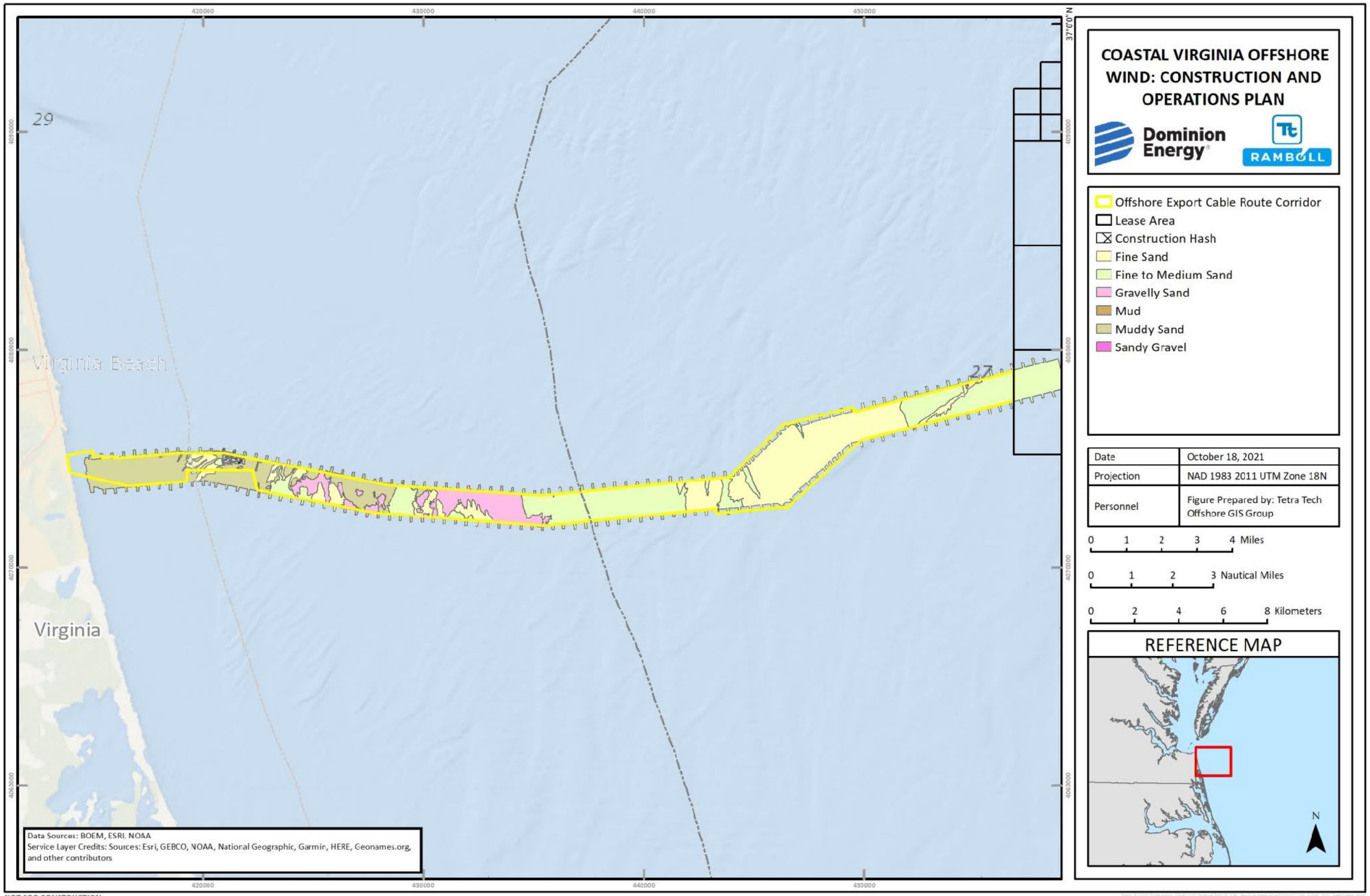
Source: Dominion Energy 2023; See COP, Appendix E for full-scale maps

Figure 3-5 Seabed habitat interpretation overview as CMECS in the Lease Area



Source: Dominion Energy 2023

Figure 3-6 Seabed morphology overview in the offshore export cable corridor



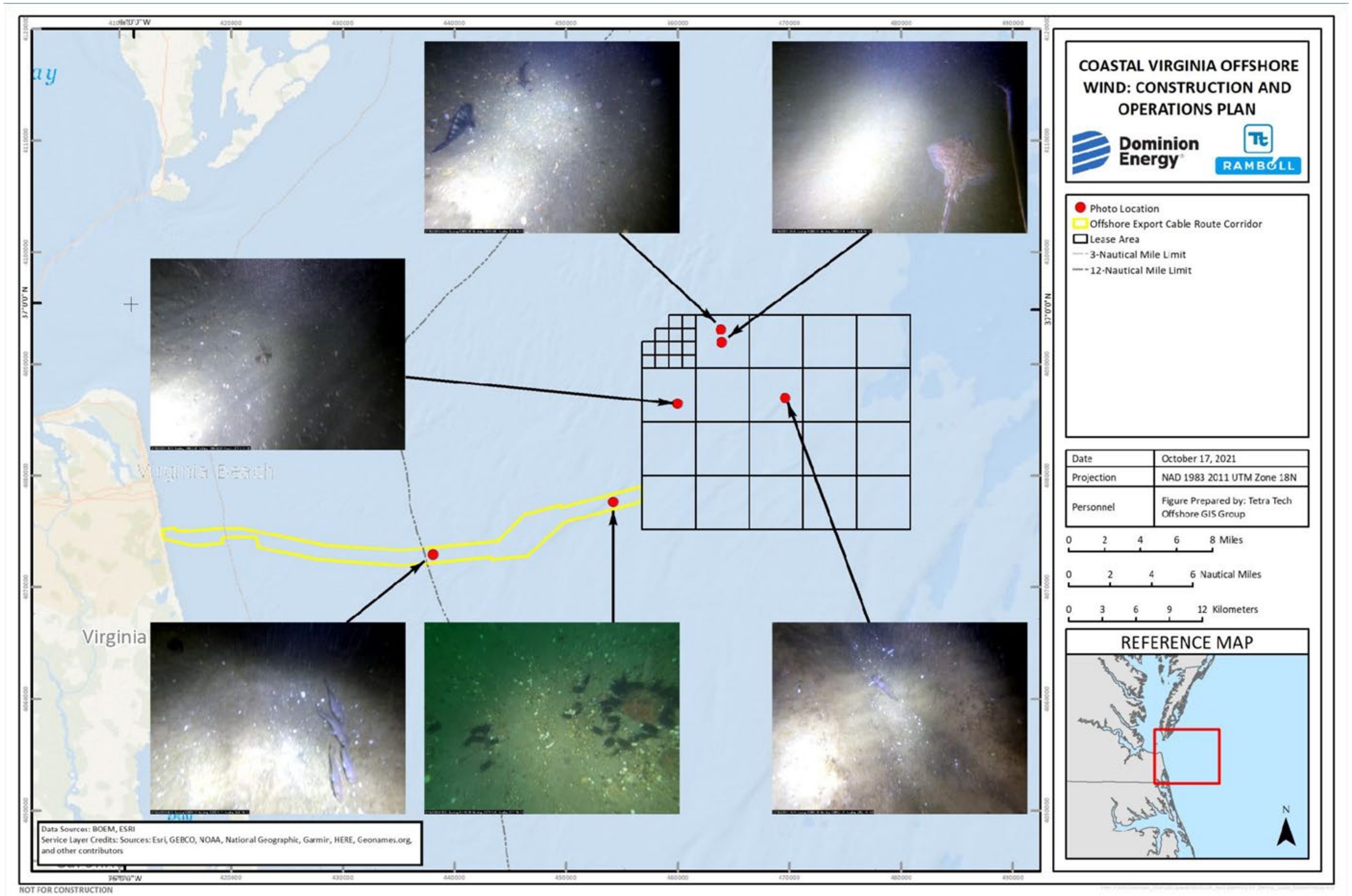
Source: Dominion Energy 2023.

Figure 3-7 Seabed habitat interpretation overview as CMECS in the offshore export cable corridor

Benthic resources were further characterized in summer 2020 (Dominion Energy 2023) and fall 2020 (TerraSond 2021; Alpine 2021) with benthic characterization surveys completed in the Offshore Project area using digital imagery, sediment grab, and water quality samples. Grab samples from all surveys (total of 202 grab samples) were analyzed for particle size distribution, total organic carbon (TOC), and benthic infauna to ground-truth the sediment types observed in digital imagery. Mean sediment composition for the 202 grab samples was approximately 97 percent coarse sand or finer, with only 3 percent consisting of granule or pebble (TerraSond 2021). Mean TOC for the summer 2020 grab samples was 0.3 percent (range 0.1 to 1.2 percent).

Survey results corroborated the habitats generated by the EFH Data Inventory for the EFH Mapper desktop analysis (Table 3-2), depicting habitat suitable for temperate, softbottom-associated species and life stages. Habitat observed in the Offshore Project area was generally homogenous, with summer bottom temperatures spanning 54.7 to 66.6°F (12.6 to 19.2°C), salinities within 31.9 to 32.8 Practical Salinity Units, and unconsolidated sediment grain sizes ranging from fine sand with silt and clay to medium/coarse sand and gravel with shell hash. Depths gradually increase in the surveyed portion of the OECC from 43 feet (13 meters) to 98 feet (30 meters) and 98 feet (30 meters) to 131 feet (40 meters) in the surveyed portion of the Lease Area.

Observed biogenic habitat during the benthic survey was limited to a single blue mussel bed (*Mytilus edulis*) within the OECC. Sessile and slow-moving epifauna observed along transects throughout the Offshore Project area were characteristic of the Mid-Atlantic softbottom habitat and included sand dollars (*Echinarachnius parma*), sea stars (*Asteroides* spp.), sea urchins (*Echinoida* spp.), moon snails (*Neverita lewisii*), whelks (*Busycon carica*), and various portunid and hermit crabs. No managed species were observed in the OECC. Of the managed species with designated EFH in the Lease Area, black sea bass, Atlantic butterfish, clearnose skate (*Raja eglanteria*), and scup were observed in digital imagery (Figure 3-8) in areas of fine to medium sand punctuated by shell hash, sand dollars, and egg masses (e.g., Loliginid, Naticid, Rajid eggs). Results are described in detail in Appendix D, *Benthic Resource Characterization*, a supplemental filing to the COP (Dominion Energy 2023). These uniform, sandy habitats and associated infaunal assemblages support an array of both managed and unmanaged demersal species. Softbottom sediments are dynamic and prone to transport by physical processes and restructuring by biological processes, such as feeding and burrowing. Managed species using these softbottom habitats for spawning, development, and foraging include Atlantic cod (*Gadus morhua*), pollock (*Pollachius virens*), flounder species, skate species, red hake (*Urophycis chuss*), monkfish (*Lophius americanus*), several migratory sharks, and others (COP Appendix E, Dominion Energy 2023; NEFMC 2017; MAFMC 2017; NMFS 2017).



Source: Dominion Energy 2023

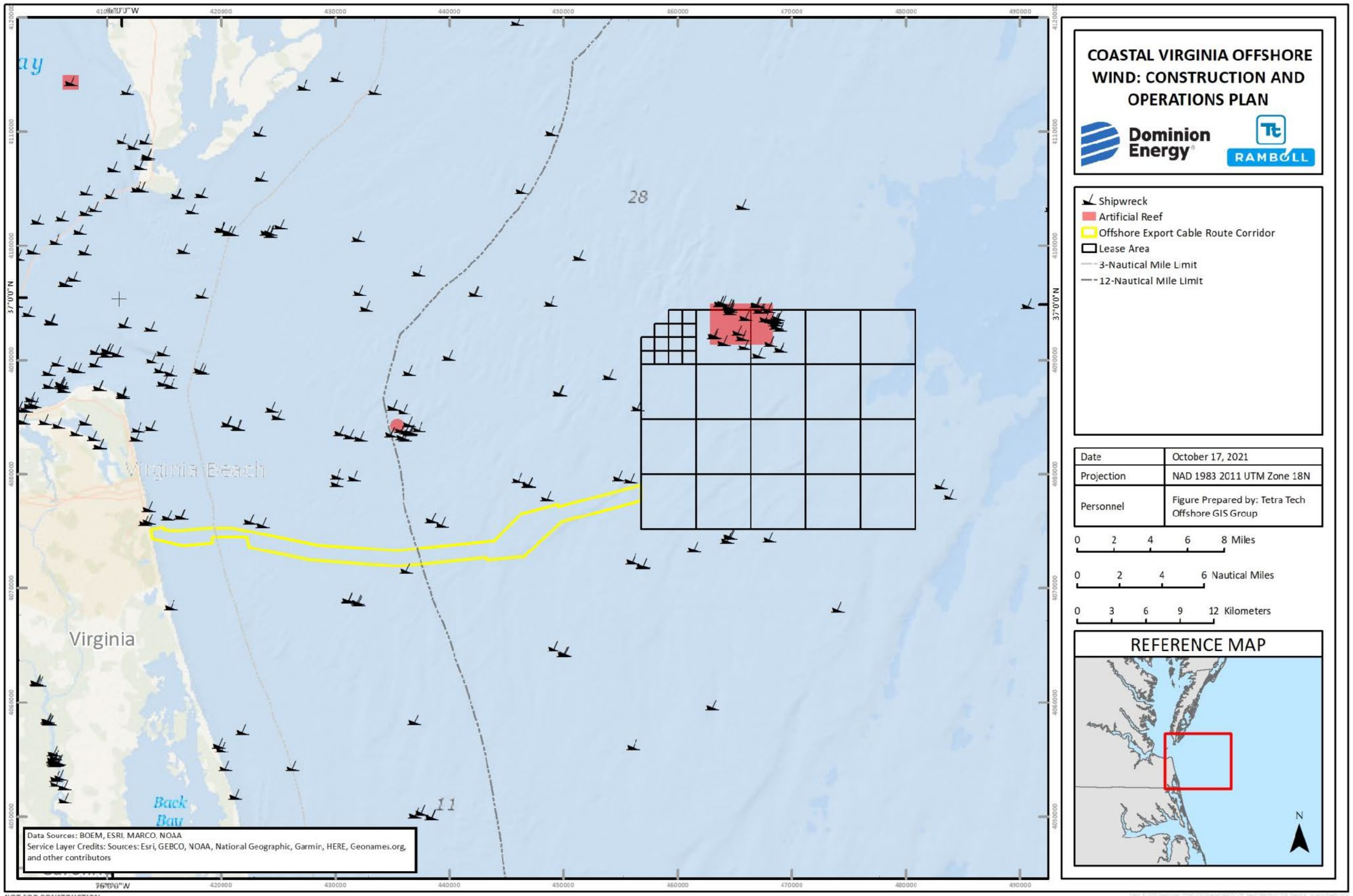
Figure 3-8 Representative plan view bottom images in the Offshore Project area collected during summer 2020 surveys

The assemblage of species using softbottom habitats varies with season and distance from the shoreline, just as pelagic assemblages do. Such species inhabit a spectrum of inshore-offshore habitats according to preferred thermal and depth gradients. For example, blacktip shark (*Carcharhinus limbatus*) neonates and young-of-year prefer shallow coastal waters from the shoreline to depths of 66 feet (20 meters) in temperatures of 70 to 90°F (21 to 32°C); juveniles and adults prefer even shallower waters (NMFS 2017). Witch flounder (*Glyptocephalus cynoglossus*) juveniles and adults, in contrast, exhibit preferences for depths of 66 feet (20 meters) to 5,135 feet (1,565 meters) in temperatures of 32 to 59°F (0 to 15°C) (NEFMC 2017). Some demersal species make inshore-offshore seasonal migrations. For example, resident red hake juveniles and adults exhibit limited seasonal migrations, preferring inshore waters in spring and fall and offshore waters in summer and winter (Steimle et al. 1999a).

3.1.3 Benthic Habitat: Hardbottom EFH

Naturally occurring hardbottom habitats and structured reefs are rare in the MAB; no hardbottom was detected in the 2020 to 2021 HRG or benthic surveys in the Offshore Project area (TerraSond 2021; Alpine 2021; COP Appendix E, Dominion Energy 2023), which is consistent with previous hydrographic surveys in this region (Cutter and Diaz 1998; Diaz et al. 2004; Poppe et al. 2005; Diaz et al. 2006; USACE 2009; Greene et al. 2010; McNeilan et al. 2013; Guida et al. 2017; MARCO 2021). An artificial reef habitat was created in the northern portion of the Lease Area known as the Fish Haven (Figure 3-9), where several large World War II-era tankers and transport ships, tires, and other structures were placed beginning in the 1970s (Lucy 1983). The VMRC continues to facilitate artificial reef development by adding scuttled cables, tires, and other materials to the Fish Haven (VMRC 2022).

Artificial reefs, such as Triangle Reef, provide hard vertical relief and structural complexity in the form of crevices and interstitial spaces; such complexity offers refuge from predation and energy-depleting currents, as well as a forage base resulting from increased biomass of prey. During 2020 surveys for Dominion Energy, several cables and other anthropogenic debris associated with Triangle Reef were observed along transects located within Fish Haven. Notably, managed species with EFH designated in the Offshore Project area, including black sea bass, butterfish, and clearnose skate, were observed aggregating either directly on these cables or within the same transect in the vicinity of the artificial habitat.



Source: Dominion Energy 2023

Figure 3-9 Publicly documented shipwrecks and artificial reefs in the Offshore Project area and vicinity

3.1.4 Benthic-Pelagic Coupling

The energy transfer that occurs between the seafloor and water column as organisms eat, excrete waste, and decompose is termed benthic-pelagic coupling. Most marine organisms are neither wholly benthic nor wholly pelagic, but rather rely on the habitat continuum to support their various life stages. The Atlantic sea scallop (*Placopecten magellanicus*), for example, has benthic egg and planktonic larval stages. After hatching, scallop larvae mature in the plankton for 5 to 6 weeks before transforming into juveniles and settling on benthic substrates. Adults spend the rest of their lives filter-feeding on plankton in the water column of the pelagic habitat, enriching the sediment with their wastes, and releasing new generations to repeat the cycle (Munroe et al. 2018). Longfin inshore squid (*Loligo pealeii*), by contrast, have pelagic larval, juvenile, and adult stages; however, adults anchor egg masses, or "mops," to hard substrates in benthic habitats (Cargnelli et al. 1999a; Jacobson 2005). Bivalve mollusks such as the Atlantic surfclam use softbottom sediments and extend their siphons into the water column to feed on plankton and nutrient-rich detritus (Cargnelli et al. 1999a).

Per NOAA Fisheries, EFH includes the waters and substrates necessary for species' growth to maturity (including spawning, breeding, and feeding) [16 U.S.C. 1801(10)], where "necessary" indicates a level required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. The joint contribution of benthic and pelagic habitat components to EFH is evident in the seafloor substrates, water column depths, and the intersection of the two at the sediment-water interface.

