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Appendix E: Essential Fish Habitat Assessment

Coastal Virginia Offshore Wind Commercial Project

Dominion Energy®

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The assessment presented herein is consistent with the Project Design Envelope considered by Dominion Energy Virginia (Dominion Energy) prior to summer 2022. Due to maturation of the Coastal Virginia Offshore Wind Commercial Project (Project) design, Dominion Energy was able to refine several components of the Project and has subsequently revised the Construction and Operations Plan (COP) as re-submitted in February 2023. The primary changes are summarized as follows:

- The Maximum Layout includes up to 202 wind turbine generators (WTGs), with a maximum WTG capacity of 16 megawatts. As the Preferred Layout, Dominion Energy proposes to install a total of 176, 14.7-megawatt capacity WTGs with 7 additional positions identified as spare WTG locations. For both the Preferred Layout and Maximum Layout, the Offshore Substations will be within the WTG grid pattern oriented at 35 degrees and spaced approximately 0.75 nautical mile (1.39 kilometers) in an east-west direction and 0.93 nautical mile (1.72 kilometers) in a north-south direction.
- Removal of Interconnection Cable Route Options 2, 3, 4, and 5 from consideration. As the Preferred Interconnection Cable Route Option, Dominion Energy proposes to install Interconnection Cable Route Option 1.

The analysis presented in this appendix reflects the initial 205 WTG position layout as well as Interconnection Cable Route Options 1, 2, 3, 4, 5, and 6 as the maximum Project Design Envelope. Reduction in the Project Design Envelope is not anticipated to result in any additional impacts not previously considered in the COP. Therefore, in accordance with the Bureau of Ocean Energy Management's Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan (2018), the appendix has not been revised. Additional details regarding evolution of the Project is provided in Section 2 of the COP and details regarding the full Project Design Envelope are provided in Section 3 of the COP.

APPENDIX E ESSENTIAL FISH HABITAT ASSESSMENT
REVISION LOG

Revision Number	Date	Description	Signed
1	10/2021	Initial Issue	Tetra Tech
2	5/6/2022	Response to BOEM Comments	Tetra Tech

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ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
°F	degree Fahrenheit
μm	micrometer
ac	acre
ASMFC	Atlantic States Marine Fisheries Commission
BOEM	Bureau of Ocean Energy Management
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CVOW	Coastal Virginia Offshore Wind
Dominion Energy	Dominion Energy Virginia
EA	Environmental Assessment
EFH	Essential Fish Habitat
EFHA	Essential Fish Habitat Assessment
EMF	electric and magnetic fields
FMC	Fishery Management Council
FMP	Fishery Management Plan
GARFO	Greater Atlantic Regional Fisheries Office
gpm	gallons per minute
ft	foot
ha	hectare
HAPC	Habitat Area of Particular Concern
HRG	High-Resolution Geophysical
km	kilometer
Lease Area	Outer Continental Shelf Offshore Virginia (Lease No. OCS-A-0483)
m	meter
MAFMC	Mid-Atlantic Fishery Management Council
MAG/TVG	Magnetometer/Transverse Gradiometer
MBES	Multibeam echo sounder
MCS	Multi-Channel Seismic
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSIR	Marine Site Investigation Report
NEFMC	New England Fishery Management Council
nm	nautical mile
NOAA	National Oceanographic and Atmospheric Administration
NOAA Fisheries	NOAA National Marine Fisheries Service
O&M	Operations and Maintenance
OCS	Outer Continental Shelf
Offshore Project Area	Project Components in Lease Area and Offshore Export Cable Route Corridor
PDE	Project Design Envelope
ppt	parts per thousand
Project	Coastal Virginia Offshore Wind Commercial Project
SBP	Sub-Bottom Profiler
SCS	Single-Channel Seismic

SSS	Side scan sonar
UHRS	Ultra-High Resolution Seismic
U.S.	United States
VMRC	Virginia Marine Resources Commission
WEA	Wind Energy Area
WTG	Wind Turbine Generator

E.1 INTRODUCTION

The Virginia Electric and Power Company, doing business as Dominion Energy Virginia (Dominion Energy), is proposing to construct, own, and operate the Coastal Virginia Offshore Wind (CVOW) Commercial Project (the Project). The Project will be located in the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS) Offshore Virginia (Lease No. OCS-A-0483) (Lease Area), which was awarded to Dominion Energy through the Bureau of Ocean Energy Management (BOEM) competitive renewable energy lease auction of the Wind Energy Area (WEA) offshore of Virginia in 2013. The Lease Area covers approximately 112,799 acres (ac; 45,658 hectares [ha]) and is approximately 27 statute miles (23.8 nautical miles [nm], 44 kilometers [km]) off the Virginia Beach coastline.

Federal jurisdiction of fisheries of the United States (U.S.) applies to marine waters between the state boundary (3 nm [5.6 km]) and the U.S. Exclusive Economic Zone (200 nm [370 km]). The Commonwealth of Virginia has jurisdiction in marine and tidal waters between the shoreline and the state boundary. The Virginia Marine Resources Commission (VMRC) manages fisheries in the state portion of the Offshore Project Area and shares responsibility for some managed species with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) and/or the Atlantic States Marine Fisheries Commission (ASMFC).

The NOAA Fisheries and Fishery Management Councils (FMCs) created under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) jointly manage fishery resources in the federal portion of the Offshore Project Area. The Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC) regulate commercially and recreationally valuable species and stocks through fishery management plans (FMPs) and designate Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC). EFH is designated as the seafloor, water column, and sediment-water interfaces necessary for spawning, breeding, growth, and maturity (16 U.S.C. § 1802[10]). Jurisdiction is determined by species rather than location, as species ranges often cross administrative boundaries.