4. EFH Designations within the Project Area and OECC

The EFH designations described in this section correspond to those currently accepted and designated by the New England Fishery Management Council (NEFMC), MAFMC, South Atlantic Fishery Management Council (SAFMC), and NOAA Highly Migratory Species Division (NEFMC 2017). Many EFH designations are determined for each cell in a 10' latitude by 10' longitude square grid in state and federal waters. The Lease Area intersects four cells and the OECC intersects five cells (Figure 4-1). The specific FMPs with protective designations of EFH include:

- NEFMC
    - Northeast Multispecies FMP
    - Atlantic Sea Scallop FMP
    - Monkfish FMP
    - Atlantic Herring FMP
    - Skate FMP
- MAFMC
    - Atlantic Mackerel, Squid, and Butterfish FMP
    - Spiny Dogfish FMP
    - Summer Flounder, Scup, and Black Sea Bass FMP
    - Bluefish FMP
    - Atlantic Surfclam and Ocean Quahog FMP
- NOAA Highly Migratory Species Division
    - Consolidated Atlantic Highly Migratory Species FMP
- SAFMC
    - Coastal Migratory Pelagics FMP

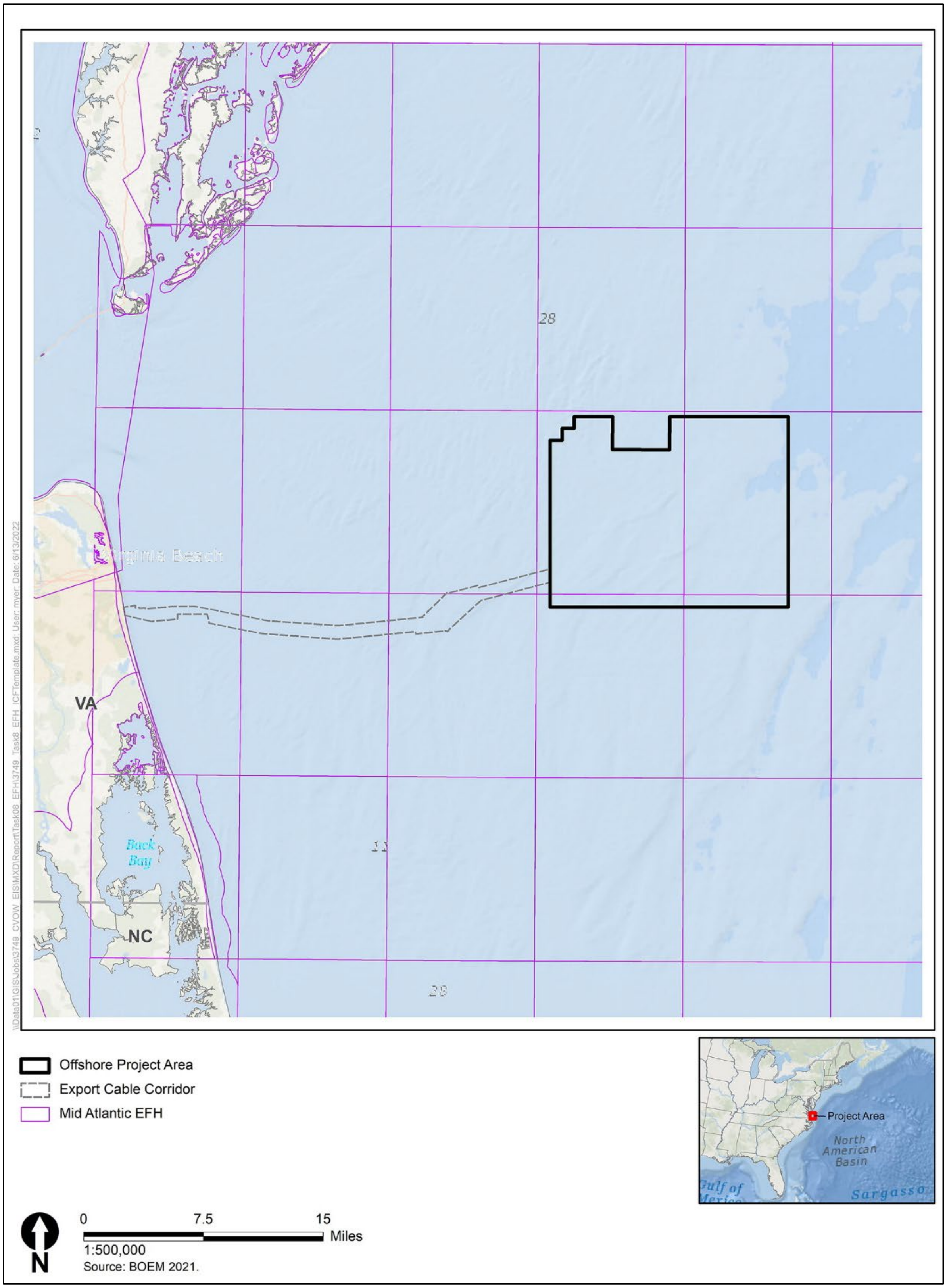


Figure 4-1 Essential Fish Habitat (EFH) grid units as designated by NOAA Fisheries that intersect with the Lease Area and Offshore Export Cable Corridor

4.1. EFH Designations Within the Project Area

EFH is designated for 41 fish species within the Lease Area and the OECC (Table 4-1). Both substrate and water habitats are cited as EFH within both the Lease Area and OECC.

Approximately 600 fish species are resident or transient through the benthic and pelagic habitats of Virginia's coastal waters (Robins and Ray 1986). Benthic or pelagic EFH has been designated in the Offshore Project area for one or more life stages of 41 species. Species with EFH in the Offshore Project area were identified using the NOAA Fisheries EFH Mapper (2022a), NEFMC Omnibus Amendment 2 (2017), MAFMC FMPs, NOAA Fisheries Highly Migratory Species Amendment 10 (2017), and NOAA Fisheries EFH source documents. Dominion Energy further refined this list of species and life stages by conducting extensive surveys of the Lease Area and OECC.

Table 4-1 Essential Fish Habitat (EFH)-designated species in the Project areas (Lease Area and offshore export cable route [OECC])

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
Atlantic albacore tuna (*Thunnus alalunga*)					●	●	●	●		**General habitat description**: Juveniles migrate to northeastern Atlantic waters in the summer for feeding. Adults are commonly found in northern Atlantic waters in September and October for feeding. **Juveniles**: EFH for juvenile albacore tuna is designated as pelagic offshore waters of the U.S. Atlantic east coast from Cape Cod to Cape Hatteras. **Adults**: Adult albacore tuna EFH is also designated along the U.S. Atlantic east coast from Cape Cod to Cape Hatteras generally farther offshore than EFH for juveniles.
Atlantic angel shark (*Squatina dumeril*)					●	●	●	●		**General habitat description**: Insufficient data is available to differentiate EFH between the juvenile and adult size classes; therefore, EFH is the same for those life stages. **Juveniles/ Adults**: EFH in the Atlantic Ocean includes continental shelf habitats from Cape May, New Jersey to Cape Lookout, North Carolina, which encompasses the OECC and Lease Area.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
Atlantic bluefin tuna (*Thunnus thynnus*)					●	●	●	●		**General habitat description**: Bluefin tuna inhabit northeastern waters to feed and move south to spawning grounds in the spring. Bluefin tuna is considered a Species of Concern because they support important recreation and commercial fisheries, and population size is unknown (NOAA 2020). **Juveniles**: EFH for juvenile bluefin tuna is waters off Cape Cod to Cape Hatteras within an area of the slope sea east of the proposed Lease Area. **Adults**: EFH for adult bluefin tuna is pelagic waters from the mid-coast of Maine to the Mid-Atlantic.
Atlantic butterfish (*Peprilus triacanthus*)	●	●	●		●	●	●	●		**General habitat description**: Butterfish are found in the offshore development area throughout the year and are present in nearshore areas in the fall, and therefore may be affected by cable installation (NOAA 2021b). Butterfish larvae are common in high salinity and mixing zones where bottom depths are between 134 and 1,148 feet. Juvenile and adult butterfish are generally found over sand, mud, and

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										mixed substrates in bottom depths between 33 to 918 feet (NOAA 2013). **Eggs**: EFH is designated for butterfish eggs in pelagic habitats with depths under 4,921 feet and average temperatures between 48 to 71°F in inshore estuaries and embayments from Massachusetts Bay to the south shore of Long Island, New York, in Chesapeake Bay, and in patches on the continental shelf/slope from Maine southward to Cape Hatteras, North Carolina. **Larvae**: EFH for butterfish larvae is designated as pelagic habitats in inshore estuaries and embayments from Boston Harbor to Chesapeake Bay and over the continental shelf, from the Gulf of Maine to Cape Hatteras. **Juveniles/Adults**: EFH for juvenile and adult butterfish is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound on the inner and Outer Continental Shelf from the Gulf of Maine to Cape Hatteras.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
Atlantic cod (*Gadus morhua*)			●	●					OECC	**General habitat description**: These areas include all habitats within the OECC that contain structurally complex areas, including eelgrass, mixed sand and gravel, and rocky habitats (NEFMC 2017). These habitats are particularly important for juvenile Atlantic cod as it provides protection from predation and readily available prey sources. Cod spawn primarily in bottom habitats composed of sand, rocks, pebbles, or gravel during fall, winter, and early spring (NOAA 2013). Cod eggs are found in the fall, winter, and spring in water depths less than 361 feet. **Larvae**: EFH for larval cod is pelagic waters (depths of 98 to 230 feet) from the Gulf of Maine to the Mid-Atlantic and are primarily observed in the spring (Lough 2004).

Atlantic herring (*Clupea harengus*)			●	●	●	●	●	●		**General habitat description**: Larvae are free-floating and generally observed between August and April in areas with water depths from 164 to 295 feet. Juvenile and adult herring are found in areas with water depths from 66 to 427 feet. Atlantic herring were captured in the Northeast Fisheries Science Center (NEFSC) multispecies bottom trawl surveys (1948 to 2016) throughout the year within the Lease Area. **Eggs**: Herring eggs adhere to the bottom; therefore, EFH is designated as inshore and offshore benthic habitats mainly in the Gulf of Maine, Georges Bank, and Nantucket Shoals in depths of 16 to 295 feet on coarse sand, pebbles, cobbles, and boulders and/or macroalgae (NEFMC 2017). **Larvae**: EFH for larval Atlantic herring is pelagic waters in the Gulf of Maine, Georges Bank, and southern New England. **Juveniles/Adults**: EFH for juvenile and adult herring is pelagic and bottom habitats in the Gulf of Maine, Georges Bank, southern New England, and the Mid-Atlantic region.
Atlantic mackerel (*Scomber scombrus*)	●	●	●	●	●	●	●	●		**General habitat description**: Eggs float in the upper 33 to 49 feet of the water column, while larvae can be found in depths ranging from 33 to 427 feet

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										(Studholme et al. 1999).The depth preference of juvenile mackerel shifts seasonally as they are generally found higher in the water column (66 to 164 feet) in the fall and summer, deeper (66 to 230 feet) in the winter, and widely dispersed (98 to 295 feet) in the spring (NOAA 2022b; Studholme et al. 1999). **Eggs/Larvae**: EFH for mackerel (egg and larval stages) is pelagic habitats in inshore estuaries and embayments from Great Bay to Long Island, in inshore and offshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras (NOAA 2013). **Juveniles**: EFH for juvenile Atlantic mackerel is designated in pelagic waters with bottom depths of 33 to 361 feet within the OECC. **Adults**: EFH for adult mackerel includes pelagic habitats the same region as for juveniles, but in waters with bottom depths less than 230 feet.
Atlantic sea scallop (*Placopecten magellanicus*)	●	●	●	●	●	●	●	●		**General habitat description**: All life stages have the same EFH spatial designation, which

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										extends across much of the greater Atlantic region. During the larval stage, scallops are free-swimming and occur within the water column and near the seafloor. Hard substrate is particularly important as it provides essential habitat for settling larvae, which were found to have higher survival rates when attaching to hard surfaces rather than shifting sand or macroalgae. **Eggs**: Because sea scallop eggs are heavier than seawater and remain on the seafloor until the larval stage, EFH is designated in benthic habitats in inshore areas and the continental shelf. **Larvae**: EFH for the larval stage (referred to as "spat") includes benthic and pelagic habitats in inshore and offshore areas throughout the region. Any hard surface can provide an essential habitat for settling pelagic larvae ("spat"), including shells, pebbles, gravel, and macroalgae and other benthic organisms. Spat that settle on shifting sand do not survive. **Juveniles/Adults**: EFH for juvenile and adult sea scallops

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										include sand and gravel substrates in the benthic habitats in depths of 59 to 361 feet (NEFMC 2017).
Atlantic sharpnose shark (*Rhizoprionodon terraenovae*) (Atlantic stock)					●	●	●	●		**General habitat description:** The juvenile and adult Atlantic sharpnose EFH for the Atlantic stock were expanded from North Carolina to Chesapeake Bay and Delaware Bay. Atlantic Ocean EFH includes areas between the mid-coast of Florida and Cape Hatteras, with seasonal summer distribution in the northern part of the range as water temperatures increase in the northern areas. **Juveniles:** EFH for this life stage extends from portions of the lower Chesapeake Bay (Virginia) to the mid-coast of Florida, with seasonal summer distribution in the northern part of the range. Offshore depth extent of EFH for this life stage is 591 feet. **Adults:** EFH for this life stage extends from portions of Delaware Bay and Cape May, New Jersey to the mid-coast of Florida, including portions of Chesapeake Bay, with seasonal summer distribution in the northern part of the range.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										Offshore depth extent for this life stage is 591 feet.
Atlantic skipjack tuna *(Katsuwonus pelamis)*	●		●	●	●	●	●			**General habitat description**: Designated EFH for spawning, eggs, and larvae is restricted to the Gulf of Mexico and Atlantic waters off the coast of Florida. **Eggs/larvae:** In offshore waters in the Gulf of Mexico to the EEZ and portions of the Florida Straits. **Juveniles**: Offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank (off Massachusetts); coastal and offshore habitats between Massachusetts and South Carolina; localized in areas off Georgia and South Carolina; and from the Blake Plateau through the Florida Straits. Offshore waters in the central Gulf of Mexico from Texas through the Florida Panhandle. In all areas juveniles are found if water depth is greater than 66 feet. **Adults**: Coastal and offshore habitats between Massachusetts and Cape Lookout, North Carolina, and

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										localized areas in the Atlantic off South Carolina and Georgia, and the northern east coast of Florida. EFH in the Atlantic Ocean is also located on the Blake Plateau and in the Florida Straits through the Florida Keys. EFH also includes areas in the central Gulf of Mexico, offshore in pelagic habitats seaward of the southeastern edge of the West Florida Shelf to Texas.
Atlantic surfclam (*Spisula solidissima*)					●	●	●	●		**General habitat description**: Surfclams are generally located from the tidal zone to a depth of about 125 feet (NOAA 2013). The Atlantic surfclam occupies areas along the continental shelf from southern portions of the Gulf of St. Lawrence to Cape Hatteras, North Carolina (Cargnelli et al. 1999b). **Juveniles/Adults**: EFH for surfclams is throughout the substrate, to a depth of 3 feet below the water/sediment interface, from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ. EFH is designated in the OECC for juvenile and adult life stages and a small portion of

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										the Lease Area for the adult stage.
Atlantic yellowfin tuna (*Thunnus albacares*)					●	●	●			**General habitat description**: The Atlantic yellowfin tuna is a global species with a wide range from the central region of the Gulf of Mexico from Florida to Southern Texas and from the mid-east coast of Florida and Georgia to Cape Cod. They are also located south of Puerto Rico. **Juveniles**: EFH for juveniles is in offshore pelagic waters from Cape Cod to the mid-east coast of Florida. **Adults**: EFH for adults is in offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts, and offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau.
Basking shark (*Cetorhinus maximus*) [b]					●	●	●	●		**General habitat description**: Basking sharks are generally observed in the northwestern and eastern Atlantic coastal regions from April to October and are thought to follow zooplankton distributions (Sims

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										et al. 2003). Basking shark aggregations have been observed offshore Cape Cod, Martha's Vineyard, and Morishes Inlet, Long Island (NMFS 2017). Basking sharks are considered a Species of Concern because of interactions with vessels, being caught as bycatch, and low reproductive rates, which leads to slow recovery (NMFS 2017). **Juveniles/Adults**: EFH for juvenile and adult basking sharks is designated in the U.S. Atlantic east coast pelagic waters from the Gulf of Maine to the northern Outer Banks of North Carolina (NMFS 2017).
Black sea bass (*Centropristis striata*)	●	●	●	●	●	●	●	●		**General habitat description**: Adults are generally associated with structurally complex habitats. Juveniles and adults are most commonly observed in the Lease Area and OECC in the spring and fall (Drohan et al. 2007; NOAA 2021c). **Eggs**: Black sea bass eggs are highly abundant in the "mixing" and "seawater" salinity zones. Eggs are generally found from May through October on the continental shelf, from southern New England to North Carolina.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										Larvae: North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina. **Juveniles:** Black sea bass juveniles are usually found in association with rough bottom, shellfish and eelgrass beds, human-made structures in sandy shelly areas; offshore clam beds and shell patches may also be used during the wintering. **Adults**: EFH for juvenile and adult black sea bass is demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras (NOAA 2013). Structured habitats (natural and man-made), sand and shell are usually the substrate preference.
Blacktip shark (*Carcharhinus limbatus*)					●	●	●	●		**General habitat description:** Coastal areas of the Mid-Atlantic Bight, including estuaries, out to the 30-meter depth contour. Mainly associated with shell, coarse sand and rocky habitats. including the mouth of Coastal

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										estuarine habitats from Delaware to Florida. **Juveniles/Adults:** EFH is in Atlantic coastal areas from Florida to the Maryland/Virginia line (northern extent of EFH is Chincoteague Island), including the mouth of Chesapeake Bay and adjacent coastal areas along the Delmarva Peninsula in shell, sand, and rocky habitats.
Bluefish (*Pomatomus saltatrix*)	●		●		●	●	●	●		**General habitat description:** Bluefish inhabit pelagic waters in and north of the Mid-Atlantic Bight for much of the year but make seasonal migrations south in the winter (Shepherd and Packer 2006). **Eggs/Larvae:** Eggs are found in mid-shelf waters ranging from 98 to 230 feet in southern New England to Cape Hatteras. Eggs are not found in estuarine waters. Larvae are found in oceanic waters (Able and Fahay 1998; Shepherd and Packer 2006). **Juveniles:** Juveniles found in pelagic waters over the continental shelf (from the coast out to the limits of the EEZ) from Massachusetts to Cape Hatteras. From Cape Hatteras

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										south Juvenile found over the continental shelf from the coast out to the eastern wall of the Gulf Stream through Key West, Florida (Shepherd and Packer 2006). **Adults:** Adults are found in oceanic, nearshore, and continental shelf waters. Adults are observed in the inland bays of New Jersey from May through October and are not associated with a specific substrate (Stone et al. 1994). The species migrates extensively and is distributed based on season and size of the individuals within the schools (Shepherd and Packer 2006). There are two predominant spawning areas on the east coast: one during the spring that is located offshore from southern Florida to North Carolina and the other during summer in the Mid-Atlantic Bight (Wilk 1982).
Clearnose skate (*Raja eglanteria)*			●	●	●	●	●	●		**General habitat description:** Clearnose skate juvenile and adult EFH is defined as saline waters of coastal bays of the Mid-Atlantic to Saint John’s River, Florida.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										Larvae: No larval life stage exists for this species. Upon hatching, they are fully developed juveniles (Nelson et al. 2017). **Juveniles:** Sub-tidal benthic habitats in coastal and inner continental shelf waters from New Jersey to the St. Johns River in Florida, including the high salinity zones of Chesapeake Bay, Delaware Bay, and the other bays and estuaries. EFH for juvenile clearnose skates occurs from the shoreline to 98 feet, primarily on mud and sand, but also on gravelly and rocky bottom. **Adults:** Sub-tidal benthic habitats in coastal and inner continental shelf waters from New Jersey to Cape Hatteras, including the high salinity zones of Chesapeake Bay, Delaware Bay, and the other bays and estuaries. EFH for adult clearnose skates occurs from the shoreline to 131 feet, primarily on mud and sand, but also on gravelly and rocky bottom.
Cobia (*Rachycentron*		●	●	●	●	●	●	●		**General habitat description**: EFH is designated within the

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
canadum) Spanish mackerel (*Scomberomorus maculatus*) King mackerel (*Scomberomorus cavalla*)										OECC and offshore development area; these species prefer warmer waters but migrate into the Mid-Atlantic Bight and farther north in the summer (NOAA 2022c). **All life stages**: EFH for all life stages occurs in the South- and Mid-Atlantic Bights and includes sandy shoals of capes and offshore bars, high profile rocky bottom, and barrier island ocean side waters, from the surf to the shelf-break zone. EFH also includes Sargassum from the Gulf Stream shoreward. For cobia, EFH also includes high salinity bays, estuaries, seagrass habitats, and the Gulf Stream, which disperses pelagic larvae.
Common thresher shark *(Alopias vulpinus)* [c]	●	●	●	●	●	●	●	●		**General habitat description**: Common thresher sharks occur in coastal and oceanic waters but are more common in 15 to 45 feet water depths. **All life stages**: EFH for all life stages is coastal and pelagic waters from Cape Cod to North Carolina and in other localized areas off the Atlantic Coast.
Dusky shark (*Carcharhinus obscurus*) [c]			●	●	●	●	●	●		**General habitat description**: Dusky sharks migrate to northern areas of their range in