Under the MSA, federal agencies must consult with NOAA Fisheries regarding any actions authorized, funded, undertaken, or proposed to be authorized, funded, or undertaken under their jurisdiction. For any proposed offshore wind projects located in the northwestern Atlantic Ocean, BOEM must consult with the NOAA Fisheries' Greater Atlantic Regional Fisheries Office (GARFO). The present EFH Assessment (EFHA) was prepared in accordance with 50 Code of Federal Regulations (CFR) § 600.920(e)(1) to support BOEM during consultation with GARFO under the MSA. Potential impacts of construction, operations and maintenance (O&M), and decommissioning of the Project on species with designated EFH for one or more life stages in the Offshore Project Area are discussed. Habitat maps within the Offshore Project Area have been prepared according to GARFO's Recommendations for Mapping Fish Habitat to ensure the benthic habitat information presented in this EFHA is sufficient for BOEM to meet consultation requirements (NMFS-GARFO 2021). For the purposes of this Assessment, the Offshore Project Area includes the portions of the Project Components located in the Lease Area and Offshore Export Cable Route Corridor (Figure E-1).

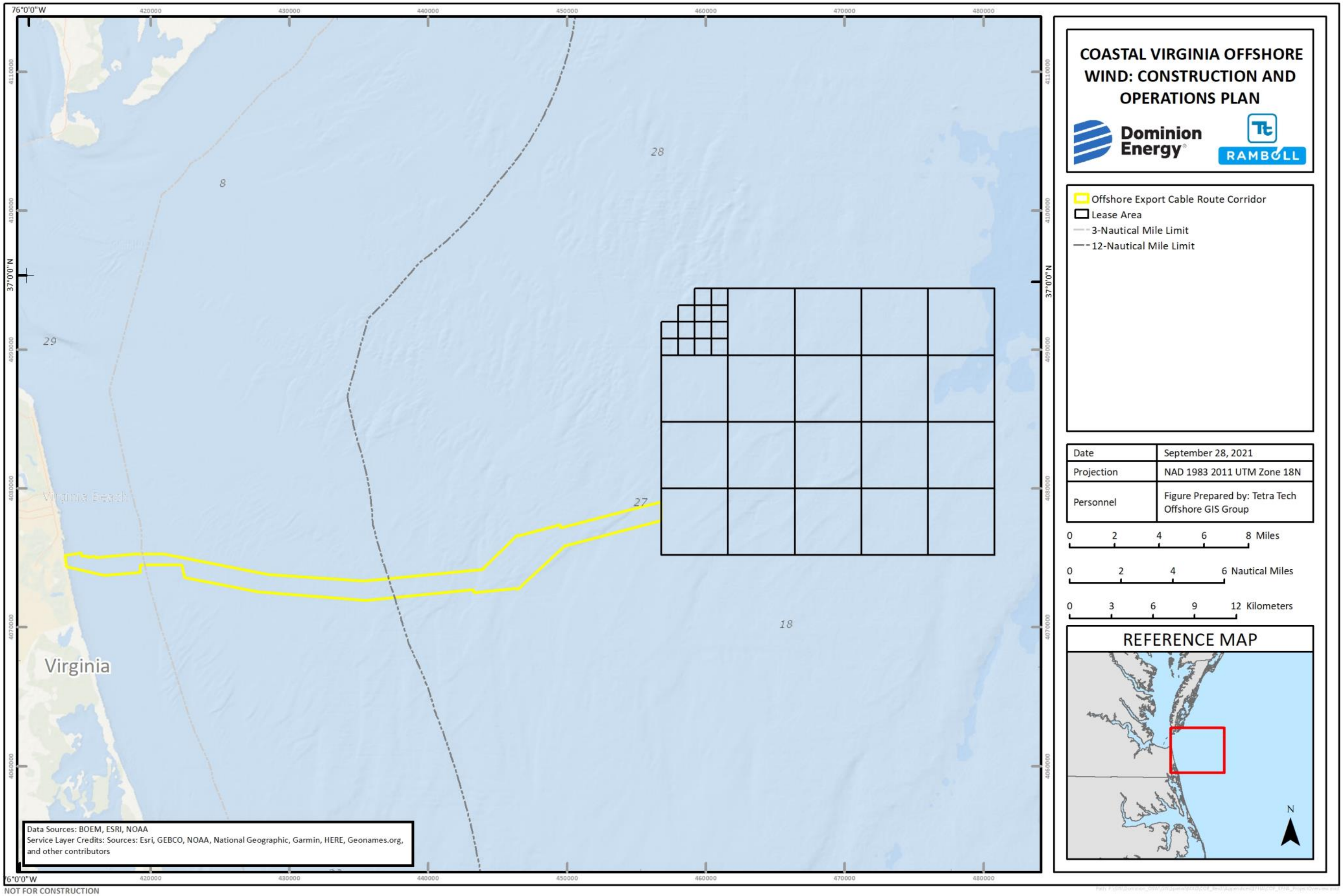

Figure E-1. **CVOW Commercial Offshore Project Area Overview**

This EFHA is an Appendix to the Construction and Operations Plan (COP), which presents a comprehensive description of the Project, affected environments, and potential impacts to numerous resources. A description of the affected physical and biological environments and potential impacts to benthic and pelagic habitats is presented in COP Section 4.1.1, Physical and Oceanographic Conditions; COP Section 4.1.2, Water Quality; and COP Section 4.2.4, Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat. This Assessment cross-references the COP sections and related appendices, including Appendix D, Benthic Resource Characterization Report; Appendix J, Sediment Transport Analysis; and Appendix Z, Underwater Acoustic Environment.