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										the summer and return south in the fall as water temperatures decrease. Dusky shark is a Species of Concern because the northwestern Atlantic/Gulf of Mexico population is estimated to be at 15 to 20% of the mid-1970s abundance (Cortés et al. 2006). Although commercial and recreation fishing is prohibited, the main threat to the dusky shark population is from bycatch and illegal harvest. **Neonate**: EFH for neonate dusky shark includes offshore areas of southern New England to Cape Lookout, North Carolina (NMFS 2017). **Juveniles/Adults**: EFH for juvenile and adult dusky sharks is waters over the continental shelf from southern Cape Cod to Florida (NMFS 2009).
Little skate (*Leucoraja erinacea*)					●	●	●	●		**General habitat description**: Demersal species that has a range from Nova Scotia to Cape Hatteras and is highly concentrated in the Mid-Atlantic Bight and on Georges Bank. Found year-round on Georges Bank and tolerates a wide range of temperatures (Packer et al. 2003a). Prefers sandy or

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										pebbly bottom but can also be found on mud and ledges (Collette and Klein-MacPhee 2002). **Juveniles/Adults**: EFH is similar for both life stages and includes intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the mid-Atlantic region. EFH primarily occurs on sand and gravel substrates, but also is found on mud (NEFMC 2017).
Longfin inshore squid *(Loligo pealeii)*		●			●	●	●	●		**General habitat description**: Longfin inshore squids lay eggs in masses referred to as “mops” that are demersal and anchored to various substrates and hardbottom types, including shells, lobster pots, fish traps, boulders, submerged aquatic vegetation, sand, and mud (NOAA 2013). Female longfin squid lay these egg mops during 3-week periods, which can occur throughout the year (Hendrickson 2017). Known longfin squid spawning grounds, which coincide with areas of concentrated squid fishing, intersect with the OECC. Pre-recruits (juveniles) and recruits (adults) inhabit inshore areas in the spring and

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										summer and migrate to deeper, offshore areas in the fall to overwinter (NOAA 2013). **Eggs**: EFH for longfin inshore squid eggs is inshore and offshore bottom habitats from Georges Bank to Cape Hatteras. **Juveniles/Adults**: EFH for juveniles and adults, also referred to as pre-recruits and recruits, is pelagic habitats inshore and offshore continental shelf waters from Georges Bank to South Carolina.
Monkfish (*Lophius americanus*)	●	●								**General habitat description**: Monkfish eggs float near the surface in veils that dissolve and release zooplanktonic larvae after 1 to 3 weeks (MADMF 2017). Monkfish eggs and larvae are generally observed from March to September. **Eggs/Larvae**: EFH for monkfish eggs and larvae is surface and pelagic waters of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras.
Pollock (*Pollachius virens*)	●	●	●	●						**General habitat description**: Pollock eggs are buoyant upon fertilization and occur in the water column (Cargnelli et al.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										1999c). The larval stage lasts between 3 and 4 months and is also pelagic. **Eggs**: EFH for pollock eggs is pelagic inshore and offshore habitat in the Gulf of Maine, Georges Bank, and southern New England (NEFMC 2017). **Larvae**: EFH designations for larvae are similar to those for eggs and includes pelagic inshore and offshore habitats in the Gulf of Maine, Georges Bank, and southern New England, but larvae can be found farther south in the Mid-Atlantic region, with bays and estuaries also included in these regions.
Red hake (*Urophycis chuss*)		●		●		●				**General habitat description**: Juvenile red hake are pelagic and congregate around floating debris for a time before descending to the bottom (Steimle et al. 1999a). Although adult red hake are generally demersal, they can be found in the water column (Steimle et al. 1999a). **Eggs/Larvae**: EFH for red hake eggs and larvae is surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England,

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										and the middle Atlantic south to Cape Hatteras. **Juveniles**: EFH for juvenile red hake is bottom habitats with a substrate of shell fragments.
Sand tiger shark (*Carcharias taurus*) [b]			●	●	●	●	●	●		**General habitat description**: Neonate sand tiger sharks inhabit shallow coastal waters within the 25-meter isobath (NMFS 2017). The sand tiger shark is a Species of Concern because population levels are estimated to be only 10% of pre-fishery conditions. **Neonates**: EFH for sand tiger shark neonates is along the U.S. Atlantic east coast from Cape Cod to northern Florida. **Juveniles**: EFH for juvenile sand tiger sharks is designated in estuarine bay habitats from northern Florida to Cape Cod (NFMS 2017). **Adults**: EFH for adult sand tiger sharks includes inshore bay and adjacent coastal and offshore waters throughout the Mid-Atlantic (NFMS 2017).
Sandbar shark (*Carcharhinus plumbeus*)			●	●	●	●	●	●	●	**General habitat description**: Sandbar sharks are a bottom-dwelling shark species that primarily forages for small bony

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										fishes and crustaceans (NMFS 2009). **Larvae/neonate:** Sandbar sharks bare live young and are considered juveniles (NMFS 2017). **Juveniles**: EFH for juvenile sandbar shark includes coastal areas of the U.S. Atlantic between southern New England and Georgia (NMFS 2017). **Adults**: EFH for adult sandbar sharks is coastal areas from southern New England to Florida.
Scup (*Stenotomus chrysops*)	●	●	●	●	●	●	●	●		**General habitat description**: Scup occupy inshore areas in the spring, summer, and fall and migrate offshore to overwinter in warmer waters on the Outer Continental Shelf (Steimle et al. 1999b). Scup was a dominant finfish species captured in the NEFSC multispecies bottom trawl survey during spring, summer, and fall surveys and in the Massachusetts Division of Marine Fisheries trawl surveys in the spring and fall. **Eggs:** Scup eggs are found in estuarine "mixing" and "seawater" salinity zones from New England to Virginia.

Species	**EFH Habitat Within Project Area**									**EFH Description**
	Eggs		**Larvae/ Neonates** [a]		**Juveniles**		**Adults**		**HAPC**	
	Lease Area	**OECC**	**Lease Area**	**OECC**	**Lease Area**	**OECC**	**Lease Area**	**OECC**		
										Larvae; EFH for scup larvae are estuaries where eggs are deposited (NOAA 2013). **Juveniles/Adults**: EFH for juvenile and adult scup are the inshore and offshore demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras (NOAA 2013).
Shortfin mako shark *(Isurus oxyrinchus)* [c]				●	●	●	●	●		**General habitat description**: EFH for shortfin mako sharks in the Atlantic Ocean includes pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank (off Massachusetts) to Cape Cod (seaward of the 200-meter bathymetric line); coastal and offshore habitats between Cape Cod and Cape Lookout, North Carolina; and localized habitats off South Carolina and Georgia **All life stages**: EFH for all life stages is combined and considered the same due to insufficient data needed to differentiate EFH by life stage.
Smooth dogfish (*Mustelus canis*) [c]			●	●	●	●	●	●		**General habitat description**: Smooth dogfish are primarily demersal and undergo temperature-stimulated migrations between inshore and

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										offshore waters to a maximum depth of 656.2 feet (NMFS 2017). **All life stages**: Due to insufficient information on the individual life stages (neonate, juvenile, and adult), EFH for smooth dogfish is designated for all life stages combined and occurs in both the Lease Area and OECC. EFH for smooth dogfish includes coastal areas and inshore bays and estuaries from Cape Cod Bay to South Carolina, inclusive of inshore bays and estuaries (e.g., Delaware Bay, Long Island Sound). EFH also includes continental shelf habitats between southern New Jersey and Cape Hatteras, North Carolina (NMFS 2017).
Spiny dogfish (*Squalus acanthias*)					●	●	●	●		**General habitat description**: The spiny dogfish is widely distributed throughout the world, with populations existing on the continental shelf of the northern and southern temperate zones, which includes the North Atlantic from Greenland to northeastern Florida, with concentrations from Nova Scotia to Cape Hatteras. Based on seasonal

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										temperatures, spiny dogfish migrate up to 994.2 miles along the east coast. **Juveniles/Adults**: EFH for juvenile and adult spiny dogfish is waters on the continental shelf from the Gulf of Maine through Cape Hatteras (NOAA 2013). NEFSC bottom trawl surveys collected spiny dogfish juveniles at depths ranging from 36 to 1,640.4 feet. Adults are found in deeper waters inshore and offshore from the shallows to 2,952.7 feet deep (Collette and Klein-MacPhee 2002).
Summer flounder (*Paralichthys dentatus*)	●	●	●	●	●	●	●	●	OECC	**General habitat description**: Eggs are generally observed between October and May, while larvae are found from September through February. Juvenile summer flounder inhabit inshore areas such as salt marsh creeks, seagrass beds, and mudflats in the spring, summer, and fall and move to deeper waters offshore in the winter. Adults inhabit shallow coastal and estuarine areas during the warmer seasons and migrate offshore during the winter (Packer et al. 1999).

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										Eggs/Larvae: EFH for eggs and larvae is pelagic waters found over the continental shelf from the Gulf of Maine to Cape Hatteras. **Juveniles/Adults**: EFH for juvenile and adult summer flounder is demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras. HAPC is designated as areas of all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH (NOAA 2013).
Tiger shark (*Galeocerdo cuvie*r)					●		●			**General habitat description**: Tiger sharks are a warm-water shark species and primarily remain south of the Mid-Atlantic Bight; however, they will occasionally travel farther north during the warmer summer months (NMFS 2017). **Juveniles/Adults**: EFH for these life stages extends from Georges Bank to the Florida Keys in offshore pelagic habitats associated with the continental shelf break at the

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										seaward extent of the U.S. EEZ boundary (NMFS 2017).
White shark (*Carcharodon carcharias*) [c]					●	●	●	●		**General habitat description**: The white shark ranges within all temperate and tropical belts of oceans, including the Mediterranean Sea. The white shark occurs in coastal and offshore waters and has a very sporadic presence. Because of the shark's sporadic presence, very little is known about its breeding habits. Sightings of the white shark in the Mid-Atlantic Bight occur from April to December. The white shark prefers open-ocean habitat. **Juveniles/Adults**: EFH for juvenile and adult white shark is combined and includes inshore waters out to 57 nautical miles from Cape Ann, Massachusetts, to Cape Canaveral, Florida (NMFS 2017).
Windowpane flounder (*Scophthalmus aquosus*)		●	●	●	●	●	●	●		**General habitat description**: Windowpane flounder are usually associated with non-complex benthic habitats (Collette and Klein-MacPhee 2002) from the Gulf of Saint Lawrence to Florida (Gutherz 1967). Spawning occurs from April to December along areas of the Northwest Atlantic.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										Eggs: EFH for eggs is surface waters around the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. **Larvae**: EFH for larvae is pelagic waters around the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. **Juvenile/Adults**: EFH for juvenile and adult life stages is bottom habitats that consist of mud or fine-grained sand substrate around the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras (NOAA 2013).
Winter skate (*Leucoraja ocellata*)					●	●	●	●		**General habitat description**: Demersal species that has a range from the southern coast of Newfoundland to Cape Hatteras and has concentrated populations on Georges Bank and the northern section of the Mid-Atlantic Bight (Packer et al. 2003b). The winter skate has very similar temperature ranges and migration patterns as the little skate.

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										Juveniles/Adults: EFH for juvenile and adult winter skate includes sand and gravel substrates in sub-tidal benthic habitats in depths from the shore to 262 to 295 feet from eastern Maine to Delaware Bay, on the continental shelf in southern New England and the mid-Atlantic region, and on Georges Bank.
Witch flounder (*Glyptocephalus cynoglossus*)	●	●	●	●	●		●			**General habitat description**: Witch flounder is a groundfish species with a range from the Gulf of Maine to Cape Hatteras, North Carolina (Cargnelli et al. 1999d). They tend to concentrate near the southwest portion of the Gulf of Maine (Collette and Klein-MacPhee 2002). Spawning occurs from May through September and peaks in July and August. **Eggs**: EFH for eggs is surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. **Larvae**: EFH for larvae is surface waters to 820 feet in the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the

Species	EFH Habitat Within Project Area									EFH Description
	Eggs		Larvae/ Neonates [a]		Juveniles		Adults		HAPC	
	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC	Lease Area	OECC		
										middle Atlantic south to Cape Hatteras. **Juveniles/Adults**: They are found over mud, clay, silt, or muddy sands at depths ranging from 66 to 5,135 feet, although the majority are found at 295 to 984 feet (Cargnelli et al. 1999d).
Yellowtail flounder (*Limanda ferruginea*)	●	●	●	●						**General habitat description**: This groundfish species ranges along the Atlantic Coast of North America from Newfoundland to the Chesapeake Bay, with the majority located on the western half of Georges Bank, the western Gulf of Maine, east of Cape Cod, and southern New England (Collette and Klein-MacPhee 2002). Present on Georges Bank from March to August. Spawning occurs in both inshore areas as well as offshore on Georges Bank in July. **Eggs/Larvae**: EFH for eggs and larvae is surface waters of Georges Bank, Massachusetts Bay, Cape Cod Bay, and the southern New England continental shelf south to Chesapeake Bay.

[a] Shark species emerge from egg cases fully developed and are referred to as neonates.
[b] Indicates Species of Concern.
[c] Indicates EFH designations are the same for all life stages or designations are not specified by life stage.

4.1.1 HAPC

4.1.1.1 Summer Flounder HAPC

Summer flounder (*Paralichthys dentatus*) HAPC is defined as all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH. If native species are eliminated, then exotic species should be protected because of functional value.

Juvenile and adult summer flounder have both been documented as having a preference for sandy habitats (Timmons 1995; Bigelow and Schroeder 1953; Schwartz 1964; Smith 1969) but are also commonly found in mudflats and seagrass beds within coastal bays and estuaries within Chesapeake Bay (Packer et al. 1999; MAFMC 1998; Wyanski 1990). In general, adult and older juveniles can be found in shallow, inshore and estuarine waters during the summer and fall and then move offshore to deeper waters in the winter and spring, although some juveniles will remain in the bays and estuaries for the winter (Packer et al. 1999; Smith and Daiber 1977; Able and Kaiser 1994; Reid et al. 1999b). Within the Project area, adult and juveniles may utilize habitats within the OECC during winter months. Impacts of Project activities on juvenile and adult summer flounder HAPC are analyzed in Chapter 5, *Potential Impacts of the Project on EFH*.

4.1.1.2 Sandbar Shark HAPC

Sandbar shark (*C. plumbeus*) HAPC has been designated within potential vessel transit routes into Hampton Roads, Virginia. The sandbar shark HAPC is in the lower Chesapeake Bay and in the mouth of the bay and is presented in Figure 4-2. Impacts of Project activities on juvenile and adult sandbar sharks HAPC are analyzed in Chapter 5, *Potential Impacts of the Project on EFH*.

4.2. Species Groups

Species groups, which are used throughout this assessment, are groups of EFH species and/or life history stages that predominantly share the same habitat type. Benthic/epibenthic species groups are sorted into two habitat types (softbottom or complex) based on the benthic habitat with which the species is most typically associated, with the potential for any species to be found in heterogenous complex as that habitat type could include both softbottom and complex habitat.

Prey species are included as species groups because they are consumed by managed fish and invertebrate species as prey, and thus are a component of EFH.

Sessile Benthic/Epibenthic – Softbottom (includes slow-moving benthic/epibenthic species and/or life stages; could include heterogenous complex habitat)

- Atlantic herring (eggs)
- Atlantic sea scallop (eggs, larvae, juveniles, adults)
- Atlantic surfclam (juveniles, adults)
- Longfin inshore squid (eggs)
- Skates (Rajidae) (eggs)

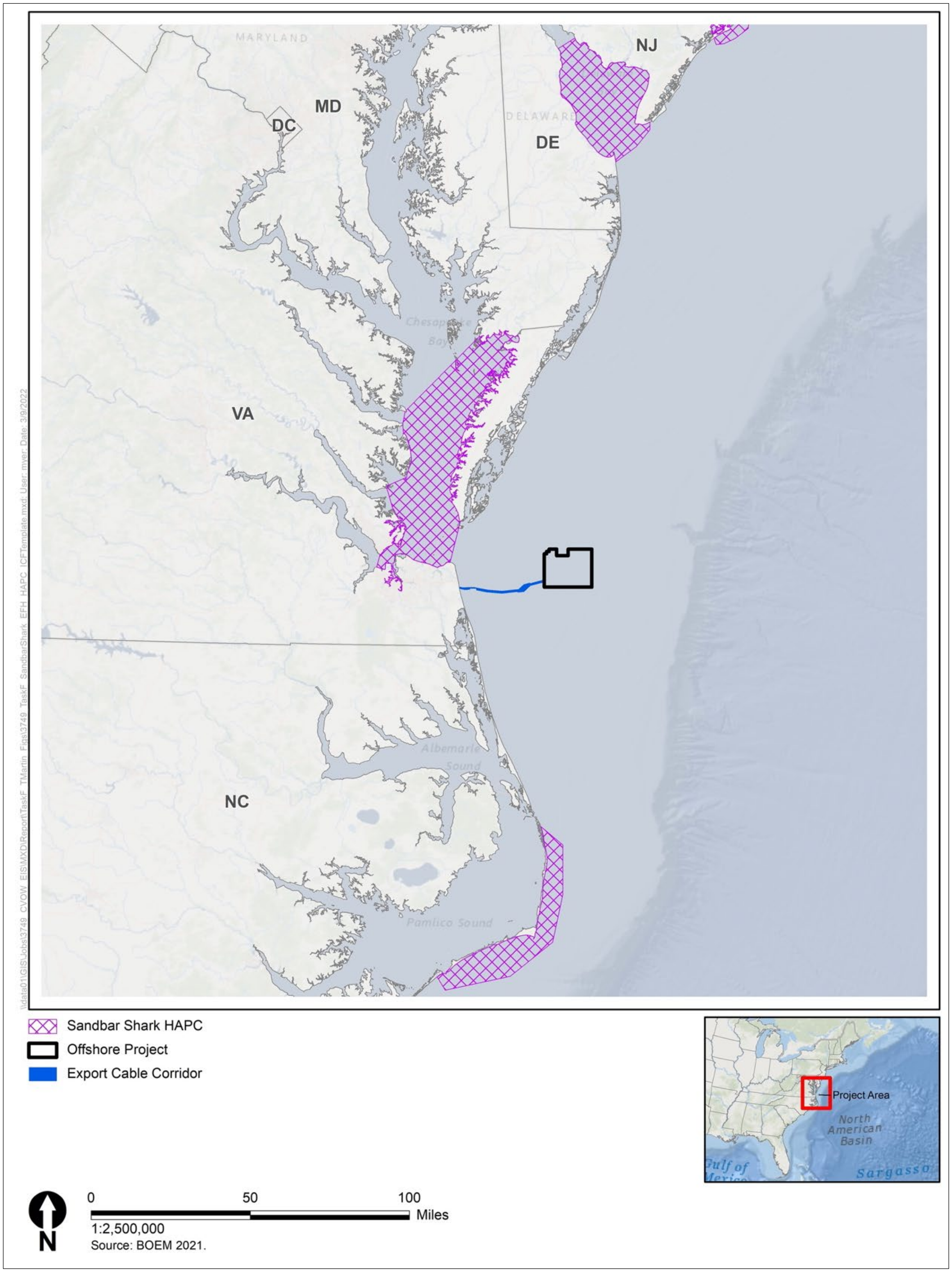


Figure 4-2 Sandbar shark HAPC in the Project area

Mobile Benthic/Epibenthic – Softbottom (could include heterogenous complex habitat)

- Atlantic angel shark (*Squatina dumeril*) (juveniles, adults)
- Blacktip shark (juveniles, adults)
- Monkfish (eggs, larvae)
- Red hake (juveniles)
- Scup (eggs, larvae, juveniles, adults)
- Skates (neonates, juveniles, adults)
- Windowpane flounder (*Scophthalmus aquosus*) (juveniles, adults)
- Witch flounder (juveniles, adults)

Sessile Benthic/Epibenthic – Complex Habitat (includes slow-moving species and/or life stages; could include heterogenous complex habitat)

- Longfin and northern shortfin squid (*Illex illecebrosus*) (egg mops, adults)
- Skates (eggs)

Mobile Benthic/Epibenthic – Complex Habitat (could include heterogenous complex habitat)

- Atlantic cod (eggs, larvae, juveniles, adults)
- Atlantic herring (juveniles, adults)
- Black sea bass (juveniles, adults)
- Little skate (*Leucoraja erinacea*) (juveniles, adults)
- Pollock (juveniles, adults)
- Red hake (juveniles, adults)
- Scup (juveniles, adults)
- Sandbar shark (juveniles, adults)
- Smooth dogfish (*Mustelus canis*) (juveniles, adults)
- Spiny dogfish (*Squalus acanthias*) (juveniles, adults)
- Summer flounder (eggs, larvae, juveniles, adults)
- Tiger shark (*Galeocerdo cuvier*) (juveniles, adults)
- White shark (*Carcharodon carcharias*) (neonates juveniles, adults)
- Winter skate (*Leucoraja ocellata*) (neonates juveniles, adults)
- Yellowtail flounder (*Limanda ferruginea*) (juveniles, adults)

Pelagic

- Atlantic albacore tuna (*Thunnus alalunga*) (juveniles, adults)
- Atlantic bluefin tuna (*T. thynnus*) (eggs, larvae, juveniles, adults)
- Atlantic butterfish (eggs, larvae, juveniles, adults)
- Atlantic herring (larvae, juveniles, adults)
- Atlantic mackerel (eggs, larvae, juveniles, adults)

- Atlantic skipjack tuna (*Katsuwonus pelamis*) (juveniles, adults)
- Atlantic yellowfin tuna (*T. albacares*) (juveniles, adults)
- Basking shark (*Cetorhinus maximus*) (juveniles, adults)
- Black seabass (eggs, larvae)
- Bluefish (eggs, larvae, juveniles, adults)
- Blue shark (*Prionace glauca*) (juveniles, adults)
- Cobia (*Rachycentron canadum*) (eggs, larvae, juveniles, adults)
- Common thresher shark (*Alopias vulpinus*) (juveniles, adults)
- Dusky shark (*C. obscurus*) (juveniles, adults)
- Longfin inshore squid (larvae, juveniles, adults)
- King mackerel (*Scomberomorus cavalla*) (eggs, larvae, juveniles, adults)
- Northern shortfin squid (larvae, juveniles, adults)
- Pollock (eggs, larvae)
- Red hake (eggs)
- Shortfin mako (*Isurus oxyrinchus*) (juveniles, adults)
- Spanish mackerel (*S. maculatus*) (eggs, larvae, juveniles, adults)
- Tiger shark (juveniles, adults)
- Windowpane flounder (eggs, larvae)
- Witch flounder (eggs, larvae)
- White shark (adults)

Prey Species – Benthic/Epibenthic

- Bivalves such as blue mussel, eastern oyster (*Crassostrea virginica*), hard clams (*Mercenaria mercenaria*), soft-shell clams (*Mya arenaria*)
- Annelid worms
- Crustaceans – e.g., amphipods, shrimps, crabs

Prey Species – Pelagic

- Anchovy, bay (*Anchoa mitchilli*) and striped (*A. hepsetus*)
- River herring (alewife [*Alosa pseudoharengus*], blueback herring [*A. aestivalis*])
- Sand lance (*Ammodytes americanus*)

4.3. NOAA Trust Resources

The Atlantic States Marine Fisheries Commission, in cooperation with the states and NOAA Fisheries, manages more than two dozen fish and invertebrate species separately from the MSA; many of these species are also identified as NOAA Trust Resources. Of these species, the Project may potentially affect those listed in Table 4-2.