The required components of the EFHA are presented as follows:

- Summary of EFH for all life stages of managed species that may be exposed to stressors associated with the Project (Section E.2, Managed Species and Habitats in the Offshore Project Area);
- Description of the Project, including definitions of terms and descriptions of construction, operations and maintenance, and decommissioning activities; as well as avoidance, minimization, and mitigation measures incorporated into the Project (Section E.3, Description of the Proposed Action);
- Potential effects to designated EFH for all life stages of managed species (Section E.4, Effects of the Project on EFH);
- Summaries and determination of effects (Section E.5, Summary of Effects on EFH); and
- Literature cited (Section E.6, References).

Life history profiles of managed species with designated EFH for one or more life stages in the Offshore Project Area (including EFH maps) are presented in Attachment E-1, Profiles of Managed Species in the Offshore Project Area. Each species description includes a table and map of EFH acreages intersecting the Offshore Project Area for all relevant life stages. Attachment E-2, Oversized Tables presents the potential impacts of the Project on each managed species and life stage for which EFH intersects the Offshore Project Area. Attachment E-3, Oversized Maps presents the maps/charts generated from the HRG (High-Resolution Geophysical) survey data and geotechnical survey data, including seabed characterization in accordance with Coastal and Marine Ecological Classification Standard (CMECS) and NMFS-GARFO habitat mapping recommendations (NMFS-GARFO 2021). A detailed analysis of the seabed, resulting from the HRG surveys is included in Appendix C, Marine Site Investigation Report (MSIR).

E.2 MANAGED SPECIES AND HABITATS IN THE OFFSHORE PROJECT AREA

Approximately 600 fish species are resident or transient through the benthic and pelagic habitats of Virginia’s coastal waters (BOEM 2014a). Benthic or pelagic EFH has been designated in the Offshore Project Area for one or more life stages of 33 species.

Species with EFH in the Offshore Project Area were identified using the NOAA Fisheries EFH Mapper (2021), 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 Offshore

Export Cable Route Corridor using multibeam echo sounder (MBES), side scan sonar (SSS), digital imagery, and sediment grab samples. The results of these surveys are described in detail in the Benthic Resource Characterization Report (Appendix D).

In the Offshore Project Area, the MAFMC and NEFMC share authority with NOAA Fisheries to manage and conserve fisheries stocks in federal waters. NOAA Fisheries' Highly Migratory Species Division is responsible for tunas and sharks in the Offshore Project Area. In addition, the ASMFC manages more than two dozen fish and invertebrate species in cooperation with the states and NOAA Fisheries; many of these species are also identified as NOAA Trust Resources.

State regulatory bodies manage and conserve fisheries stocks in state waters. The VMRC Fisheries Management Division develops and implements policies affecting saltwater recreational and commercial fisheries in the Commonwealth's tidal waters. The Division's Fisheries Plans and Statistics Department monitors the Commonwealth's finfish and shellfish fisheries and develops management plans with assistance from Fisheries Management Advisory Committees composed of representatives of fisheries interest groups. Together, the Department and Committees have developed FMPs for black drum, blue crab, bluefish, shad and river herring, spotted seatrout, striped bass, weakfish, and others (VMRC 2021a). Please note that scientific names of managed fish and invertebrate species are in Table E-1.

Table E-1 summarizes managed species that may occur seasonally or year-round in the Offshore Project Area; detailed life history profiles and EFH designations for these species are provided in Attachment E-1. EFH for temperate and subtropical–tropical managed species is organized into five life stages: egg, larva, juvenile, adult, and spawning adult. NOAA Fisheries' Highly Migratory Species Division has simplified these life stages to egg, larva, and spawning adult. Sharks are managed as neonates (newborns and pups aged less than 1 year), juveniles, and adults.

FMCs, councils, and divisions may also designate HAPCs, which are areas of EFH critical to the survival of given species. The nearest HAPC to the Offshore Project Area is Norfolk Canyon, located 21 nm (40 km) from the northeast corner of the Lease Area. There is no designated HAPC in the Offshore Project Area (NOAA Fisheries 2021).

Table E-1. Species in the Offshore Project Area Managed by Federal, Regional, and State Agencies

Common Name	Scientific Name	Essential Fish Habitat (EFH) Life Stages Designated within the Offshore Project Area
New England Fishery Management Council		
Atlantic cod	*Gadus morhua*	Egg, Larva
Atlantic herring a/	*Clupea harengus*	Juvenile, Adult
Atlantic sea scallop	*Placopecten magellanicus*	ALL
clearnose skate	*Raja eglanteria*	Juvenile, Adult
monkfish b/	*Lophius americanus*	ALL
pollock	*Pollachius virens*	Larva
red hake	*Urophycis chuss*	Adult
windowpane flounder	*Scophthalmus aquosus*	ALL
winter skate	*Leucoraja ocellata*	Juvenile
witch flounder	*Pseudopleuronectes americanus*	Egg, Larva
yellowtail flounder	*Limanda ferruginea*	Larva
Mid-Atlantic Fishery Management Council		
Atlantic butterfish	*Peprilus triacanthus*	ALL
Atlantic mackerel	*Scomber scombrus*	Egg, Juvenile, Adult

Common Name	Scientific Name	Essential Fish Habitat (EFH) Life Stages Designated within the Offshore Project Area
Atlantic surfclam	*Spisula solidissima*	Juvenile, Adult
black sea bass a/	*Centropristis striata*	Larva, Juvenile, Adult
bluefish a/	*Pomatomus saltatrix*	ALL
longfin inshore squid	*Doryteuthis pealeii*	Egg, Juvenile, Adult
scup a/	*Stenotomus chrysops*	Juvenile, Adult
spiny dogfish a/ b/	*Squalus acanthias*	Sub-adult Female, Adult Female, Adult Male
summer flounder a/	*Paralichthys dentatus*	ALL
NOAA Fisheries—Highly Migratory Species		
albacore tuna	*Thunnus alalunga*	Juvenile
Atlantic angel shark	*Squatina dumeril*	ALL
Atlantic bluefin tuna	*Thunnus thynnus*	Juvenile, Adult
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	Juvenile, Adult
skipjack tuna	*Katsuwonus pelamis*	Juvenile, Adult
yellowfin tuna	*Thunnus albacares*	Juvenile, Adult
blacktip shark	*Carcharhinus limbatus*	Juvenile, Adult
common thresher shark	*Alopias vulpinus*	ALL
dusky shark	*Carcharhinus obscurus*	ALL
sand tiger shark	*Carcharias taurus*	ALL
sandbar shark	*Carcharhinus plumbeus*	ALL
Smooth hound shark complex (smooth dogfish)	*Mustelus canis*	ALL
tiger shark	*Galeocerdo cuvier*	Juvenile, Adult
Atlantic States Marine Fisheries Commission and Virginia Marine Resources Commission		
amberjack c/	*Seriola dumerili*	N/A—EFH is only designated for federally managed species
American eel	*Anguilla rostrata*	
American lobster	*Homarus americanus*	
American shad	*Alosa sapidissima*	
Atlantic croaker	*Micropogonias undulatus*	
Atlantic menhaden	*Brevoortia tyrannus*	
Atlantic sturgeon	*Acipenser oxyrinchus*	
billfish c/	Istiophoriformes	
black drum	*Pogonias cromis*	
blue crab c/	*Callinectes sapidus*	
channeled whelk c/	*Busycotypus canaliculatus*	
cobia	*Rachycentron canadum*	
groupers c/	Epinephelidae	
horseshoe crab	*Limulus polyphemus*	
jonah crab	*Cancer borealis*	
red drum	*Sciaenops ocellatus*	
river herring	*Clupeidae*	
sheepshead c/	*Archosargus probatocephalus*	
spadefish c/	*Chaetodipterus faber*	
spot	*Leiostomus xanthurus*	
spotted seatrout	*Cynoscion nebulosus*	
striped bass	*Morone saxatilis*	
tautog	*Tautoga onitis*	
tilefish c/	Malacanthidae	
weakfish	*Cynoscion regalis*	

Notes:
a/ joint management with ASMFC
b/ joint management by NEFMC and MAFMC
c/ VMRC only

E.2.1 Previous EFHA Consultations for U.S. Atlantic Offshore Wind Projects

The MSA requires all federal agencies to consult with NOAA Fisheries on any actions, or proposed actions, permitted, funded, or undertaken by the agency that may adversely affect EFHs. BOEM has consulted with NOAA Fisheries on pre-COP activities such as leasing and developing Site Assessment Plans (SAPs) for several Lease Areas in the U.S. Atlantic OCS, including New Jersey, Delaware, Maryland, and Virginia (BOEM 2012); Rhode Island and Massachusetts (BOEM 2013); Massachusetts (BOEM 2014b); North Carolina (BOEM 2015a) and New York (BOEM 2016). Additionally, BOEM is conducting ongoing project-specific EFH consultations to evaluate construction and O&M impacts to EFH in the U.S. Atlantic OCS. These include the Block Island Wind Farm (USACE 2014), CVOW Pilot Project (BOEM 2015b), Cape Wind Energy Project (BOEM 2019), South Fork Wind Farm (BOEM 2021a, 2021b), Ocean Wind Offshore Wind Farm (Federal Register 2021a), Revolution Wind Offshore Wind Farm (Federal Register 2021b), and Atlantic Shores (Federal Register 2021c). Essential Fish Habitat Assessments prepared to support these consultations have determined that construction, installation, and conceptual decommissioning of these projects would have minor adverse effects on EFHs resulting from noise, seabed disturbance, water quality impacts from sediment suspension and deposition, vessel activity, lighting, and introduction of novel structures into the water column. Analyses and determinations resulting from project-specific EFH consultations on the Atlantic OCS similar to the CVOW Commercial Project are incorporated into the present EFHA to the extent practicable.

E.2.2 Review of EFH in the Project Area

EFH for temperate and subtropical-tropical managed species is designated for five life stages: egg, larval, juvenile, adult, and spawning adult. Highly Migratory Species are managed as eggs, larvae, and spawning adults. Sharks are managed as neonates (newborns and pups less than 1 year), juveniles, and adults. For most species, EFH for each of life stage is designated in 10 by 10-minute squares based on habitat features, literature reviews, fishery-independent data, and best professional judgement of fisheries managers.