NOAA Trust Resources have also been identified in the vicinity of the Lease Area and OECC. These resources are summarized in Table 4-2 and discussed in detail in Chapter 7, *NOAA Trust Resource Species*.

Table 4-2 NOAA Trust Resources within the offshore development area

Species	Scientific Name	Life Stage Within Project Area			
		Egg	Larvae	Juvenile	Adult
River herring (alewife, blueback herring)	*Alosa pseudoharengus, A. aestivalis*			x	x
American eel	*Anguilla rostrata*		x	x	x
Striped bass	*Morone saxatilis*			x	x
Tautog	*Tautoga onitis*			x	x
Weakfish	*Cynoscion regalis*	x	x	x	x
Forage species (Atlantic menhaden, bay anchovy, sand lance)	*Brevoortia tyrannus, Anchoa mitchilli,* Ammodytidae spp.	x	x	x	x
American shad	*A. sapidissima*			x	x
Blue crab	*Callinectes sapidus*	x	x	x	x
Horseshoe crab	*Limulus polyphemus*	x	x	x	x
Bivalves (blue mussel, eastern oyster, ocean quahog, soft-shell clam)	*Mytilus edulis, Crassostrea virginica, Arctica islandica, Mya arenaria*	x	x	x	x
Spot	*Leiostomus xanthurus*	x	x	x	x
Atlantic croaker	*Micropogonias undulatus*	x	x	x	x
Spotted hake	*Urophycis regia*	x	x	x	x
Smallmouth flounder	*Microstomus kitt*	x	x	x	x
Bobtail squid	Sepiolidae spp.	x	x	x	x
Northern kingfish	*Menticirrhus saxatilis*	x	x	x	x
Sea robins	Triglidae spp.	x	x	x	x
Gulf stream flounder	*Citharichthys arctifrons*	x	x	x	x

5. Potential Impacts of the Project on EFH

The Proposed Project would generate direct and indirect effects on EFH through accidental releases, anchoring, seabed preparation, and installation of scour protection; noise, crushing, burial, and entrainment effects; and suspended sediments and turbidity from bed disturbance. These effects would occur intermittently and at varying locations in the Project area over the duration of Project. Thus, the suitability of EFH for managed species may be reduced depending on the nature, duration, and magnitude of each effect. Durations can be broken into three time periods: short-term is anticipated for 2 to 3 years; long term is the range between 3 years and the life of the Project; and permanent is beyond the life of the project. Permanent impacts would include structures that remain beyond Project decommissioning. Definitions of potential impact levels are provided in Table 5-1.

Table 5-1 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.

5.1. Construction and Operation Activities

5.1.1 Installation of WTG/OSS Structures and Foundations

Dominion Energy COP (Dominion Energy 2023) noted updated values for benthic impacts for the Maximum Layout of 202 WTGs (and 3 OSSs). Table 5-2 provides anticipated impact acreages for both the Maximum Layout and the applicant Preferred Layout. Some impacts of the Preferred Layout are estimated and are marked as such. Short-term impacts will take up to 3 years to recover and would include any of the temporary impacts listed in the table below. Long-term impacts would remain the life of the Project, and include the WTGs, OSSs which are anticipated to be removed to 15 feet (4.6 meters) below the mud line upon decommissioning (COP Section 3.6; Dominion Energy 2023). The scour protection and cable protection impacts would be permanent and last beyond the Project.

Table 5-2 Benthic impacts of the Maximum Layout, and Preferred Layout

Disturbance Type	Component	Updated COP Maximum Layout of 202 WTGs (Acres/ Hectares)	Preferred Layout of 176 WTGs (Acres/ Hectares)	Notes on changes
Long-term/ Permanent	WTG foundation with scour protection	191.9/77.7	103.8/42	Updated COP: based on WTGs with 230-foot (70-meter) diameter with scour protection. Permanent impact area per WTG is 0.95 acres (0.39 hectares). The Preferred Layout requires 180 feet (59 meters) diameter with scour protection per WTG. Permanent impact area per WTG location is 0.59 acres (0.24 hectares) as design changes.
	OSS piles with scour protection	11.4/4.6	11.4/4.6	Based on 3 OSSs with 4-leg piled jacket foundations with 230-foot (70-meter) diameter with scour protection per leg. This value does not change based on the number of WTGs.
	Cable protection (offshore trenchless punch-out, cable crossings)	1.19/0.48	1.19/0.48	Cable protection at the Offshore Trenchless Installation Punch-Out Location, if needed, based on maximum of 82 feet (25 meters) long by 6.6 feet (2 meters) wide concrete mattresses, for a total of approximately 0.012 acres (0.005 hectares) at each of the 9 punch-out locations. This impact falls within the footprint of the OECC. Cable crossings based on bottom protection consisting of 2 concrete mattresses placed end to end each measuring approximately 20 feet (6 meters) in length, by 10 feet (3 meters) in width and top protection consisting of 7 concrete mattresses placed end to end each measuring approximately 20 feet (6 meters) in length by 10 feet (3 meters) in width placed perpendicular to the bottom protection for a total of approximately 0.04 acres (161.876 square meters) for each of the 27 cable crossings.

Disturbance Type	Component	Updated COP Maximum Layout of 202 WTGs (Acres/ Hectares)	Preferred Layout of 176 WTGs (Acres/ Hectares)	Notes on changes
	Total Permanent	**204.49/ 82.75**	**116.39/ 47.10**	
Short-term	Inter-array cable pre-lay grapnel run	2,988.8/ 1,209.5	2,604.1[1]/ 1,053.8[1]	Updated COP: maximum length of inter-array cable 300.7 miles (484 kilometers), pre-lay grapnel run within proposed 82-foot (25-meter) wide inter-array installation corridor. The Preferred Layout is based on the calculation of impact per WTG and applied to 176 WTGs.
	Inter-array cable installation	2,405.59/ 973.5	2,095.96[1]/ 848.2[1]	Updated COP: Inter-array cable trench based on maximum total inter-Array cable length of 300.7 miles (484 kilometers) multiplied by trench width 66 feet (20 meters). This temporary disturbance will occur within the footprint of the inter-array cable pre-lay grapnel run corridor. The Preferred Layout is based on the calculation of impact per WTG and applied to 176 WTGs.
	Offshore expert cable pre-lay grapnel run/Maximum construction corridor for total cable length	3,358.51/ 1,359.14	3,358.51/ 1,359.14	Offshore Export Cable Corridor maximum disturbance based on total cable length of 49.01 miles (79 kilometers), that includes the number of cables (nine), multiplied by maximum 65.62 feet (20 meters) width for grapnel run/short-term construction areas. Pre-lay grapnel will be done along each of the 9 individual cable routes within the Offshore Export Cable Corridor. Total max length of Offshore Export Cables 337.9 miles (543.8 kilometers) multiplied by 82 feet (25 meters) wide installation corridor per cable. This value does not change based on the number of WTGs.
	Offshore export cable installation	2,047.87/ 828.74	2,047.87/ 828.74	Offshore Export Cable trench based on maximum the Offshore Export Cable length of 337.9 miles (543.8 kilometers), that includes the number of cable (nine), multiplied

Disturbance Type	Component	Updated COP Maximum Layout of 202 WTGs (Acres/ Hectares)	Preferred Layout of 176 WTGs (Acres/ Hectares)	Notes on changes
Short-term cont.				by maximum 50 feet (15 meters) width of trench. This temporary disturbance will occur within the footprint of the Offshore Export Cable pre-lay grapnel run. This value does not change based on the number of WTGs.
	UXO and large marine debris clearance and mitigation	1.58/0.64	1.58/0.64	The seabed disturbance footprint for UXO and large marine debris identification/mitigation not avoided by micrositing, is approximately 161.5 square feet (15 square meters) per mitigation of one UXO, or piece of marine debris. The Applicant has assumed that up to 212 UXOs (0.79 acres) and 212 pieces of large marine debris 0.79 acres) will require relocation, anticipated to be a total of 1.58 acres. This value does not change based on the number of WTGs.
	WTG work area	3,526.50/ 1,427.12	3,072.6/ 1,243.44	Based on a work area diameter of 984 feet (300 meters)/ WTG position.
	Maximum footprint for the OSSs	3.16/1.28	3.16/1.28	Based on the maximum footprint of 216.5 by 255.9 feet (66 by 78 meters) for each OSS Jacket Foundations, with additional temporary construction impact occurring within a 656.2 by 164.0 feet (200 by 50 meters) area adjacent to the western side of each OSS to support the potential jacking of the jack-up vessel (JUV). This value does not change based on the number of WTGs.
	Cable protection (offshore trenchless punch-out and cable crossings)	8.92/3.61	8.92/3.61	Offshore trenchless punchout based on up to 108 goal posts, each with a 3.5 foot (1.07 meter) diameter and 9 JUVs. The punch-out falls within the footprint of the OECC. Cable crossings impacts from 27 crossings would equal about 0.12 acres (0.005 hectares). This value does not change based on the number of WTGs.

Disturbance Type	Component	Updated COP Maximum Layout of 202 WTGs (Acres/ Hectares)	Preferred Layout of 176 WTGs (Acres/ Hectares)	Notes on changes
	Anchoring disturbance (offshore and nearshore construction activities)	1,659.2/ 671.45	1,659.2/ 671.45	This value does not change based on the number of WTGs.
	Subtotal of Short-term Impact Area[2]	11,546.67/ 4,672.77	10,708.09/ 4,333.41	
	Total Short-term [3]	16,000.13/ 6,475.02	14,851.92/ 6,010.36	
Grand Total[4]		**16,204.62/ 6,557.53**	**14,968.31/ 6,057.46**	

[1] Impact acres calculated based on a ratio of impact per WTG calculation from the maximum scenario of 202 and applied to 176.
[2] Subtotal excludes the cables as they fall within the footprint of the pre-lay grapnel run disturbance; therefore, only light blue cells are considered in the subtotal.
[3] Sum of all short-term impacts.
[4] Sum of short-term, long-term, and permanent impacts.

5.1.1.1 Vessel Activities

During installation of 202 potential WTG foundation sites, with a Preferred Layout of 176 WTGs installed, and three OSS structures along with associated scour protection features, it is estimated that 16 construction vessels with various configurations would be required (COP Volume I, Table 3.4-5; Dominion Energy 2023). The construction vessels that would be used for Project construction are described in COP Section 3.4.1.5 and Table 3.4-5 (Dominion Energy 2023). Typical large construction vessels used in this type of construction have estimated lengths of 230 feet (70.1 meters) (COP Section 3.4.1.5; Dominion Energy 2023). Based on information provided in the COP, construction activities (including offshore installation of WTGs, OSSs, inter-array cables, interconnection cable, and export cable) would require up to 73 construction vessels, transiting between the various ports and the Project area on a variety of schedules depending on the phase of construction.

Detailed O&M vessel activity is not yet outlined in the COP; however, the main vessel transits will be conducted by Crew Transfer Vessels and Service Operation Vessels. Dominion Energy has estimated that Project operations would involve roughly weekly crew transfer vessel and biweekly service operations vessel transits, equating to approximately annual vessel round trips originating from the Norfolk, Virginia O&M facility (COP Appendix N; Dominion Energy 2023). This equates to a 0.37 percent increase over baseline vessel activity (see Section 2.1.3.2 for a discussion of baseline data limitations). This 253 annual round-trip estimate is based on current information provided by Dominion Energy; the estimated number does not comport with O&M service trip estimates for other U.S. East Coast wind farm projects with published COPs, which estimate several hundred to thousands of annual service round trips; however, this is the vessel transit data available for analysis in the EFH.

5.1.1.1.1 Habitat Loss/Conversion

Most construction vessels would utilize dynamic positions (DP) systems, but some would require anchoring to support construction activities. Construction vessels such as jack-up barges utilize stabilization spuds. These activities would occur during installation of WTG and OSS foundation installation. Anticipated benthic habitat-disturbing activities during WTG and OSS installation include anchor placement, anchor chain sweep, and spud placement. According to the NOAA Habitat Complexity Categories, all activities within the WTG and offshore substation work area are comprised of 100 percent softbottom habitat (Table 3-3). Therefore, no impacts on complex habitats from WTGs, OSSs, and scour protection are expected. As the project nears, anchoring plans will need to be requested by NMFS to avoid or minimize anchoring in complex habitats. Utilizing DP vessels would reduce the amount of seafloor disturbance and reduce seafloor impacts. Vessels using anchoring systems have a greater potential to disturb the seabed and result in burial or crushing impacts on infauna and habitat loss or conversion for demersal species. Dominion Energy expects that anchoring disturbance from offshore and nearshore construction would be 1,659.2 acres (671.45 hectares) (Table 5-2).

5.1.1.1.2 Sediment Suspension/Redeposition from Anchoring Activities

Aside from monopile installation, most other construction activities would utilize DP vessels within the Lease Area, reducing seafloor disturbance impacts. These impacts would include increased turbidity levels and potential for contact causing mortality of mainly benthic species. No sensitive resources were identified within the Lease Area (hardbottom areas or biogenic [shellfish or seagrass beds]). All impacts due to anchor activities would be localized and temporary; contact impacts from anchor, spud can, or leg contact would recover in the short term. Construction operations under the proposed Project would not occur simultaneously, and the footprint of each anchor, spud can, or leg placement would be relatively small and of short duration and would represent a minor impact on the demersal portions of the EFH for the documented finfish and invertebrate species.

5.1.1.1.3 Potential Introduction of Exotic/Invasive Species via Ballast

Vessels associated with the construction activities of the CVOW-C may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Project 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 the EFH of the listed species discussed in Chapter 4, resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of best management practices (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 EFH resulting from these accidental releases.

Marine invasive species have been accidentally introduced into habitats along the U.S. Atlantic seaboard in multiple instances. Pederson et al. (2005) lists 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. Additionally 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 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 potential for introducing an invasive species through ballast water releases or biofouling from installation activities related to the CVOW-C construction activities is quite small and only related to the vessels utilized to import components of some of the WTG systems (monopiles and generators). These vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and U.S. Environmental Protection Agency National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim to prevent the release of ballast waters contaminated with an invasive species. As such, accidental releases from the construction activities related to the Lease Area would not be expected to contribute appreciably to overall impacts on EFH; impacts related to the release of invasive species on the EFH resources are considered negligible within the Lease Area.

5.1.1.2 Pile Driving

5.1.1.2.1 Underwater Sound

An increase in underwater noise is the most likely impact-producing factor (IPF) that could affect the EFH of the listed finfish and invertebrates within the Lease Area, predominantly during installation of the WTG and OSS foundations, cofferdams, and nearshore structures. The CVOW-C PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations and OSS jacket foundations. Vibratory pile driving would be utilized to install the cofferdams and impact pile driving of the monopile posts (COP Appendix Z; Dominion Energy 2023). All these activities have potential to produce noise above recommended fish acoustic thresholds (Table 5-3).

There is limited publicly available site-specific ambient sound information collected from the proposed Project area. NOAA's SoundMap (NOAA Fisheries 2022d, which is a mapping tool that provides maps of the temporal, spatial, and frequency characteristics of man-made underwater noise resulting from various activities, provides some information for an area encompassing the Project area. The underwater sound speed is influenced by the temperature, salinity, and depth. For the Proposed Action, sound speed profiles were obtained from the NOAA Sound Speed Manager software for May to October when the proposed offshore construction activities would occur. (COP Appendix Z; Dominion Energy 2023). Underwater acoustic modeling was conducted for the Project COP, *Underwater Acoustic Assessment* (Appendix Z; Dominion Energy 2023), for both activities, and the results are summarized in Table 5-3. 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 10-decibel (dB) noise attenuation during installation of the WTG and OSS foundations, and 0 dB noise attenuation for all other modeled activities is provided for each modeled scenario in Table 5-3. For fish, NMFS has adopted recoverable injury criteria relative to impulsive sources using dual criteria developed by the Fisheries Hydroacoustic Working Group (2008). These dual criteria were created to ensure that fish were neither exposed to high levels of accumulated energy for repeated impulsive sounds nor single strikes. The Fisheries Hydroacoustic Working Group (2008) criteria include a maximum accumulated sound exposure level over 24 hours ($L_{E,24h}$) and a maximum peak sound pressure level ($L_{p,pk}$) for a single pile-driving strike (Popper et al. 2014). Currently, the Fisheries Hydroacoustic Working Group (2008) recommends a 150 dB referenced to (re) 1 micropascal (μPa) criterion for behavioral response of all fish and does not distinguish between impulsive and non-impulsive noise. However, swim bladders in some fish play a role in sound detection and perception; therefore, a fish's susceptibility to injury from noise exposure depends, in part, on the presence and function of a swim bladder. Therefore, threshold criteria are also available from Popper et al. (2014), which have not been adopted by NMFS, but they distinguish between different types of fish based on their hearing sensitivity, as detailed further below:

- Fish with no swim bladder or other gas chamber. This group includes elasmobranchs (sharks and rays, such as the giant manta ray [*Mobula birostris*]), jawless fishes, flatfish, and gobies (Gobidae) that are expected to be only capable of detecting particle motion (Casper et al. 2012). These species are least susceptible to barotrauma, or tissue injury that results from rapid pressure changes (e.g., forced change in depth, explosions, intense sound) (Popper et al. 2014).
- Fish with swim bladders or other gas volumes not involved in hearing. This group includes some pelagic species such as Atlantic salmon (*Salmo salar*) and tuna, as well as Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*). These fishes are susceptible to barotrauma and are only capable of detecting particle motion.
- Fish with swim bladder or other gas volumes involved in hearing. This group includes Atlantic cod, herring, shad (*A. sapidissima*), otophysans, mormyrids, and squirrelfish (Holocentridae). They detect both sound pressure and particle motion and are susceptible to barotrauma.
- Fish eggs and larvae (Popper et al. 2014).

Table 5-3 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)
		$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	All Fish
Standard Driving Installation – Impact Pile Driving	10	258	458	477	881	477	1,089	477	881	516	6,195	516	5,005	10,669
Standard Driving Installation – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	1,212	--	845	843
Hard-to-Drive Installation – Impact Pile Driving	10	258	509	477	967	477	1,194	477	967	516	6,665	516	5,417	10,669
Hard-to-Drive Installation – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	1,058	--	709	843
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	10	258	625	477	1,145	477	1,439	477	1,145	516	7,427	516	6,122	10,669

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)
		$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	$L_{p,pk}$	$L_{E,24h}$	All Fish
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	1,655	--	1,236	843
OSS Piled Jacket – Impact Pile Driving	10	66	66	101	376	101	491	101	376	175	3,808	175	2,863	4,336
OSS Piled Jacket – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	569	--	340	337
Cofferdam Installation – Vibratory Pile Driving	0	--	--	--	--	--	--	--	--	--	838	--	641	470
Goal Post Pile Installation – Impact Pile Driving	0	--	--	--	--	--	--	--	--	--	--	--	--	6,750

- = not applicable; dB = decibel; $L_{p,pk}$ = peak sound pressure level in units of dB referenced to 1 micropascal; $L_{E,24h}$ = 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

Effects on finfish and invertebrates within their respective EFH would occur during the construction phase of the proposed Project because of equipment noise, particularly impact pile-driving noise. Potential impacts on finfish and invertebrates, as described in COP Section 3.13.1 (Dominion Energy 2023), include injury and behavioral disturbances. Potential for injury is characterized using two metrics, $L_{p,pk}$, $L_{E,24h}$. 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 $L_{E,24h}$ metric characterizes the potential for injury resulting from cumulative exposure to sound above a given threshold (Table 5-3) within a full 24-hour period. Potential injury from the $L_{p,pk}$ metric is unlikely to occur, as the maximum range to the $L_{p,pk}$ threshold during WTG foundation installation with a 10 dB noise attenuation is 1,460 feet (45 meters), which would be easily avoided by fish during construction considering 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 4.2-11; Dominion Energy 2023). All other modeled scenarios result in smaller ranges to the injury threshold further reducing the likelihood of exposure to the $L_{p,pk}$ threshold. Additionally, the implementation of mitigation measures such as soft starts (ramp-up procedures), though geared toward marine mammals and sea turtles (COP Section 4.2.3.3, Table 4.2-11; Dominion Energy 2023) would further minimize the potential for serious injury due to the $L_{E,24h}$ threshold. Ramp-up would facilitate a gradual increase of hammer blow energy to allow fish to leave the area prior to the start of operations at full energy that could result in injury. Ramp-ups could be effective in deterring fish from foundation installation activities prior to exposure resulting in a serious injury. This reduces the risk of exposure and injury to fish during pile driving under the Proposed Action and is, therefore, unlikely to occur. The predominant impact expected during impact pile driving on finfish and invertebrates within their EFH is behavioral responses such as startle responses or avoidance of the ensonified area during construction. However, as discussed in Chapter 3 above, 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. Overall, the duration of impact pile-driving activities would be relatively short term (approximately 4 hours per day if two piles are installed) 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. Due to the temporary, localized nature of noise produced by impact pile driving under the Proposed Action construction scenario and the implementation of mitigation measures (COP Section 4.2.3.3, Table 4.2-11; Dominion Energy 2023), which would minimize the risk of exposure to above-threshold noise levels, moderate impacts on the EFH of the listed finfish and invertebrates would be expected. BOEM would ensure that Dominion Energy prepare and submit a Pile Driving Monitoring Plan to BOEM, BSEE, and NMFS for review and concurrence at least 90 days before start of pile driving. An operational sound field verification plan to determine the operational noises emitted from the Offshore Project area would also be created by Dominion Energy. The plan would be reviewed and approved by BOEM and NMFS.

Vibratory pile driving during installation of the WTGs may exceed acoustic injury thresholds up to 0.9 mile (1.4 kilometers) from the source with a 10 dB noise attenuation (Table 5-3); however, this is based on the $L_{E,24h}$ metric, which, as discussed for impact pile driving, requires fish to remain in the ensonified area for up to 24-hours, which is unlikely to occur. The behavioral threshold may be exceeded up to 2,962 feet (903 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 the EFH of the listed finfish and invertebrates would be negligible.

All fishes can detect and use particle motion (Popper and Hawkins 2018). The organ located in the inner ear of fishes contains a dense structure called the otolith (i.e., ear stone), which lies near the auditory sensory macula (i.e., layer of sensory hair cells). The otolith organ acts as an accelerometer and enables detection of particle motion. Particularly fish with primitive swim bladders that are not involved in hearing, like Atlantic sturgeon, particle motion is thought to play a key role in detection of underwater noise (Hawkins and Chapman 2020). However, measurements of sensitivity to particle motion and pressure were rarely performed simultaneously, leaving a data gap in the understanding of particle motion sensitivity in fish (Popper and Hawkins 2018). Additionally, particle motion levels associated with high intensity noise sources are often difficult to measure and isolate from sound pressure levels (Popper and Hawkins 2018). Current understanding of the potential effects of particle motion on fish and invertebrates is very limited. It is expected that particle motion associated with impulsive noise sources, such as impact pile driving, will have similar effects to pressure waves in fish species, and may also have the potential to affect fish tissues. However, lack of evidence for any source due to extreme difficulty of measuring particle motion and determining fish's sensitivity to particle motion renders establishing of any guidelines or thresholds for particle motion exposure currently impossible (Popper et al. 2014; Popper and Hawkins 2018). Additionally, due to the physics of underwater noise, particle motion is only expected to be dominant within short ranges around the source (Mickle and Higgs 2022; Harding and Cousins 2022), outside of which sound pressure would dominate.

The maximum area of potential ensonification from impact pile driving activities of the WTGs and OSSs is shown in Figure 5-1. This figure shows the maximum extent of potential adverse effects as varying concentric circles from the WTG or OSS foundation. The center image shows the Lease Area as a whole, while the insets to the right of the figure show an example of the ensonification around a representative WTG and OSS (different scales) since the structures vary. The thresholds correspond to a scenario of 10 dB mitigation, for installation of two WTG piles per day, one using the standard impact piling schedule and one using the hard driving piling schedule; and the only scenario modeled for the OSSs. Although the figure shows all overlapping threshold ranges for the foundation locations across the Lease Area simultaneously, construction will only take place at a maximum of two WTG locations per day, and concurrently piling is not expected (i.e., one WTG foundation will be installed before the developer moves to the second foundation location for that day). Therefore, the range of ensonification will be localized around one foundation location at a time during the approximate 2-hour impact pile-driving period estimated for a single foundation and will be orders of magnitude smaller than shown across the entire Lease Area. Additionally, acoustic ranges are not a uniform circle around the noise source and can vary due to local conditions of the water column and seafloor. Therefore, Figure 5-1 is a general visual representation of the maximum area of potential ensonification during pile driving activities.

5.1.1.2.2 Habitat Loss/Conversion (Area of Piles)

Construction and installation of the Lease Area would include installation of 202 potential WTG foundation sites for the Maximum Layout, with a Preferred Layout of 176 WTGs. In either layout, there would also be three OSSs. Each of these offshore structures would add foundations and scour protection to support the foundation. The addition of WTGs and OSSs would therefore convert a portion of the benthic habitat from soft-bottom to hard-bottom and also provide novel surfaces vertically. These vertical structures would modify the characteristics of pelagic habitats from the seabed to the sea surface used by many managed species and their prey and foraging resources. Over time, these new hard structures would become colonized by sessile organisms, such as mussels, and anemones creating complex habitats that effectively serve as artificial reefs within the Lease Area (Degrear et al. 2020).

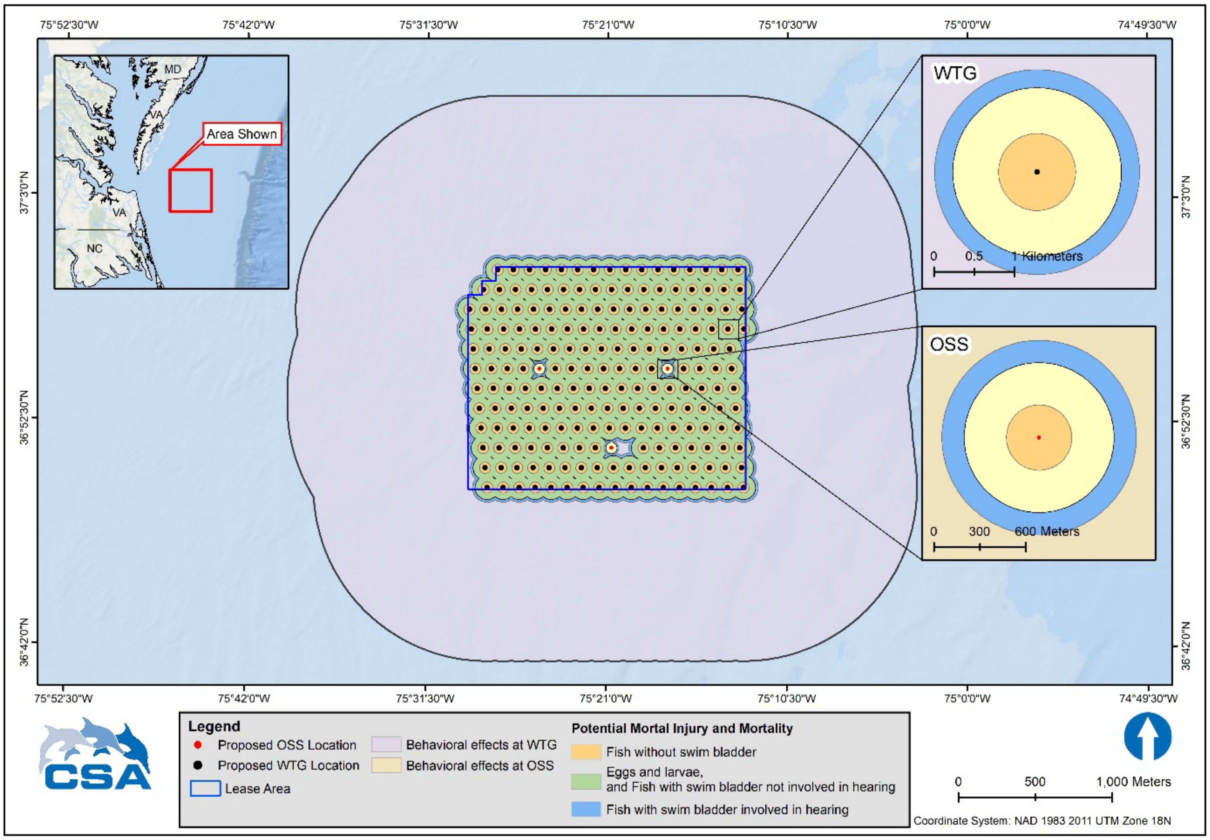


Figure 5-1 Maximum modeled area of acoustic effect during Wind Turbine Generator (WTG) and Offshore Substation (OSS) impact pile driving activities within the Offshore Project area by fish hearing group designated by Popper et al. (2014)

Note: The figure shows the threshold ranges for each WTG and OSS pile to provide a maximum potential area of effect; however, pile-driving activities will only take place at a maximum of two WTG locations per day, and concurrently piling is not expected (i.e., one WTG foundation will be installed before the developer moves to the second foundation location for that day). Therefore, the range of ensonification will be localized around one foundation location at a time during the approximate 2-hour impact pile-driving period estimated for a single foundation and will be orders of magnitude smaller than shown across the entire Lease Area.

The loss and conversion of the softbottom sand habitat would impact invertebrate managed species such as longfin inshore squid, Atlantic surfclam, and Atlantic sea scallop that use the demersal or softbottom habitats during sensitive life stages such as eggs (longfin inshore squid) larvae and require the softbottom habitats as adults. Juvenile and adult benthic infauna such as Atlantic surfclam and Atlantic sea scallop would be crushed or displaced by the installation of the foundation during installation. Managed demersal finfish species that could be affected are neonates for the dusky shark, blacktip sharks, clearnose skates, juvenile and adult scup, Atlantic sharpnose shark, and Atlantic angel shark. The impacts of the installation and presence of the WTG and OSS on managed species of finfish and invertebrates would likely be minor and potentially negligible when considering meniscal reduction of habitat loss and conversion within the Lease Area. WTG and OSS foundations would be placed in areas characterized as softbottom sand using the NOAA Habitat Complexity Categories. With the installation of 202 WTG positions, and three OSSs a total of 203.3 acres (82.3 hectares) of soft-bottom benthic habitat would be converted. In the Preferred

Layout of 176 WTGs and three OSSs, 115.2 acres (46.6 hectares) would be converted (Table 5-2) See COP Table 4.2-17 for more detail (Dominion Energy 2023). The total acreage of the Lease Area is approximately 112,799 acres (45,658 hectares). Therefore, 0.18 percent of the Lease Area would be converted from the installation of WTGs, OSSs and their associated scour protection for the Maximum Layout and decreased to 0.10 percent in the Preferred Layout (Table 5-2). The estimated percentage of seafloor affected or reduced within the Lease Area from the installation of the structures alone, would result in a negligible impact on the EFH of the managed species identified in this assessment.

5.1.1.3 Pelagic Effects

Anthropogenic structures, especially tall vertical structures that extend from the seafloor to the surface such as the WTG and OSS foundations, once in place 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 managed species of finfish and invertebrates are typically undetectable (BOEM 2021), the cumulative effects of the presence of multiple structures on local or regional-scale hydrodynamic processes are not currently well understood (Dorrell et al. 2022). 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 would 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. This modeling study assessed four post-installation scenarios. Two of the managed species that occur within the Lease Area, summer flounder and Atlantic sea scallop, were selected as focal species in this study (silver hake [*Merluccius bilinearis*] was the third focal species assessed in the model but does not have a defined EFH within the Lease Area). 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. The offshore structures would attract finfish and invertebrates that approach the structures during routine movement or during migration. Such attraction could alter or slow migratory movements of managed species that utilize the MAB during egg, larvae, and juvenile development. 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.

Habitat complexity is an important contributor to diversity and abundance of a large number of commercially and ecologically important managed species (e.g., through facilitating refuge from prey during early life stages, providing areas of post-larval settlement) (Loren et al. 2007; Malatesta and Auster 1999). 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 2021) 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). The recruited epifaunal will be dominated by suspension feeders that transfer pelagic nutrient resources to the benthic community, potentially decreasing pelagic primary productivity (Slavik et al. 2017). The trophic resources of the filter-feeding epifauna could include the eggs and larvae of managed species and their prey species. Further, colonization by non-native 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 managed finfish and invertebrate species would be minor and may include minor beneficial impacts. All impacts would be permanent as long as the structures remain.

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 (Andersson and Öhman 2010; Coates et al. 2014, Danheim et al. 2020; English et al. 2017; Degrear, 2020) through there is also a concern due to consolidating prey for predators and fishers.

5.1.1.4 Seabed Preparation Installation Activities (grapnel runs)

5.1.1.4.1 Habitat Loss/Conversion

Prior to installation of offshore structure foundations, seabed surface preparation may be required to remove any obstructions such as anthropogenic debris, or fishing gear. An area of up to 656.16 feet (200 meters) around the center of each OSS will be checked and cleared for debris, large boulders, and UXOs. Three passes of pre-lay grapnel runs would occur: one along the centerline and two parallel passes outside of the centerline. UXO surveys would be completed as well and mitigated as needed. UXO mitigation benthic impacts were not provided for the structures alone, however approximately 1.58 acres (0.64 hectares) is anticipated across the Project and is not anticipated to greatly change based on the WTG layout (Table 5-2). Since no boulders/rocks were found in either of the extensive survey activities for the CVOW Pilot or Commercial Projects, Dominion Energy does not anticipate the need for boulder removal but has included the possibility that it may be needed following further detailed engineering and installation planning. Preparation activities for the WTGs are expected to be similar.

The NOAA Habitat Complexity Categories cross-walked to benthic habitat types (i.e., complex, heterogenous complex, and softbottom) indicates that the entire 201.93 acres (81.72 hectares) of habitat to be affected consists of 100 percent softbottom sand resources. Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples, with some very isolated patches of mud and gravel. These mud and gravel habitats are not within any of the WTG or OSS sites. The Seabed Mobility Study (COP Appendix CC, Dominion Energy 2023) characterized the seabed within the Lease Area as having slow dynamic changes of the ridges not detectable within the 10-year span of the background data for the study. The sand waves are present in the northwest corner and were found to have fairly low migration rates around 2 meters per year, while other sand waves were stable. There is little movement of the finer sands in the deeper flat areas with the exception of a few channelized locations. Consequently, only a few proposed WTGs lie within the axis of moving bedforms and may be concerned by erosion or accumulation of sediment along migration paths (COP Appendix CC; Dominion Energy 2023).

The benthic habitats within the WTGs, OSS foundation sites, and cable corridors would temporarily be disturbed by preconstruction seabed preparation, anchoring, clearing operations, and potential relocation of UXOs that are unable to be avoided through micrositing. Sand ripples and waves disturbed by these installation construction activities 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 2023; Kraus and Carter 2018). The primary technique that would impact the softbottom habitat the most would be pre-lay grapnel runs utilized to clear debris within the cable corridors and the footprint area of the WTGs and OSSs. This preconstruction activity is required within the IACC, installation of the

WTGs and OSSs. Dominion Energy has estimated that up to 6,347.31 acres (2,568.67 hectares) of softbottom seafloor habitat (COP Table 4.2-17; Dominion Energy 2023) would be disturbed in relation to these grapnel runs, for the inter-array cables connecting the WTGs to each other and the OSSs (Table 5-2). In the Preferred Layout about 5,962.61 acres (2,412.98 hectares) would be temporarily disturbed by these grapnel runs. The impacts related to grapnel runs would be very localized, short-term, and would recover completely without mitigation. The grapnel runs would impact the eggs larvae and adult life stages of invertebrate managed species such as longfin inshore squid, Atlantic surfclam, and Atlantic sea scallop. Managed finfish species that could be affected are neonates for the dusky shark, blacktip sharks, clearnose skates and juvenile and adult of scup, Atlantic sharpnose shark, and Atlantic angel shark. The activities outlined in this section relate to seafloor preparation activities (grapnel runs) and would result in temporally short and localized impacts on the EFH of managed species. There would be no habitat loss or conversion in relation to the grapnel runs. The impacts on managed species within the Lease Area from seabed habitat loss or conversion during the installation of the WTGs and OSSs, would be negligible based on the assessment that the softbottom sand habitats would recover shortly after disturbance and without mitigation (Boyd et al. 2005; Dernie et al. 2003; Hobbs 2002, 2006) and the potential for beneficial impacts as well.

5.1.1.4.2 Sediment Suspension/Redeposition

The primary technologies that would have the largest spatial impact on the seafloor habitat would be pre-lay grapnel runs to be completed. Dominion Energy has estimated that about 2,385.5 acres (965.4 hectares) (COP Table 4.2-17; Dominion Energy 2023) of seafloor would be disturbed during the seafloor preparation operations involving grapnel runs throughout the Lease Area. See Section 5.1.2 for the cable corridors. The benthic habitat within these IACCs is composed of 100 percent softbottom sand using the NOAA Habitat Complexity Categories cross-walked to benthic habitat types (Table 3-3) The impacts related to the grapnel runs would be very localized and temporary. The softbottom sand habitat would recover completely without mitigation. Sediment deposition and burial during these installation operations could cause impacts on sensitive life stages, such as demersal eggs, larvae, juveniles, and adult life stages of invertebrate managed species such as longfin inshore squid, Atlantic surfclam, Atlantic sea scallop. Managed finfish species that could be affected are neonates for the dusky sharks, blacktip sharks, clearnose skates, and the juvenile and adult scup, Atlantic sharpnose sharks, and Atlantic angel sharks. Sediment deposition impacts on managed species of finfish and invertebrates would be expected to range between negligible and minor.