Managed species with EFH in the Offshore Project Area were identified using the NOAA Fisheries EFH Mapper (2021), NEFMC Omnibus Amendment 2 (2017), MAFMC FMPs, NOAA Fisheries Highly Migratory Species Amendment 10 (2017), and NOAA Fisheries EFH source documents. Dominion Energy conducted extensive surveys of the Lease Area and Offshore Export Cable Route Corridor using MBES, SSS, digital imagery, and sediment grab samples to characterize EFH. The results of these surveys are described in detail in the Benthic Resource Characterization Report (Appendix D) and are available for viewing on the CVOW EFH Assessment Web Application (Tetra Tech 2021). Designated EFH by species and life stage is presented in Table E-2.

Table E-2. Designated EFH by Species and Life Stage in the Offshore Project Area

Managed Species	Lease Area				Offshore Export Cable Route Corridor							
					Federal Waters				State Waters			
	Life Stage											
	E	L	J	A	E	L	J	A	E	L	J	A
Atlantic cod (*Gadus morhua*)	-	X	-	-	X	X	-	-	X	-	-	-

Managed Species	Lease Area				Offshore Export Cable Route Corridor							
					Federal Waters				State Waters			
	Life Stage											
	E	L	J	A	E	L	J	A	E	L	J	A
Atlantic herring (*Clupea harengus*)	-	-	X	X	-	-	X	X	-	-	-	X
Atlantic sea scallop (*Placopecten magellanicus*)	X	X	X	X	-	-	-	-	-	-	-	-
clearnose skate (*Raja eglanteria*)	-	n/a	X	X	-	n/a	X	X	-	n/a	X	X
monkfish (*Lophius americanus*)	X	X	X	-	X	X	-	X	X	X	-	X
pollock (*Pollachius virens*)	-	X	-	-	-	X	-	-	-	-	-	-
red hake (*Urophycis chuss*)	-	-	-	X	-	-	-	-	-	-	-	-
windowpane flounder (*Scophthalmus aquosus*)	X	X	X	X	X	X	X	X	X	-	X	-
winter skate (*Leucoraja ocellate*)	-	n/a	X	-	-	n/a	X	-	-	n/a	-	-
witch flounder (*Pseudopleuronectes americanus)*	X	X	-	-	X	X	-	-	X	-	-	-
yellowtail flounder (*Limanda ferruginea*)	-	X	-	-	-	X	-	-	-	-	-	-
Atlantic butterfish (*Peprilus triacanthus*)	-	X	X	X	X	-	X	X	-	-	X	X
Atlantic mackerel (*Scomber scombrus*)	X	-	X	X	X	-	X	X	-	-	-	X
Atlantic surfclam (*Spisula solidissima*)	-	-	X	X	-	-	X	X	-	-	-	-
black sea bass (*Centropristis striata*)	-	X	X	X	-	X	X	X	-	-	X	X
bluefish (*Pomatomus saltatrix*)	X	X	X	-	X	X	X	X	-	-	X	X
longfin inshore squid (*Doryteuthis [Amerigo] pealeii*)	-	-	X	X	X	-	X	X	X	-	-	-
scup (*Stenotomus chrysops*)	-	-	X	X	-	-	X	X	-	-	X	X
spiny dogfish (*Squalus acanthias*)	n/a	-	-	X	n/a	-	-	X	n/a	-	-	X
summer flounder (*Paralichthys dentatus*)	X	X	X	X	X	X	X	X	-	-	X	X
albacore tuna (*Thunnus alalonga*)	-	-	X	-	-	-	X	-	-	-	X	-
Atlantic angel shark (*Squatina dumeril*)	n/a	X	X	X	n/a	-	-	-	n/a	-	-	-
Atlantic bluefin tuna (*Thunnus thynnus*)	-	-	X	X	-	-	X	X	-	-	X	X
Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)	n/a	-	-	X	n/a	-	X	X	n/a	-	X	X
Atlantic skipjack tuna (*Katsuwonus pelamis*)	-	-	X	X	-	-	X	X	-	-	-	X
Atlantic yellowfin tuna (*Thunnus albacares*)	-	-	X	X	-	-	X	-	-	-	X	-
blacktip shark (*Carcharhinus limbatus*)	n/a	-	X	X	n/a	-	X	X	n/a	-	X	X
common thresher shark (*Alopias vulpinus*)	n/a	X	X	X	n/a	X	X	X	n/a	X	X	X

Managed Species	Lease Area				Offshore Export Cable Route Corridor							
					Federal Waters				State Waters			
	Life Stage											
	E	L	J	A	E	L	J	A	E	L	J	A
dusky shark (*Carcharhinus obscurus*)	n/a	X	X	X	n/a	X	X	X	n/a	X	-	-
sand tiger shark (*Carcharias taurus*)	n/a	X	X	X	n/a	X	X	X	n/a	X	X	X
sandbar shark (*Carcharhinus plumbeus*)	n/a	X	X	X	n/a	X	X	X	n/a	X	X	X
smooth hound shark complex / smooth dogfish (*Mustelus canis*)	n/a	X	X	X	n/a	X	X	X	n/a	X	X	X
tiger shark (*Galeocerdo cuvier*)	n/a	-	X	X	n/a	-	X	X	n/a	-	X	X

Notes:
X EFH for this life stage is designated in the given portion of the Offshore Project Area
\- No EFH for this life stage is designated in the given portion of the Offshore Project Area
n/a No EFH is designated for this life stage
A Adult (including Sub-Adult)
E Egg
L Larva (or neonate if shark species)
J Juvenile

E.2.3 Categories of EFH: Habitat Types

The Offshore Project Area contains three broad categories of EFH that support managed species: water column (pelagic habitat), softbottom (benthic habitat), and hardbottom (benthic habitat; Table E-3).