5.1.1.4.3 Entrainment

Through the assessment of the geophysical surveys completed and presented in Section 4.1 of the CVOW-C COP (Dominion Energy 2023), Dominion Energy has proposed to use grapnel-clearing procedures for the seabed preparation methodology. Other types of preparation may be required to modify the seafloor and enable construction in areas where sand-waves or megaripples may occur. It is not uncommon to use hydraulic dredges that withdraw large volumes of water during these operations. If used, water intake poses an entrainment risk especially for eggs and larvae life stages. The seabed preparation activities to be utilized by Dominion Energy would not include any hydraulic dredging processing and, therefore, no risk of entrainment is anticipated with the installation of the offshore structures.

5.1.1.4.4 Underwater Sound (Vessels)

Sound generated through the vessel activities supporting the installation of WTG and OSS monopile foundations and other offshore activities (HRG surveys equipment, support vessels) is likely to occur within and near the Project area. Noise impacts associated with WTG and OSS monopile installation vessels are discussed in Section 5.1.1.1, *Vessel Activities,* and would be short term and localized and extend only a short distance beyond the WTG and OSS footprint. Impacts from noise related to vessel operations would be lower than impacts related to trenching, seafloor excavation, and WTG and OSS pile-driving installation. Noise from the preparation activities would likely result in short-term behavioral changes in a broader area. These impacts would be short term, and finfish and mobile invertebrate EFH species would be expected to return to the areas of impact after the monopile operations are completed. Because of the short time frame and localized nature of these activities the impacts for EFH species are considered to be minor.

5.1.1.5 Installation of Scour Protection

5.1.1.5.1 Habitat Loss/Conversion

Construction of the scour protection is described in the COP (Volume I, Section 3.4.1.1; Dominion Energy 2023) for each of the WTGs and OSS foundations. Dominion Energy proposes to install the scour protection pads prior to installing the WTG and OSS foundations. Including the scour protection around the bases of the foundations, the benthic impact area from the WTGs and OSSs would be around 203.3 acres (82.3 hectares) of softbottom habitat in the Lease Area. In the Preferred Layout of 176 WTGs, 115.2 acres (46.6 hectares) would be permanently affected from the WTGs and OSSs.

The NOAA Habitat Complexity Categories cross-walked to benthic habitat types (i.e., complex, heterogenous complex, and softbottom) indicate that the entire area of habitat to be affected consists of 100 percent softbottom sand resources. The loss and conversion of the softbottom sand habitat would impact the sensitive life stages of demersal eggs, larvae, and adult life stages of invertebrate managed species such as longfin inshore squid, Atlantic surfclam, and Atlantic sea scallop. Managed finfish species that could be affected are neonates for the dusky shark, blacktip sharks, clearnose skates and juvenile and adult scup, Atlantic sharpnose shark, Atlantic angel shark.

The impacts of the installation and presence of the scour protection features around the WTGs and OSSs on managed species of finfish and invertebrates would likely be minor and potentially negligible when considering a miniscule reduction of habitat loss and conversion within the Lease Area. The total acreage of the Lease Area is approximately 112,799 acres (45,658 hectares); therefore, the estimated percentage of seafloor permanently affected in the Lease Area from the installation of the structures and their scour protection is 0.18 percent, or 0.10 percent in the Preferred Layout. This amount of softbottom habitat loss surrounded by vast amount of similar habitat would result in a negligible impact on the EFH of the managed species identified in this assessment.

5.1.1.5.2 Sediment Suspension/Redeposition from Installation

Preparation activities for the scour protection of 202 potential WTG sites, with a Preferred Layout of 176 WTGs installed and three OSSs may require the removal of anthropogenic debris within the proposed sites. The grapnel runs and potential relocation of UXOs would likely be the primary preparation activity as discussed in Section 5.1.1.4, *Seabed Preparation Installation Activities Effects*. Scour protection proposed by Dominion Energy includes dumped rocks, geotextile sand containers, and concrete mattresses. 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. The COP describes two layers of scour protection—the first layer is a filter layer for the second (armor) layer. The COP states that the WTG monopile scour protection would be installed prior to installation of the WTG monopiles. Dominion Energy additionally states that at specific locations undetermined at this time, the second layer (rock layer) might be installed post-WTG monopile foundation installation, depending on the type and size of stone necessary. Stones, if utilized for scour protection would be placed precisely using a DP vessel equipped with a fallpipe. The turbidity that would be generated during this installation activity would be short term and localized (see Section 5.1.2.3.3 for more details). The impacts related to sediment suspension and redeposition from the installation of the scour protection features around the WTGs and OSSs foundations would affect the managed species that utilize this demersal habitat. The turbidity and sediment suspension and redeposition resultant from the rock placement would settle out within hours after the rock placement is completed and would return to background water quality conditions. The motile managed species of finfish and invertebrates would initially avoid the area of construction and any adverse effects related to the elevated turbidity caused by the sediment suspension. The impacts related to sediment suspension and redeposition would likely be minor and potentially negligible when considering the temporal and spatial extent of this activity in the Lease Area.

5.1.2 Inter-array and Offshore/Onshore Cable Installation

5.1.2.1 Vessel Activity

5.1.2.1.1 Habitat Loss/Conversion

During installation within the IACC, OECC, and nearshore cable sections multiple vessels would be used for the installation of CVOW-C power cable networks. Dominion Energy is planning to use multiple construction vessels with various configurations (COP Volume I, Table 3.4-5; Dominion Energy 2023). Most of the proposed vessels would be equipped with DP systems, but some would require anchoring to support construction activities. Construction vessels such as jack-up barges would utilize stabilization spuds; other vessels would use anchor spreads. Within the OECC, roughly 1,000 to 1,800 feet (305 to 549 meters) from the shore will be a nearshore trenchless punch-out location. This area will be used to feed the OECC cables from the offshore waters through the nearshore waters to the onshore cable landing. These impacts fall within the footprint of the OECC and are detailed within COP Section 3.3.2 (Dominion Energy 2023). The punch-out would be located in muddy sand nearshore habitat (Figure 3-7). Within the Lease Area 100 percent of the benthic resources are softbottom sand using the NOAA Habitat Complexity Categories cross-walked to benthic habitat types (Table 3-3). Once the anchors or spuds are removed the softbottom and sand/mud habitats would recover within a few months with no mitigation (Dernie et al. 2003). As anticipated the shallower waters of the OECC near the DNODS has the highest expected migration rates that vary between 1.5 and 18 meters per year for the most mobile sections, with sand wave migration potentially changing the bathymetry up to 2.5 meters for the next 30 years (Appendix CC; Dominion Energy 2023).

Utilizing DP vessels would reduce the amount of seafloor disturbance and reduce seafloor impacts. Vessels using anchoring systems have a greater potential to disturb the seabed and result in burial or crushing impacts on benthic epifauna and infauna and temporary habitat loss of use to motile demersal invertebrate and finfish managed species.

5.1.2.1.2 Sediment Suspension/Redeposition from Anchoring Activities

Preparation activities for the installation of cables within the IACC and OECC would involve performing UXO surveys, potential relocation of UXOs that are unable to be avoided through micrositing, and grapnel runs within the IACC and OECC. The UXO operations would involve performing a geophysical survey that is designed for, and focused on, identifying potential survey targets that have a signature suggesting that an UXO may be within the cable corridor. The vessels that would perform these activities would be using a DP navigational and maneuvering system, thereby removing potential impacts on the benthic habitat and eliminating any sediment suspension or deposition.

Prior to installation of the power cables within the IACC and OECC, pre-lay grapnel-clearing operations would be required within the IACC and OECC. As stated previously these operations would be completed utilizing DP systems to navigate and maneuver the vessels during grapnel run operations. Utilizing the DP capable vessels would practically eliminate any sediment suspension or redeposition due to the operation of the vessel, and there would be no impact on the managed species within the Project area. See Section 5.1.2.3.3 for sediment transport model results.

5.1.2.1.3 Potential of Introduction of Exotic/Invasive Species via Ballast

Impacts from potential introduction of invasive species from vessel activity would be similar to those discussed under Section 5.1.1, *Installation of WTG/OSS Structures and Foundations*.

5.1.2.2 Seabed Preparation (Including UXO Removal and Grapnel Runs)

5.1.2.2.1 Habitat Loss/Conversion (Including Loss of Infauna/Epifauna; Dredge Disposal Location/Side Casting Area)

As designed and presented in Appendix E of the CVOW-C Draft EIS (BOEM 2022), Table E-2, Dominion Energy is planning to install 717.6 miles (1,155 kilometers) of power cables within the IACC (300.7 miles [484 kilometers]) and 337.9 miles [543.7 kilometers]) of cable within the OECC. Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, pre-grapnel runs, and UXO identification surveys and clearance of large marine debris. Dominion Energy does not anticipate the need for boulder or sand wave removal, based on analysis of previous G&G survey data which did not identify any boulders larger than 1.6 feet (0.5 meters). Pre-grapnel runs may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the siting corridor. The pre-grapnel runs will create a path 82 feet (50 meters) wide, the cable installation trench will be constructed inside of this cleared path. The clearance of UXOs would clear a path 164 feet (50 meters) wide around the expected cable corridors, although this may require a larger sweep near high risk areas (e.g., DNODS). The seabed disturbance footprint for UXO identification and mitigation, which will entail relocation of UXO that cannot be avoided by micrositing, is anticipated to be approximately 161.5 square feet (15 square meters). Dominion Energy anticipates that 1.58 acres (0.64 hectares) of seafloor would be temporarily disturbed for UXO mitigation and removal of large marine debris (Table 5-2). Potential detonation of UXOs is not included under the Proposed Action and is not anticipated.

The planned pre-lay grapnel run operations would take place within 2,988.8 acres (1,209.5 hectares) of IACC and 3,358.51 acres (1,359.14 hectares) of OECC benthic habitat in the Maximum Layout (COP Table 4.2-17; Dominion Energy 2023). In the Preferred Layout of 176 WTGs, 2,604.1 acres (1,053.8 hectares) in the IACC, and no changes in the OECC (3,358.51 acres [1,359.14 hectares]) would be disturbed by pre-lay grapnel runs. Combined, a maximum of 6,347.31 acres (2,5678 hectares) would be disturbed from pre-lay grapnel runs (Table 5-2). Since pre-lay grapnel runs would impact the Lease Area and OECC roughly six percent of the total Project area (113,434.37 acres (45,905.26 hectares) would be temporarily impacted.

As stated, and outlined in Section 5.1.1.3, *Pelagic Effects,* this pre-construction activity would be short term and localized to the area of the grapnel train. Demersal motile and epifaunal and infaunal invertebrate and finfish EFH species would be the most affected group during one of more life stages. These surface sediment preparation activities would result in short-term adverse effects. The softbottom habitats within the Lease Area and OECC are expected to recover within a few weeks to months without the mitigation (Boyd et al. 2005; Dernie et al. 2003; VIMS 2000), which would allow the affected managed species to return and inhabit and utilize the benthic resources.

5.1.2.2.2 Sediment Suspension/Redeposition

Sediment suspension and subsequent redeposition would occur in relation to the preparation activities (UXO and pre-lay grapnel runs). As described in Sections 5.1.1.3 and 5.1.1.4, the softbottom sand habitats in the IACC and softbottom sand and mud habitats within the OECC would be affected, but the sediments in suspension would settle out within or near the vicinity of the grapnel ground tackle path, minimizing the impact on infaunal invertebrate EFH species (Atlantic surfclams and sea scallops) along with the multiple life stages of motile invertebrates and finfish EFH species. This habitat is expected to recover quickly without mitigation. The impact on managed species in relation to these sediment preparation activities is expected to be minimal. To date, no studies have taken place to specifically address changes in abundance or distribution of scallops or clams in response to the addition of WTGs (Hogan et al. 2023).

5.1.2.2.3 Entrainment

Through the assessment of the geophysical surveys completed and presented in COP Section 4.1 Dominion Energy has proposed to use grapnel-clearing procedures for the seabed preparation methodology (Dominion Energy 2023). Other types of preparation can be utilized to modify the seafloor in areas where sand-waves or megaripples may hinder the operation of cable installation equipment (cable jetting sleds, etc.). It is not uncommon to use hydraulic dredges that withdraw large volumes of water during these operations. If used, water intake poses an entrainment risk especially for eggs and larvae life stages. The seabed preparation activities to be utilized by Dominion Energy would not include any hydraulic dredging processing; therefore, no risk of entrainment is anticipated with the installation of the seabed preparation for the inter-array export cables.

5.1.2.2.4 Underwater Sound (Vessels)

Sound generated through the vessel activities supporting the installation of cables using jet plows and trenching technologies and other offshore activities (HRG surveys equipment, support vessels) is likely to occur within and near the Project area. Noise impacts associated with grapnel runs would be short term and localized and extend only a short distance beyond the cable corridor. Impacts from noise would be lower than impacts from the trenching and disturbance to the seafloor; regardless, the most prominent noise-producing activities would be related to trenching and seafloor excavation and WTG and OSS pile-driving installation. Noise from the preparation activities would likely result in short-term behavioral changes in a broader area. These impacts would be short term, and finfish EFH species would be expected to return to the areas of impact following the seabed preparation activities. Because of the short time frame and localized nature of these activities the impacts for EFH species are considered to be minor.

5.1.2.3 Trenching/Cable Installation

5.1.2.3.1 Habitat Loss/Conversion (Including Loss of Infauna/Epifauna; Conversion of Hardbottom to Softbottom Habitats – Fining of Sediments)

Installation of the inter-array cables within the IACC for the Proposed Action would temporarily affect 2,988.8 acres (1,209.5 hectares) (CVOW-C Draft EIS Appendix E, Table E-2) of seafloor habitat within the Lease Area for the Maximum Layout. In the Preferred Layout of 176 WTGs 2,604.1 acres (1,053 hectares) would be disturbed (Table 5-2). As described in Section 5.1.1, 100 percent of the benthic habitat within the Lease Area consists of softbottom habitat. Dominion Energy has proposed using the jet plow methodology to bury the inter-array cables down to a depth of 16.4 feet (5 meters) below stable seabed. Jet plowing functions by injecting (jetting) and fluidizing the seafloor sediment to allow the cable to settle into a short-term localized benthic disturbance is anticipated during the array cable installation process. Cable laying speed for both the IACC and OECC operations would progress at 197 feet per hour to 1,148 feet per hour (60 meters per hour to 350 meters per hour) (COP Section 3.4.1.4; Dominion Energy 2023).

OECC cable installation is estimated to temporarily impact 3,358.51 acres (1,359.14 hectares) for the maximum Layout, with no changes expected in the Preferred Layout. The sediment suspended during this operation would settle out in close vicinity of the cable trench reducing the impact area. It is anticipated that pelagic species and motile demersal life stages would avoid construction activities based on installation speeds, and direct impacts are not anticipated. Direct impacts on foraging habitat are expected to be localized to the width of the trench (49 feet [15 meters]) and short term as infauna and epifaunal benthos recolonize the affected area (Boyd et al. 2005; VIMS 2000). Indirect impacts on EFH could occur as a result of sediment suspension, temporarily decreasing foraging success due to increased turbidity. It would be expected that normal foraging behavior would resume following completion of installation and settlement of suspended sediments.

Within the OECC there are areas categorized as rocky, using the NOAA Habitat Complexity Categories cross-walked to benthic habitat types (Table 3-3). The rocky habitat consists of areas shown to have 2.8 acres (1.13 hectares) of gravel mixes and cover and habitats consisting of gravelly sediments covering 1,691.2 acres (684.4 hectares) within the OECC. All nine cables would be installed within a construction trench within the 49.01 mile (78.9 kilometer) -long OECC. Dominion Energy estimates the trench would be 33 to 50 feet (10 to 15 meters) wide. The footprint of a single cable that would be affected within the OECC is estimated to be 292.4 acres (118.4 hectares). Within the OECC, the nine cables would generally be spaced approximately 164 to 2,716 feet (50 to 828 meters) apart. At certain locations, the cables may be spaced 164 to 328 feet (50 to 100 meters) apart based on natural and environmental constraints. Conservatively, the requested operational right of way width due to trenching the nine cables is a width of 2,953 feet (900 meters) (COP Table 3.3-8; Dominion Energy 2023). A total of 10.7 percent of the benthic resources within the OECC is composed of rocky habitat (Table 3-3). It is presumed that 10.7 percent of the surface area within one of the nine cables would impact 29 acres (11.7 hectares) of rocky habitat. An even smaller portion of the OECC consists of softbottom mud habitat, 11.52 acres (4.66 hectares) or 0.07 percent. This would result in 0.21 acre (0.08 hectare) of mud habitat within a single OECC and cumulatively 1.89 acres (0.76 hectare) of mud softbottom affected through the installation of the nine OECC cables.

The width of the OECC would change throughout to accommodate for habitat type, as well as nearby conflicting uses (such as the disposal site, nearshore). Therefore, calculating exact acreages of benthic impacts of various habitats within the OECC is impractical. However, these habitats are quick to recover from disturbance, full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005) or less.

The installation of the inter-array cables, cable connecting substations and the OECC may result in direct impacts from the jet plow and trenching installation operations. These direct impacts could involve crushing or burial of infauna and slow-moving organisms and life stages. Another mechanism for direct impacts could result from fluidizing the sediments during jetting operations burying and mechanically damaging and impacting life stages of benthic managed species. Mobile demersal and pelagic managed species like longfin squid and finfish species would be able to avoid the jetting operations, but their foraging opportunities would be reduced causing potential secondary effects on EFH-designated species and life stages that prey upon benthic and epibenthic organisms. Cable installation activities through areas of mobile seabed will be micro sited based on the Project-specific studies conducted for the COP (Appendices D, J, K, and W; Dominion Energy 2023). Models show that the leading edges of the shoal are the most active area and would, therefore, refill more quickly than the crest, while the trailing edges would refill more slowly (CSA 2010). Models predicted that refilling of crests dredged in longitudinal stripes, with alternating untouched areas would be uniform along the length of the excavation. This approach would also have the potential to enhance biological recruitment. Past studies on offshore dredging and sand mining projects within Maryland and Delaware have demonstrated that shoal width, length, and base area all increase until water depth is approximately 115 feet (35 meters) and then begin to decrease (Nairn 2011). While shoals are within the growth state, they are likely to rebuild themselves once dredged (CSA 2010; Nairn 2011). Polychaetes are the dominant infauna in these habitats, followed by amphipods and bivalves (Hobbs 2006; USACE 2009). Although the impact on these sand shoals from cable installation would injure and or kill all benthic organisms in the path of construction, these benthic fauna are likely to recover fairly rapidly (Boyd et al. 2005; Dernie et al. 2003; Hobbs 2002, 2006). Furthermore, in a similar study off the Virginia coast no differences in sediment grain size composition or fish density and assemblage were observed between a sand borrow site and the control site (Hobbs 2006). Overall, the small areas that will be disturbed for cable installation relative to the large geographic range of many migratory fish species indicates that the fish populations are not likely to be affected (Hobbs 2002; VIMS 2000).

5.1.2.3.2 Entrainment

Entrainment related to the jet plow operations within the IACC and OECC would result in mortality of species with EFH for pelagic or planktonic early life stages. This mortality would occur during water withdrawal from the cable laying vessel supporting and towing the jet plow system. Entrainment of early pelagic life stages via water withdrawals would result in 100 percent mortality because of the stresses associated with being flushed through the pump system and temperature changes (USDOE 2012). Due to the limited volume of water withdrawn, BOEM does not expect population-level impacts on any given managed or NOAA trust species.

5.1.2.3.3 Sediment Suspension and Redeposition

The primary installation techniques that may impact the softbottom habitat the most would be jet plowing for burial of the inter-array cables and cable to be installed within the OECC. Dominion Energy has estimated that up to 6,347.31 acres (2,568.67 hectares) of softbottom seafloor habitat (COP Table 4.2-17; Dominion Energy 2023) could be disturbed during jet plow operations, 5,962.61 acres (2,412.95 hectares) in the Preferred Layout (Table 5-2). The impacts related to jet plowing would be very localized and short term and would recover completely without mitigation. However, in areas where seabed conditions might not allow for cable burial to the desired depth of 9.8 feet (3 meters) for the IACC and 16.4 feet (5 meters) for the OECC, potentially other methodologies may be required but are not assessed in this EFH.