Table E-3. Categories of Essential Fish Habitat in Offshore Project Area

EFH Category	Representative Habitats in CVOW Offshore Project Area
Pelagic Habitat: Water Column	All waters and associated currents from the seafloor to the sea surface, including bays and estuaries
Benthic Habitat: Softbottom	Seafloor substrate characterized by soft, unconsolidated sediments, including silt, mud, clay, sand, gravel, pebbles, cobbles, and shell fragments
Benthic Habitat: Hardbottom	Seafloor substrate characterized by complex, three-dimensional artificial reef habitat, including ships, tires, cable spools, and other intentionally deployed materials (e.g., Fish Haven)

E.2.3.1 Pelagic Habitat: Water Column EFH

Pelagic habitats are the open waters from the seafloor to the sea surface. They are characterized by physical parameters such as depth, distance from shore, light penetration, temperature, and turbidity. For example, the photic zone falls within the top 650 feet (ft; 198 meters [m]) of ocean where sunlight penetrates the water column. This zone strongly influences pelagic habitats by supporting photosynthetic phytoplankton and dispersing planktonic egg and larval stages (NOAA Fisheries 2017). Physiochemical conditions including dissolved oxygen, currents, pH, and temperature further influence the occurrence and abundance of these managed species (Pineda et al. 2007). Such conditions in the Offshore Project Area are described in greater detail in the COP (see Section 4.1.1, Section 4.1.2, and Appendix X, Metocean Assessment) and summarized here.

Current patterns, local weather, broad climactic events, and anthropogenic activities can influence dynamic water quality parameters such as conductivity, dissolved oxygen, and pH. Light penetration and temperature generally covary with depth, although these relationships may not be linear. Inner shelf waters (60–100 ft [18–30 m]) are influenced by nearshore conditions such as winds and tidal action; intermediate shelf waters (100–160 ft [30–50 m]) are mostly wind driven; and shelf edges (160–330 ft [50–100 m]) are influenced primarily by the southbound Labrador Current and northwest Gulf Stream (Lee et al. 1981; Atkinson and Targett 1983).

A persistent cross-shelf salinity gradient exists in the Mid-Atlantic Bight because of freshwater runoff from the Hudson-Raritan Estuary System, Delaware Bay, and Chesapeake Bay (Castelao et al. 2010). 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 Mid-Atlantic Bight range from 32.7 to 34.5 parts per thousand (ppt) (NOAA 2003). 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 (29.8-34.0 ppt), indicating relative stability of this pelagic habitat feature (Guida et al. 2017).

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 (VDEQ 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 to 62 ft (0 to 19 m) in the Offshore Export Cable Route Corridor and 62 to 134 ft (19 to 41 m) in the Lease Area (NOAA 2021). 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 E-2).

During 2020 and 2021, Dominion Energy completed full-coverage HRG and geotechnical surveys in the Lease Area and Offshore Export Cable Route Corridor (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, 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 E.2.3.2.2, Habitat Mapping. These surveys included a total of five vessels and approximately 20,000 km of survey lines in the Lease Area, and three vessels and approximately 3,300 km of survey lines in the Offshore Export Cable Route Corridor. The bathymetry of the entire Offshore Project Area (TerraSond 2021; Alpine 2021), is shown with bathymetric contours as an overview in Figure E-2 and Figure E-3, with additional detailed panels in Attachment E-3. Depth profiles and acreages are shown in Table E-4. 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.