Dominion Energy (2022) completed a Sediment Transport Modeling Study (COP Appendix J; Dominion Energy 2023). Samples were collected at 25 locations, 17 of which were within the OECC. On average sediment samples from the OECC had 81 percent fine sediment. It is important to note that these concentrations do not occur at all locations simultaneously. Given the speed of the jet plow, only small sections of the Offshore Project area would be disturbed at any given time during Project construction, which is the reason the model used the volume of sediment put into suspension in 30 minutes of jet plow travel (trench length of 328 feet [100 meters]) (COP Appendix J; Dominion Energy 2023). In addition, due to the depth of water within the Offshore Project area, the plume should not be visible from the surface (COP Appendix J; Dominion Energy 2023). Results of this conservative analysis found that suspended sediment concentrations dropped out rapidly with time. At most locations within the Offshore Project area, the concentrations of suspended sediments drop by 75 percent or greater within 4 minutes of jet plowing activity. Fine sand, the coarsest fine sediment particle class, has a settling velocity of 5.9 feet per minute (3 centimeters per second) and remains in suspension for approximately 1 minute (COP Appendix J; Dominion Energy 2023). Therefore, at locations with higher sand content, suspended sediment concentrations decreased by 69 percent or greater within 1 minute of jet plowing operations. This reduced the amount of sediment that could be transported in the water column due to currents, and most of the fine sand deposits within 16.4 feet (5 meters) of the trench centerline. The very fine sediments (clay) remained in suspension for about 4 hours, a relatively short period of time. The results of the study additionally indicate that deposition thicknesses decreased rapidly away from the trench (COP Appendix J; Dominion Energy 2023). Average deposition thicknesses were less than 0.4 inch (1 centimeter) within 82.0 feet (25 meters) of the trench centerline for flood tides and less than 0.4 inch (1 centimeter) within 32.8 feet (10 meters) of the trench centerline for ebb tides. In areas of installation with coarse sediments as identified in the OECC (1,694 acres [686 hectares] of rocky substrate, 2.8 acres [1.1 hectares] of gravel mixes, and 1,691.2 acres [684.4 hectares] of gravelly substrate). These sediment types would be immediately deposited in the jet plow trench. However, jet plow configurations, including the angle of the plow blade and water pressure through the jet nozzles, can be adjusted during cable installation and could result in less sediment mobilizing in the water column than the results of the conservative model.

Generally, permit requirements for these operations would mandate mitigation activities to reduce the temporal and spatial impacts related to jet plow activities. Even with stringent adherence to mitigation procedures, sediment dispersion and redisposition could have negative impacts on eggs and larvae of demersal managed species of finfish and invertebrates. Impacts related to sediment deposition and burial may vary based on season/time of year. 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 2021). Immediately following installation, impacts from suspended sediments can potentially cause mortality to demersal fish eggs due to burial and reduced hatching success (Berry et al. 2011). Impacts on demersal life stages and sessile organisms due to burial via sediment deposition may occur but are expected to be localized and short term. The impacts of sediment deposition and burial on finfish, invertebrates, and EFH from the installation of the cables would likely be minor.

5.1.2.3.4 Horizontal Directional Drilling

The preferred installation method for the proposed offshore export cable landings is an offshore trenchless installation methodology utilizing HDD. Dominion Energy has proposed this methodology to reduce the amount of benthic habitat modification and loss. An HDD operation consists of drilling a conduit shaft from onshore to a target punch-out location offshore. Dominion Energy has proposed the use of cofferdams or conductor barrels to facilitate lowering the direct pipe burial to 6.6 feet (2 meters) below the seabed to alleviate the need for additional cable protection and minimize the release of sediment and drilling fluids into the marine environment during offshore export cable pull-in activities. Trenchless installation (e.g., HDD) has the potential for impacts in the event of an inadvertent release of drilling fluids at the offshore exit hole (punch-out location), which could result in adverse impacts on water and benthic habitat quality through increases in turbidity, as well as exposure to hazardous chemicals for EFH and EFH-designated species. BMPs, such as monitoring of the drilling mud volumes, pressures, and pump rates and returns, would be followed to determine if drill mud loss occurs in amounts that signal a possible inadvertent release, also known as a *frac-out event*. A Drilling Mud Release Plan would be developed and implemented to prevent and minimize impacts. Cofferdams help control any drilling mud release that may occur at the HDD exit pit as the drill stem initially exits the punch-out location. The installation strategy would involve the installation of cofferdams expected to be approximately 1,000 to 1,800 feet (305 to 549 meters) offshore and would be constructed by installing 20-inch (0.51-meter) steel sheet piles in a tight configuration around an area of approximately 20 by 50 feet (6.1 by 15 meters) for each of the offshore power cables in the OECC. Cofferdams would be installed via vibratory pile driving.

Trenchless installation activities are anticipated to take approximately 9 to 12 months, with a total of nine conduits and 4 to 5 weeks per conduit.

Marine construction equipment such as jack-up barges may be used near the offshore trenchless installation exit pit, punch-out location to support the drilling and/or product pipe installation process. Jack-up barges are temporarily set up by extending their supports into the mudline to withstand the weight of the jack-up barge and the associated construction equipment. The depth to which the supports extend into the mudline may vary depending on the location, type of barge, and subsurface conditions. This process eliminates the need to install piles. The maximum area of temporary disturbance for the cable landing location is anticipated to be 2.8 acres (1.1 hectare), and the maximum temporary workspace at the nearshore trenchless installation area would be up to 8.8 acres (5.6 hectares). Demersal motile and epifaunal and infaunal invertebrate as well as finfish EFH species during one of more life stages would be the most affected groups from these activities. The excavation of the exit pits and cable installation activities would result in short-term adverse effects. The softbottom habitats within these relatively small areas within the OECC are expected to recover within a few weeks to months without mitigation (Boyd et al. 2005), which would allow the affected managed species to return and inhabit and utilize the benthic resources. The HDD operations are expected to have negligible impacts on EFH and EFH-designated species and would be temporary, short term, and spatially localized.

5.1.2.3.5 Underwater Sound (Vessels, Jet Plow)

Trenching activities and burial methods conducted in support of cable installation are known to emit noise comparable to that 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 operations would occur during initial cable installation and infrequently 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 on EFH species and would be temporary, short, and spatially localized to the trenching/burial operation footprint.

5.1.2.4 Cable Protection (Concrete Mattresses, etc.)

The cable protection approach that Dominion Energy would implement would be to achieve full cable burial along each cable segment. Approximately 0.1 percent of the length of offshore export cables would require cable protection. Once the cables are installed, Dominion Energy plans to reassess the burial depths and install protection systems where the desired burial depth is not achieved and where cable protection is warranted, such as the 27 cable crossings. The cable protection systems proposed, if needed, include rock dumping, laying concrete mattresses, and possible ducting. Habitat conversion would occur in the areas where WTG and OSS foundations required cable protection, as described in Section 5.1.2.4, *Cable Protection (Concrete Mattresses etc.)* and would be roughly 1.19 acres (0.48 hectares) but the amount of each type of cable protection features to be installed has not yet been determined. The short-term impacts during the installation would be 8.92 acres (3.61 hectares) and would be expected to recover without mitigation.

5.1.2.4.1 Habitat Loss/Conversion (Including Loss of Infauna/Epifauna)

One area where cable protection systems are required is located along the OECC where the export cables would cross three fiber optic cables, which is planned between mile posts 13 and 17 (kilometer posts 23 and 27) (COP Section 3.4.1.4, Dominion Energy 2023). The planned protection systems depend on the technical requirements at the site and include dumped rocks, geotextile sand containers, and concrete mattresses. The final design and installation methodology would be negotiated with the owner/operators of the fiber optic cables.

Dominion Energy anticipates that the cable protection at the three fiber optic cable crossings would include two concrete mattresses: one countersunk below the Offshore Export Cable to separate it from the existing buried fiber optic cable, and one laid over top of the Offshore Export Cable. The bottom mattress will consist of two pieces of tapered edge mattress, each measuring approximately 20 feet (6 meters) in length, by 10 feet (3 meters) in width, and 6 inches (0.15 meters) height. The two pieces would be placed short end to short end. The top mattress would consist of 7 pieces of tapered edge mattress, each measuring approximately 20 feet (6 meters) in length, by 10 feet (3 meters) in width, and 6 inches (0.15 meters) in height. The top mattresses would also be placed short end to short end. The mattresses will be laid lengthways along the fiber optic cable (bottom) or Offshore Export Cable (top) for a total of 0.04 acres (161.876 square meters) for each of the 27 cable crossings. The export cable will be laid flush with the seafloor; therefore, the mattress placed on top of the cable will result in a total vertical profile increase of 6 inches (0.15 meters). Schematics of the proposed cable protection systems and dimensions are provided in the COP (Appendix K; Dominion Energy 2023). Installation of cable protection would cause long-term and localized habitat conversion resulting in a minor impact within the OECC.

5.1.2.4.2 Sediment Suspension/Redeposition

Sediment suspension and redeposition would be dependent on the type of cable protection system utilized for each section of the cable to be protected. Installation methodologies utilizing rock dumping would potentially generate higher levels of sediment suspension and turbidity in comparison to the standard utilization of diver-assisted placement of cement matrices. Divers are utilized to precisely place the mattresses over the cables to minimize damaging the power cables to be installed. Installing and placing mattresses would generate much less suspended sediments in comparison to rock dumping onto the seafloor, as outlined in Section 5.1.1.4. The sediment suspensions and redeposition impacts for the proposed cable protection system would be short term and localized. Because the protection system proposed would utilize the placement of cement mattresses, the sediment suspension would be controlled and minimal and settle out shortly after the mattress is placed, which would result in a negligible effect on the EFH and EFH-designated species.

5.1.3 Operation/Presence of Structures

5.1.3.1 Artificial Substrate (WTG/OSS/Scour Protection/Cable Protection Systems)

5.1.3.1.1 Community Structure Changes/Invasive Species

The Lease Area is primarily a homogeneous sandy seascape exhibiting both flat bottom relief and benthic features such as ripples, sand-waves, and ridges (MARCO 2021; 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). Habitat complexity is an important contributor to diversity and abundance of a large number of EFH finfish and ecologically important fish and invertebrate prey species utilized by EFH species (e.g., through facilitating refuge from prey during early life stages, providing areas of post-larval settlement; Loren et al. 2007; Malatesta and Auster 1999). Wind energy structures, including WTGs, OSSs scour protection pads, and cable protection systems, create uncommon areas of relief within habitats that are predominately characterized as areas with low-relief sand-waves and sand ripple seascapes. Structure-oriented EFH finfish are attracted to these hard substrate installations. Impacts on the softbottom sediment habitats from structure presence are localized 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. Turbines and other marine anthropogenic structures may act as fish aggregating devices (FADs). Despite observations of increased use and fish aggregations, the full impacts of this behavior on local or stock wide populations are not well understood (Hogan et al. 2023). 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 EFH species fish and epifaunal invertebrate species (Claisse et al. 2014; Smith et al. 2016; BOEM 2021); 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-native biota (e.g., invasive or nuisance species) may alter localized benthic or epipelagic communities (Glasby et. al, 2007). The addition of turbine foundations, and novel hard bottom habitat within the wind farm may foster a "stepping stone" effect (Hogan et al. 2023) for larval dispersion (De Mesel et al. 2015) as well as movement of invasive species, as it has been demonstrated for oil and gas structures (Henry et al. 2018). Considering the above information, BOEM anticipates that the impacts of the presence of structures on EFH species of finfish and invertebrates would be minor and may include minor beneficial impacts on the community structure within the Lease Area and OECC. All impacts would be permanent as long as the structures remain.

5.1.3.2 Underwater Sound

During the operational phase of CVOW-C, some EFH finfish and invertebrate species may be able to hear the continuous underwater noise of the 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 (Bartley et al. 2019). 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 close to the source. As documented by English et al. (2017), there is no information to suggest that such noise would adversely affect EFH finfish and invertebrate species. With the demonstrated and overserved attraction of multiple EFH species this provides further evidence of the non-measurable, negligible impact of noise produced during operations on the life stage of EFH species or the prey species they require.

5.1.3.3 Hydrodynamic Effects

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. These structures may modify the upwelling process and the patterns of vertical stratification in the upper ocean layers (Mostafa 2015). Although water flow typically returns to background levels within a relatively short distance from a structure and impacts on the EFH of managed species of finfish and invertebrates are typically undetectable (BOEM 2021), the cumulative effects of the presence of multiple structures on local or regional-scale hydrodynamic processes are not currently well understood (Hogan et al. 2023). 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 would 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. Due to the integration of localized turbulence and wind wake effects of individual turbines the study was able to more accurately simulate hydrographic changes and associated impacts from offshore wind farms. This 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 for the assessment of the impact on larval transport. 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 the hydrodynamic impacts associated with the presence of the WTGs and OSSs would be negligible on EFH finish and invertebrate species based on currently available information.

If 202 potential WTG foundation sites, with a Preferred Layout of 176 WTGs installed and three OSSs are installed in the Lease Area, 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. The potential for the presence of many distinct structures within the Lease Area could affect the natural feeding behaviors of pelagic species the utilize the offshore Virginia shelf waters and potentially increase the time required for migration behaviors. Managed species that may be affected the most are the 26 pelagic species listed in Section 4.2, *Species Groups*, and the highly migratory species along with their prey and foraging resources. Until more data can be gathered, BOEM anticipates that temperature would be the overriding factor that could impact the pelagic EFH species, resulting in a minor impact.

5.1.4 Operation/Presence of Inter-array and Offshore/Onshore Cables

5.1.4.1 Power Transmission (Electromagnetic Forces)

Electromagnetic forces (EMF) emanate continuously from installed electrical power transmission cables. At present, there are no thresholds indicating acceptable or unacceptable levels of EMF emissions in the marine environment (Hogan et al. 2023). 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 [Nephropidae or Homaridae]) 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 field. There is no evidence to indicate that EMFs from undersea AC power cables negatively affect managed finfish or invertebrate species (CSA Ocean Sciences Inc. and Exponent 2019). EMFs would emanate from AC cables during operation. Dominion Energy would use power cables shielding and target burial depths to minimize EMF intensity and extent (COP Appendix AA; Dominion Energy 2023). Dominion Energy commissioned Exponent to model the levels associated with the operation of the submarine cables proposed for the Project for AC electric and EMF (COP Appendix AA; Dominion Energy 2023). Although the EMFs would exist as long as the cables were operational, Exponent compared these EMF levels against previous studies' results, which indicate that the EMFs from AC cables within the proposed Lease Area are not expected to affect EFH species. The conclusions from the modeling study concur with previous studies (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015). Thermal radiation also occurs as a result of submarine power cables. Increased temperature in waters surrounding introduced power cables may affect the local thermal habitat and community composition (Hogan et al. 2023) and is an ongoing topic of study.

In summary, the available literature indicates that the EMF produced by the Project's cables would not be detectable by resident magnetosensitive fish or invertebrates. As such, operating cables are not projected to have any adverse effects on the populations or distributions or migration of managed species in the

Offshore Project area. Therefore, impacts on pelagic and demersal finfish and motile invertebrate EFH species would be expected to be negligible.

5.1.4.2 Cable Protection

5.1.4.2.1 Community Structure Changes/Invasive Species

The placement of rock armoring, geotextile sand containers, and/or concrete mattresses to segments of the OECC and potentially within IACC would result in long-term conversion of softbottom habitat to complex hardbottom benthic habitat. Approximately 68 acres (28 hectares) of softbottom habitat would be converted to complex benthic habitat by the placement of protective structures as part of the three, fiber optic cable crossing locations (COP Appendix K; Dominion Energy 2023). This habitat conversion would account for less than 2.6 percent of the total softbottom habitat within the OECC. The affected areas would be converted from softbottom habitat to a complex hardbottom. This conversion would make it unsuitable for EFH-designated species associated with softbottom habitats much in the same process that scour protection systems would change demersal habitats in the Lease Area during one or more life stages. Mattress placement in softbottom habitat would convert benthic habitat to more complex hardbottom benthic habitat and would provide similar artificial reef benefits as previously discussed in Section 5.1.1.2. The uses of cable protection systems would therefore result in long-term effects on EFH lasting for the life of the Project. If removal of the OECC cables is required, the concrete mattresses would likely be removed, restoring the affected area to softbottom sand habitat (the effects of mattress removal would be addressed under a separate future EFH consultation for Project decommissioning). EFH for demersal organisms and life stages that utilize softbottom sand habitats would be adversely affected in the intermediate term to long term by alteration of natural habitat and the placement of protective structures associated with the CVOW-C OECC.

5.2. Project Monitoring Activities

Dominion Energy is actively working with various state and academic resources, as well as commercial fishers to develop and implement the FMMP. The proposed plans are expected to occur during 2023, prior to Project construction. In addition to the whelk and black sea bass monitoring surveys, Dominion Energy is developing an Atlantic surf clam survey plan that will be provided to BOEM and NMFS when completed.

Impacts on ESA-listed marine fish specific to each survey type and equipment are described below in this section. The details of each survey type can be found in Section 2.5, *Fisheries Monitoring Plans*. Many of the potential impacts on EFH include bottom-contacting gear, which will crush and kill or injure sessile or slow-moving benthic organisms and fish. Benthic disturbances will also increase turbidity and suspend sediment locally for short periods of time following deployment and retrieval of gear. Similar impacts on ESA-listed marine fish (Atlantic sturgeon and giant manta ray) would result from fisheries monitoring survey methods that include habitat disturbance during pot setting, and potential for entrapment or entanglement in monitoring gear.

5.2.1.1.1 Whelk Surveys

The whelk surveys have been designed while actively working with Virginia Department of Environmental Quality, VMRC, the Virginia Institute of Marine Science, Rutgers University, and commercial fishers. Whelk pots are stationary pots that are baited and pose a potential risk to juvenile or small fish and other benthic invertebrate species. In addition to whelk, typical prey species may also be removed from the marine environment as bycatch in trap gear. However, any bycatch prey items will be returned to the site. Therefore, the whelk surveys will not affect the availability of prey in the Project area.

5.2.1.1.2 Black Sea Bass Surveys

Similarly black sea bass pots are stationary pots that are baited and pose a potential risk to juvenile or small fish and other benthic invertebrate species. In addition to targeted black sea bass, other fish, particularly structure-oriented species, and prey species may also be removed from the marine environment as bycatch in trap gear. Any bycatch prey items will be returned to the site; therefore, the black sea bass surveys will not affect the availability of prey in the Project area.

5.3. Decommissioning Concept

Impacts resulting from decommissioning of the Project are expected to be similar to or less than those experienced during construction. The technologies to support the decommissioning operations are expected to advance during the lifetime of the Project, which may reduce impacts. A full decommissioning plan will be provided to the appropriate regulatory agencies for approval prior to decommissioning activities and will detail potential impacts. As part of the regulatory process and resources agency negotiations for decommissioning activities a new EFH assessment evaluating the impacts on EFH species and resources would be prepared and evaluated prior to decommissioning operations.

5.4. Cumulative and Synergistic Effects on EFH

The Proposed Action of 202 WTGs and three OSSs, or a Preferred Layout of 176 WTGs and three OSSs would permanently modify approximately 204.49 acres (82.75 hectares), or 116.39 acres (47.10 hectares) respectively. These permanent impacts would include WTG and OSS foundations, scour protection, and the cable protection required within the OECC (Table 5-2). Within the Lease Area alone, approximately 203.3 acres (82.3 hectares) of the total 112,799 acres (45,658 hectares), or 0.18 percent would be permanently altered by the offshore structures and associated scour protection. This would decrease to 0.10 percent in the Preferred Layout. An additional 3,358.51 acres (1,359.14 hectares) would be temporarily disturbed by pre-construction activities and work areas required for the installation of Project infrastructure within the OECC (Table 5-2). These new structures could affect the migration of species that prefer complex habitat by providing unique complex features (relative to the primarily sandy seafloor) within this area of the MAB. This could lead to retention of those species and possibly impact spawning opportunities for some EFH species and the prey species they utilize. However, it is also possible that the new structures would provide additional habitat resources, rather than substituting for previously occupied habitat. A potential positive impact could occur due to the development of complex habitat and the expansion of complex habitat species within the Lease Area in the greater MAB. The new structures could create an “artificial reef effect”, whereby more sessile and benthic structure-oriented organisms (e.g., sponges, algae, mussels, barnacles, shellfish, sea anemones) would colonize these structures (Coates et al. 2014; Danheim et al. 2020; English et al. 2017; Degraer et al. 2020). This sessile invertebrate assemblage may provide a food source and habitat to other motile EFH invertebrates and finfish. These new developing habitats would be at the expense of the softbottom EFH species that utilize the infaunal, epifaunal, and demersal habitats.