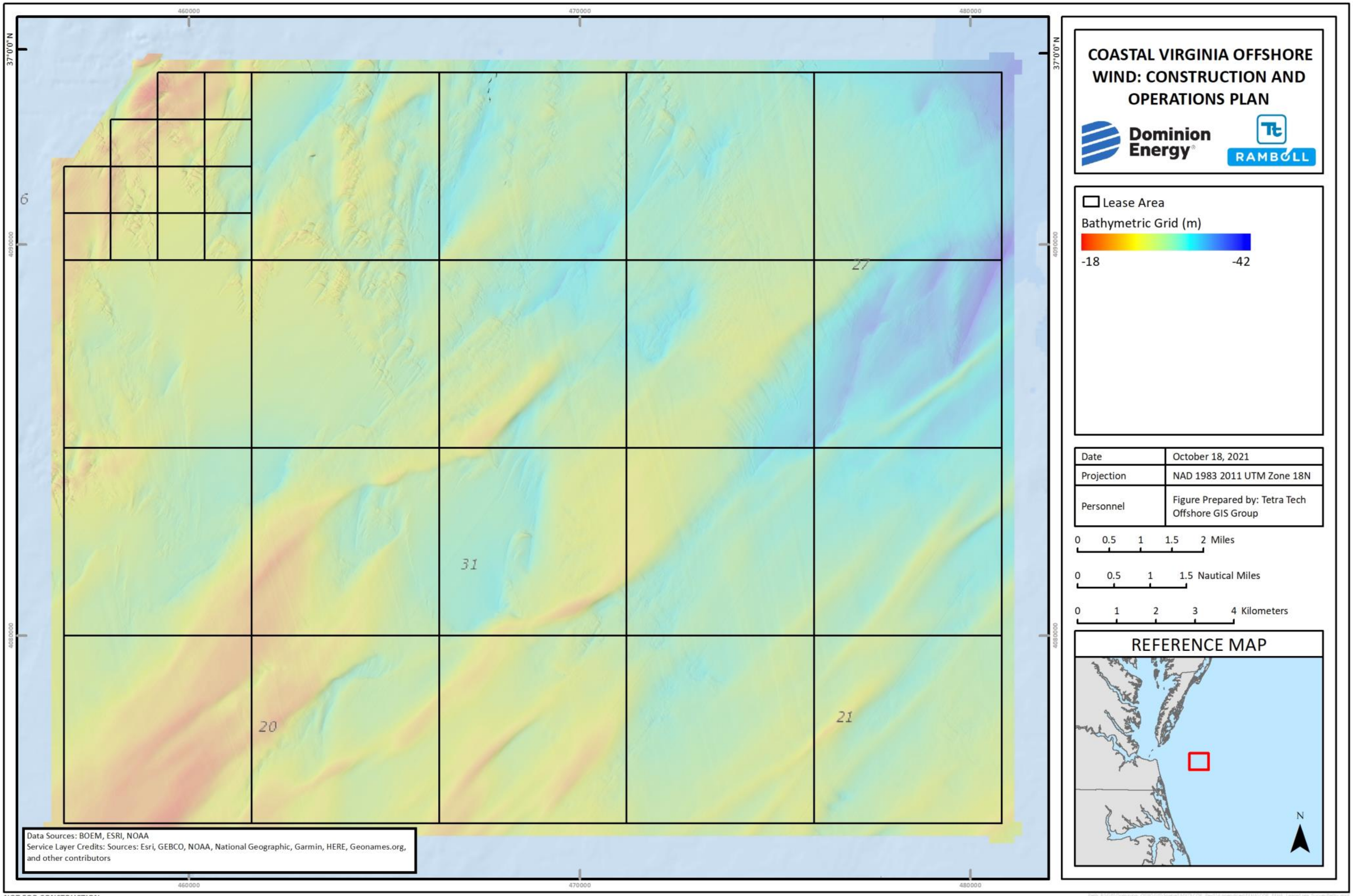

Figure E-2. Bathymetry Overview in the Lease Area (TerraSond 2021)

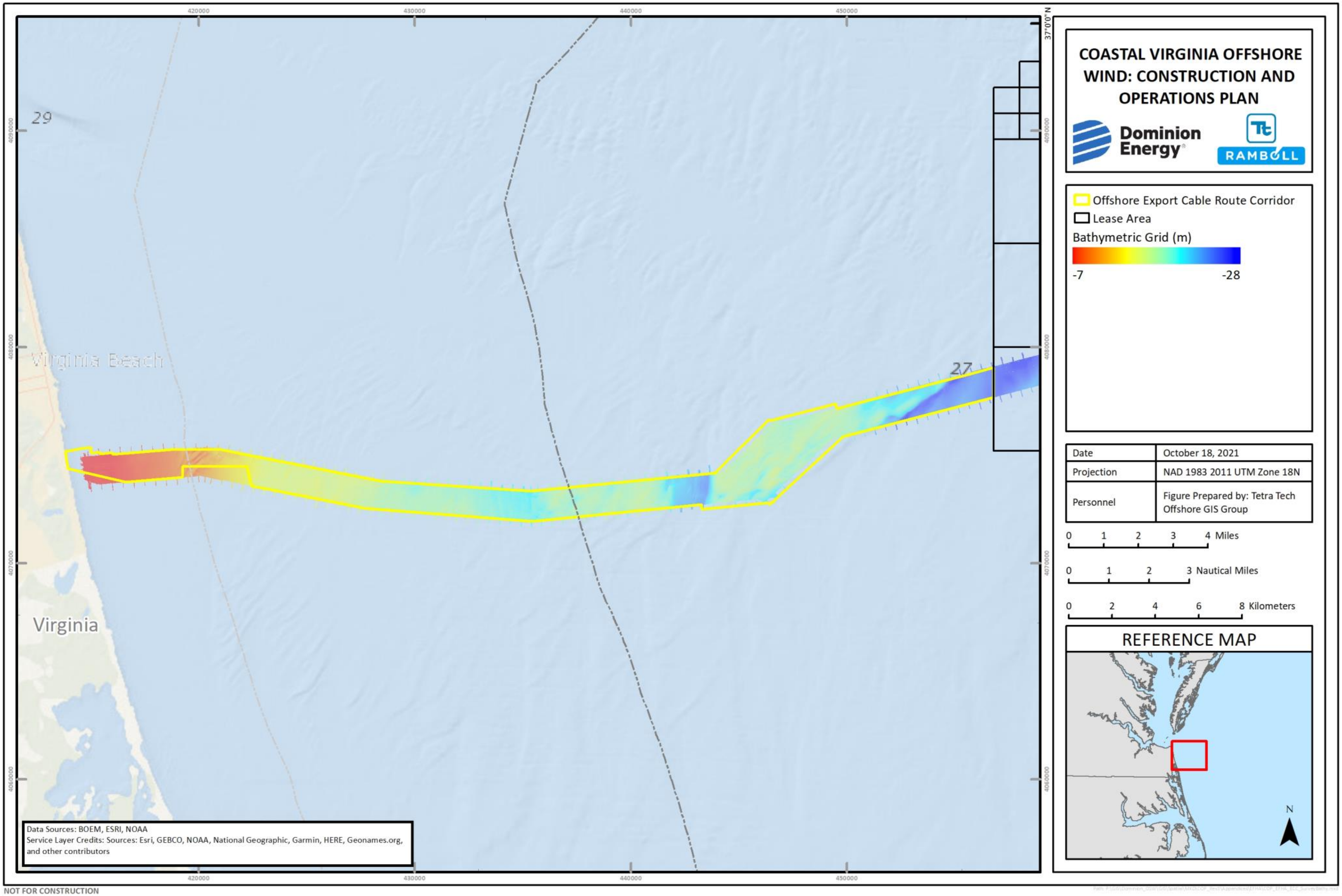

Figure E-3. Bathymetry Overview in the Offshore Export Cable Route Corridor (Alpine 2021)