BOEM anticipates that structures would be added intermittently over an assumed 2- to 3-year period (see CVOW-C Draft EIS Appendix E, Table E-1) and that they would remain until decommissioning of each facility is complete. Dominion Energy anticipates that all WTG monopile and OSS jacket foundations would be installed by October 31, 2025. However, as a contingency to account for the potential for delays due to weather, and/or other unanticipated events, Dominion Energy has proposed installation of up to 15 foundations in 2026. If required to accommodate delays in the installation schedule, the 15 installations would occur between May 1 and September 30, 2026. Due to the planned spacing of the WTGs (0.75 nautical mile [1,389 meters] in an east–west direction, and 0.93 nautical mile [1,722 meters] in a north–south direction) the behavioral effects from ensonification are the only Project parameter that could have an overlapping impact.

Using the assumptions in Appendix F, the foreseeable offshore wind scenario would include up to 3,094 new foundations by 2029 (Table F-3). Fishing practices in the region are ongoing and the bottom-contacting gear would continue to temporarily disrupt the benthic communities in and near the Project area.

Climate change would also play a role in the effects on EFH and the ambient waters and seabed morphology (De Stewart and Yuan 2019). Climate change is known to increase temperatures, alter ocean acidity, raise sea levels, and increase numbers and intensity of storms. Recent research on juvenile Atlantic sea scallops showed that ocean acidification is dissolving scallop shells, requiring the reallocation of energy to maintain their shells from growth and reproduction (Pousse et al. 2023). These changes in mean sea level, tides, and wave heights affect the morphology of the sand ridges (De Stewart and Yuan 2019). Modeling of the MAB Cold Pool from 1968 to 2019 showed rapid warming and a limiting in the spatial extent (Friedland et al. 2022). See Section 5.1.1.3, *Potential Introduction for Exotic/Invasive Species via Ballast*, for discussion on the potential hydrodynamic impacts. Increased temperatures can alter habitat, modify species' use of existing habitats, change precipitation patterns, and increase storm intensity (EPA 2016; NASA 2019). As temperatures rise, the oceans absorb the majority of the excess heat, with 60 percent of the upper ocean (0 to 2,297 feet [0 to 700 meters] deep) experiencing the increased temperatures (NOAA 2018). The warmer waters expand and create sea level rise, which greatly impacts coastal communities. Simultaneously, ocean acidity has increased by roughly 30 percent since the Industrial Revolution (EPA 2016). Increase of the ocean's acidity has numerous effects on ecosystems including reducing available calcium carbonate that organisms use to build shells, which can result in feeding shifts within food webs (EPA 2016; Friedland et al. 2022; NASA 2019) and interannual abundance fluctuations (Kane 2011). For example, between 1982 and 2018 the average center of biomass for 140 marine fish and invertebrate species along U.S. coasts shifted approximately 20 miles (32 kilometers) north. These species also migrated an average of 21 feet (6.4 meters) deeper (EPA 2016).

6. Avoidance, Minimization, and Mitigation

No applicant-proposed monitoring programs have been provided. BOEM anticipates that Dominion Energy would coordinate with the required resource agencies and non-governmental resource stakeholders to design and implement a monitoring program.

6.1. Mitigation

The avoidance, minimization. and mitigation measures proposed by Dominion Energy are listed in Table 6-1. This table is adapted from COP Section 4.2.6.3 (Dominion Energy 2023). Dominion Energy would implement these measures to avoid, minimize, and mitigate the potential IPFs described (Table 6-1). Dominion Energy plans to continue discussion and engagement with the appropriate regulatory agencies and environmental non-governmental organizations throughout the life of the Project to develop an adaptive mitigation approach that provides the most flexible and protective mitigation measures.

6.2. Relevant Alternatives to the Proposed Action

The following discusses alternative turbine layouts and IACCs proposed for the Project. Although all alternatives are not specifically geared toward reducing the impacts on EFH, these alternatives would still benefit and minimize impacts on EFH.

6.2.1 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 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 14-MW WTGs each capable of generating up to 14.7 MW with a 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. However, under Alternative B, the Fish Haven area located along the northern boundary of the Lease Area would be an exclusion zone where WTGs, inter-array cables, or other Project infrastructure would not be sited. 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 farm. This configuration would still allow micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet (152 meters), to avoid sensitive cultural resources and marine habitats. Onshore components would be the same as described under the Proposed Action. There would be a concomitant reduction in the length of inter-array cable networks connecting the removed WTGs. The reduction in permanent benthic impacts from fewer WTGs would be the same as those listed for the Preferred Layout within the Proposed Action, about 88 acres (36 hectares) less than the Maximum Layout described in the Proposed Action. The avoidance of the Fish Haven area from development under Alternative B would reduce softbottom habitat impacts overall. The number of cables or impacts within the OECC would not change, but the temporary impacts from the inter-array cables would decrease by approximately 384.7 acres (155.7 hectares). With fewer WTGs installed and the removal of inter-array cables between WTGs there would be a reduction in impacts (some temporary while other long-term or even permanent) of about 472.8 acres (191.3 hectares).

6.2.2 Alternative C—Sand Ridge Impact Minimization Alternative

Alternative C was developed through the scoping process for the Draft EIS in response to scoping comments received requesting an alternative to minimize impacts on offshore benthic habitats. Up to 172 WTGs (14 MW) would be installed in the Lease Area. In addition to avoiding the Fish Haven, Alternative C would minimize impacts through a combination of micrositing of infrastructure (WTGs, OSSs, and associated cabling) up to 500 feet (152 meters), removal of four WTGs and associated inter-array cables within sand ridge habitat area, and the relocation of one WTG to another position outside of the sand ridge habitat area. The resulting layout of 172 WTGs in the Lease Area would generate up to 2,528 MW.

NMFS has identified the sand ridge habitat in the Lease Area as a significant and unique benthic resource to be avoided to reduce the Project impact on the invertebrates, and fish that use these resources. These habitats serve important ecological functions for the benthic community and the intricate food web they support. Offshore shoal complexes support diverse invertebrate assemblages with faunal differences found between the ridge crest and trough habitats (Rutecki et al. 2014). The sand ridge habitat area encompasses 17 WTG locations, one OSS location, and associated inter-array and offshore export cables. The reconfiguration of WTGs and inter-array cables within priority sand ridge habitats under Alternative C would reduce seafloor disturbance, including the cross-cutting and trenching of sand ridges. 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. With the exception of the seven identified spare positions, other spare positions in the Lease Area are not desirable due to foundation technical design risk, shallow gas presence, commercial shipping and navigational risk concerns, erosion risk, or presence of a designated fish haven area.

Like 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 30 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. Approximately 169.7 acres (68.7 hectares) of benthic resources would be permanently impacted.

This configuration reduces seafloor disturbance, including the cross-cutting and trenching of sand ridges. The cross-cutting trenching activities will occur during two separate construction seasons with a 12-month recovery period for the affected sand ridge habitats. If Alternative C were selected as the Project design and there is a reduction of four WTGs from the Preferred Layout in Proposed Action, or Alternative B (176 WTGs) this would reduce the permanent impact on benthic resources 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 four removed WTGs in Alternative C and the micrositing around benthic sediment features where possible. Overall Alternative C would have up to 172 WTGs, a reduction of 30, or 4 WTGs from the Maximum Layout and Preferred Layout in the Proposed Action respectively, and three OSSs. This reduction of WTGs and the associated inter-array cables and cable length would affect 228 acres (92 hectares), a 16 percent reduction in the amount of disturbed benthic habitat from the Proposed Action.

6.2.3 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 the Proposed Action: an up to 3,000-MW wind energy facility of 202 WTG sties and a Preferred Layout of 176 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area, with associated export cables. Unlike the Proposed Action, 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 the Proposed Action. 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.

- **Cable Route Option D-1:** Interconnection Cable Route Option 1 would be the same as described under the Proposed Action and would be approximately 14.2 miles (22.8 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 Oceana Parcel, pending Navy approval. The total footprint of the Harpers Switching Station would be 45.4 acres (18.4 hectares).
- **Cable Route Option D-2:** 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 2-4). 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. The total footprint of the Chicory Switching Station would be 35.5 acres (14.4 acres).

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.

6.2.4 Alternative E—No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP; Project construction and installation, O&M, 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.

Table 6-1 Summary of avoidance, minimization, and mitigation measures

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
Construction; Decommissioning	Offshore Project area	Short-term disturbance of habitat Short-term loss of local prey species Short-term increase in construction-related lighting Short-term introduction of marine debris Short-term increase in risk of equipment interaction Short-term increase in underwater noise Short-term increase in risk of ship strike due to the increase in vessel traffic Short-term change in water quality, including potential oil spills	Dominion Energy has sited the offshore export cable corridor to avoid sensitive benthic habitats to the extent practical (including submerged aquatic vegetation) to minimize impacts on EFH and EFH managed species, particularly for the juvenile life stage of the EFH-managed species. Dominion Energy would require all offshore personnel and vessel contractors to implement appropriate debris control practices and protocols to prevent the accidental release of marine debris. **Passive Acoustic Monitoring (Planning) (Construction) (Operations)**. The Lessee must deploy moored or autonomous Passive Acoustic Monitoring (PAM) devices to record ambient noise, marine mammals in the Lease Area during all years of construction activities, and for at least 3 calendar years of operation following construction. The archival recorders must have a minimum capability of detecting and storing acoustic data on anthropogenic noise sources (such as vessel noise, pile driving, and WTG operation) and marine mammals. The Lessee must submit both raw and processed data with detection results to BOEM (at renewable_reporting@boem.gov), BSEE (at OSWSubmittals@bsee.gov) and NMFS (at nmfs.pacmdata@noaa.gov) within 120 calendar days following recorder collection and annually within 120 calendar days of the anniversary of the initial recorder deployments. The Lessee must consider currently available recommendations for designing underwater acoustic monitoring, including standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind accepted by BOEM. The PAM Plan must include proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the required use of PAM for monitoring. The Lessee must deploy at least three PAM buoys in coordination with BOEM and the Regional Wildlife Science Collaborative acoustic monitoring efforts within the Lease Area or adjacent OCS waters. The Lessee must submit its PAM Plan to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov). The Department of the Interior

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
Construction; Decommissioning (continued)	Offshore Project area (continued)		(DOI) will review the PAM Plan and provide comments, if any, on the plan within 45 calendar days, but no later than 90 days of its submittal. The Lessee must resolve all comments on the PAM Plan to DOI's satisfaction before implementation of the plan. If DOI does not provide comments on the PAM Plan within 90 calendar days of its submittal, the Lessee may conclude that DOI has concurred in the PAM Plan. All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste. Dominion Energy would implement the following measures as appropriate to avoid, minimize, and mitigate potential impacts of construction-related underwater noise: 1) Implement monitoring and exclusion zones where pile-driven foundations are installed, enforced by qualified NOAA Fisheries-approved Protected Species Observers; 2) Implement real-time monitoring systems; 3) Employ soft starts and shut-down procedures where technically feasible; 4) Employ soft starts for a duration of 30 minutes at the onset of pile-driving activities; and 5) Use commercially and technically available noise-reducing technologies. Dominion Energy would also ensure continued engagement with regulatory agencies regarding potential best practices. Dominion Energy has developed an Oil Spill Response Plan (COP Appendix Q; Dominion Energy 2023), detailing all proposed measures to avoid accidental spills and a protocol to be implemented should such an event occur. Additional information may be found in COP Section 4.4.12, *Public Health and Safety* (Dominion Energy 2023). All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste, and Dominion Energy would provide a full decommissioning plan to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
Operations and Maintenance	Offshore Project area	Modification of habitat Project-related electromagnetic fields (EMF) Project-related lighting Project-related marine debris Project-related underwater noise Project-related vessel traffic and increased risk for ship strike Changes in water quality, including oil spills	Dominion Energy has identified areas where sufficient cable burial is achievable, further buffering the pelagic environment from cable EMF, and cable protection would serve as an alternative barrier where sufficient cable burial is not feasible. Dominion Energy would require all offshore personnel to implement appropriate practices and protocols to avoid and minimize the release of marine debris. Dominion Energy has developed an Oil Spill Response Plan (COP Appendix Q; Dominion Energy 2023) that details all measures proposed to avoid an inadvertent spill of vessel oil or fuel and a protocol to be implemented should such an event occur. Dominion Energy would implement the following measure as appropriate to avoid, minimize, and mitigate potential impacts on water quality: 1) Vessel operation in accordance with regulations pertaining to at-sea discharges of vessel-generated waste.

6.3. Adaptive Management Plans

No applicant-proposed Adaptive Management Plan to offset potential impacts has been proposed.

7. NOAA Trust Resource Species

This section includes a discussion on anadromous fish, shellfish, crustaceans, or their habitats, that are not managed under a federal fisheries management plan. Some of these species, including diadromous fishes, serve as prey for a number of federally managed species and are therefore considered a component of EFH pursuant to the MSA. Twenty-four species of NOAA Trust Resources have been identified within the general vicinity of the Lease Area. Detailed species descriptions and life history information are provided in FMPs (MAFMC 1998; NEFMC 2017; NMFS 2009). Table 7-1 discusses species and life stages within the Lease Area and OECC as well as the impact determination for each NOAA Trust Resource species.

The following NOAA Trust Resource species or species groups may utilize habitat within the Project area:

- River herring (alewife, and blueback herring)
- American shad
- American lobster (*Homarus americanus*)
- Striped bass (*Morone saxatilis*)
- Blackfish/tautog (*Tautoga onitis*)
- Weakfish (*Cynoscion regalis*)
- Forage species (Atlantic menhaden [*Brevoortia tyrannus*], bay anchovy [*Anchoa mitchilli*], and sand eel/sand lance)
- Horseshoe crab (*Limulus polyphemus*)
- Bivalves (blue mussel, eastern oyster, quahog [*Mercenaria mercenaria*], and soft-shell clams)
- Atlantic croaker (*Micropogonias undulatus*)
- Smallmouth flounder (*Microstomus kitt*)
- Northern kingfish (*Menticirrhus saxatilis*)
- Sea robins (Triglidae spp.)

Table 7-1 Trust Resources determination by species or species group

Species	Life Stage Within Project Area	Impact Determination	Rationale for Determination
River herring (alewife, blueback herring)	Juvenile, Adult	Negligible short-term impacts	Short-term disturbance effects would occur over 2,635.4 acres (1,066.5 hectares) of benthic habitat. Only a small area (tens of acres) would be affected at any given time. Benthic community structure would recovery rapidly, within a few months of the activity.
American eel	Larvae, Juvenile, Adult		
Striped bass	Juvenile, Adult		
Tautog	Juvenile, Adult	Negligible short-term and permanent impacts	190.7 acres (77.2 hectares) of benthic habitat would be displaced or altered over the long term by placement of the WTG and OSS foundations, along with scour protection (rock concrete mattresses). The affected area represents a miniscule portion of suitable habitat for these species groups. Once scour protection is colonized it would provide habitat features for species associated with hard substrates.
Atlantic croaker	Juvenile, Adult		
Smallmouth flounder	Juvenile, Adult	Negligible short-term and permanent impacts	Dredging would be limited only to the extent required to achieve adequate cable burial depth during cable installation. Dredging may result in increased local TSS or short-term displacement, but impacts are expected to be short term and limited in spatial extent.
Northern kingfish	Juvenile, Adult	Negligible short-term and permanent impacts	Collectively, areas affected by short-term construction-related impacts would rapidly return to baseline conditions within minutes to months after the project is completed. Long-term habitat alterations and operational effects on habitat would be negligible because: Impacts are limited in intensity and extent, Species occurrence is limited, Long-term impacts may produce new potentially suitable habitats, or The area affected is insignificant relative to available habitat in the Project area.
Sea robins	Juvenile, Adult	Negligible short-term and permanent impacts	Collectively, areas affected by short-term construction-related impacts would rapidly return to baseline conditions within minutes to months after the project is completed. Long-term habitat alterations and operational effects on habitat would be negligible because: Impacts are limited in intensity and extent, and Species occurrence is limited.
Northern kingfish	Juvenile, Adult		

Species	Life Stage Within Project Area	Impact Determination	Rationale for Determination
Forage species (Atlantic menhaden, bay anchovy, sand eel)	All	Negligible short-term and permanent impacts	Short-term noise disturbance from monopile installation would reduce habitat suitability for this species within a 10-mile (16-kilometer) radius of pile-driving activity in the wind farm. Habitat conditions would be unaffected after construction is complete. Operational noise effects are below established behavioral and injury effects thresholds for fish. As an anadromous species, juveniles have the potential to occur within nearshore waters near the export cable. Individuals could be displaced for the short term during construction activities, but long-term impacts are not expected.
American shad	Juvenile, Adult	Negligible short-term and permanent impacts	
Horseshoe crab	All	Minor short-term and permanent impacts	Horseshoe crabs are known to occur in the Project area. Adults may use the habitat for spawning. Dredging associated with the Project would annually affect a minute portion of softbottom habitat. Jet plow impacts could include increased local TSS, loss of larvae due to entrainment, or short-term displacement of individuals. However, these impacts are either short term, limited in spatial extent, or insignificant to the success of the species.
Bivalves (blue mussel, ocean quahog, soft-shell clam)	All	Minor short-term and permanent impacts	Short-term disturbance effects would occur over 5,020.9 acres (2,031.8 hectares). Only a small area (tens of acres) would be affected at any given time. Benthic community structure would recover rapidly, within a few months of the activity. 259.1 acres (104.9 hectares) of benthic habitat would be displaced or altered over the long term by placement WTG and OSS foundations and scour protection (boulders, concrete pillows). Lease Area and OECC impacts have been sited to avoid and minimize overlap of long-term effects with known shellfish habitats in designated EFH. Based on the small area affected relative to the extent of designated EFH in the Project area and vicinity, the Project would have an insignificant effect on habitat for these species. The benthic community structure would adapt and recover rapidly, within a few months of the activity.

EFH = essential fish habitat; OECC = offshore export cable corridor; TSS = total suspended sediment; WTG = wind turbine generator

8. Conclusions

Forty-one species of finfish (22), elasmobranchs (16), and invertebrates (3) were identified with designated EFH within the Lease Area and OECC footprints (Table 4-1). The life stages and EFH-designated species are discussed in Chapter 4. Project construction, installation, operation, maintenance, and conceptual decommissioning activities, described in Chapter 2, would result in some adverse effects on the EFH species listed in Table 4-1. Impact analyses of Project activities on EFH are analyzed in Chapter 5. Impacts associated with construction activities, such as pile driving and jet plowing, are likely to be greater than those associated with operation and maintenance, which would include sound produced by operational WTGs and monitoring and maintenance vessel activity. EFH-designated species with one or more demersal life stages are more likely to be subjected to long-term or permanent adverse impacts than species with only pelagic life stages (Chapter 5). These permanent impacts are related to the installation of the WTG and OSS foundations as well as scour and cable protection placement that would potentially permanently convert softbottom benthic habitats into hardbottom.

The construction phase of the Project would generate impacts such as noise, related to vessel activity and pile driving, EMF, and new structures within the Lease Area and OECC. With the new structures, habitat conversion would impact the different life stages of EFH finfish and invertebrate species to varying degrees depending on the location, timing, and species affected by an activity. Short-term impacts from construction include construction-related crushing and burial effects (Section 5.1.1.1), underwater noise impacts (Section 5.1.1.2), and disturbance of bottom substrates resulting in increased turbidity and sedimentation (Section 5.1.1.1). Impacts from Project operation and maintenance would occur, although at lower levels than those produced during construction and conceptual decommissioning. Offshore structures would result in long-term effects on benthic and pelagic habitat (Section 5.1.1.3). BOEM anticipates the impacts on the EFH species resulting from the Proposed Action alone would range from **negligible** to **moderate**. Therefore, BOEM expects the overall impact on finfish and invertebrate EFH species alone would be **minor** because the effect would be localized and, for the most part, temporary. Overall, the small areas that will be disturbed for the Proposed Action, especially with the majority in softbottom sand habitats, relative to the large geographic range of the diverse fish species indicates that population impacts on fish are not expected. Most impacts would be avoided; if impacts occur, they may result in the loss of a few individuals. The proposed mitigation measure put forward by Dominion Energy (see Table 6-1 and COP Section 4.2.4.4; Dominion Energy 2023), 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).

Project decommissioning would occur at the end of the 33-year designed lifetime. The decommissioning would require a separate EFH consultation at that time.

9. References

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