Table E-4. Depth Profiles in the Offshore Project Area

Offshore Project Area	Depth Range (m)	Acres (Hectares) at Depth Range	% of Total Acreage
Offshore Export Cable Route 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 Route 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

Water temperatures in the Offshore Project Area vary greatly with depth and season. Seasonal variations include a range of 27 degrees Fahrenheit (˚F, 15 degrees Celsius [˚C]) at the seafloor and a range of 36˚F (20˚C) at the surface (Guida et al. 2017). April marks the initiation of thermal stratification, as ambient temperatures begin to raise surface water temperatures above those of bottom temperatures. Maximum surface-to-bottom thermal gradients include a range of 27˚F (15˚C) in August, followed by vertical turnover in September and October. Temperatures may drop 22˚F (12˚C) throughout the water column by the following January. These seasonal variations can trigger physiological and behavioral responses (e.g., gonadal development, seasonal migration) in managed species. Warm temperate species arrive from the south as Virginia's coastal waters warm in the summer; these species are replaced by cold temperate species from the north as water temperatures cool in the winter (BOEM 2014a). The thermal cycle redistributes highly mobile managed species and influences settlement timelines for planktonic stages of less mobile demersal species

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 (>28 ppt) as they age (Reid et al. 1999; Stevenson and Scott 2005; NEFMC 2017).

In offshore waters over the continental shelf, the photic zone supports phytoplankton (e.g., diatoms and 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 Mid-Atlantic Bight 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 Mid-Atlantic Bight, which extends from Delaware Bay to Cape Hatteras, and the South Atlantic Bight, 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 2014a). 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 four- to eight-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 and pelagic sharks) (see Attachment E-1; NEFMC 2017; NOAA Fisheries 2017).

E.2.3.2 Benthic Habitat – Softbottom EFH

E.2.3.2.1 Seabed Characterization

A detailed analysis of the seabed, resulting from the HRG surveys is included in Appendix C, MSIR, summarized in this section. 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 Mid-Atlantic Bight 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 comprised of gravel (larger than 2000 micrometers [μm]), sand (62.5 to 2000 μm), silt (4 to 62.5 μm), clay (smaller than 4 μm), 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 (EA) (Fugro 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 concur with Dominion Energy's 2020 findings that the Offshore Survey Area is dominated by fine, medium, and coarse-grain sand (Cutter and Diaz 1998; Diaz et al. 2004; Diaz et al. 2006; USACE 2009; Greene et al. 2010; Fugro 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 there is virtually zero rugosity throughout the area (Guida et al. 2017). U.S. Fish and Wildlife Service (USFWS) benthic sampling programs determined that the most abundant taxa in Virginia nearshore habitats (in descending order) were polychaetes, bivalves, and amphipods (USACE 2009). 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 Offshore Export Cable Route Corridor, which characterized the entire Offshore Project Area as softbottom habitat (TerraSond 2021; Alpine 2021). Seabed characterization and morphology features (e.g., sediment type, sandwaves, ridges, depressions, etc.) 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. 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 Offshore Export Cable Route Corridor 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 Offshore Export Cable Route Corridor. 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 m^2 resolution, as listed in Table E-5.

Table E-5. Sediment Types in the Offshore Project Area, Interpreted from MBES, SSS, and Backscatter Data Processed at 0.1 to 0.5 m^2 resolution.

Offshore Project Area	Sediment Type (CMECS)	Acres	% of Total Acreage
Offshore Export Cable Route 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 Route 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

E.2.3.2.2 Habitat Mapping

NMFS-GARFO has developed habitat mapping recommendations in coordination with BOEM to ensure that adequate data and information are included as part of EFHAs 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 (hard bottom, gravel mixes, shell, and vegetation) and non-complex sand/silt/mud habitats (grain sizes less than 2 mm) 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 m^2 resolution, and displayed on maps at a scale of 1:10,000 throughout the Project Area, as shown in Attachment E-3 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 m resolution;

- SSS Imagery: Collected at 200% coverage submitted at 0.25 m resolution;
- Multi-Channel Seismic (MCS): 150 m depth BSB, 1 m resolution;
- Single-Channel Seismic (SCS): 25 m depth BSB, 0.4 m resolution;
- Sub-Bottom Profiler (SBP): 12 m depth BSB, 0.2 m resolution;
- TVG: Gridded at 1 m resolution;
- Geotechnical and benthic samples (grab samples and imagery).

Benthic sampling (grab samples, still images, video images) was conducted during summer 2020 (Tetra Tech 2021) 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. Eighty of the 120 sites were positioned based on a regular pattern (60% of the 80 placed on even corridors, 40% of the 80 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 Attachment E-3 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 was 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 Appendix C, MSIR, 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 (SC) and ASTM D2488 to describe the surficial sediments. The digitized regions were then imported into a GIS project using ESRI ArcCatalog 10.7.1 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 (mm) 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 E-4.
- 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 CVOWC Lease Area and Export Cable Corridor, 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 CVOWC Lease Area and Export Cable Corridor. 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 E-5 through Figure E-8, with additional detailed panels shown at a 1:10,000 scale in Attachment E-3. 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).

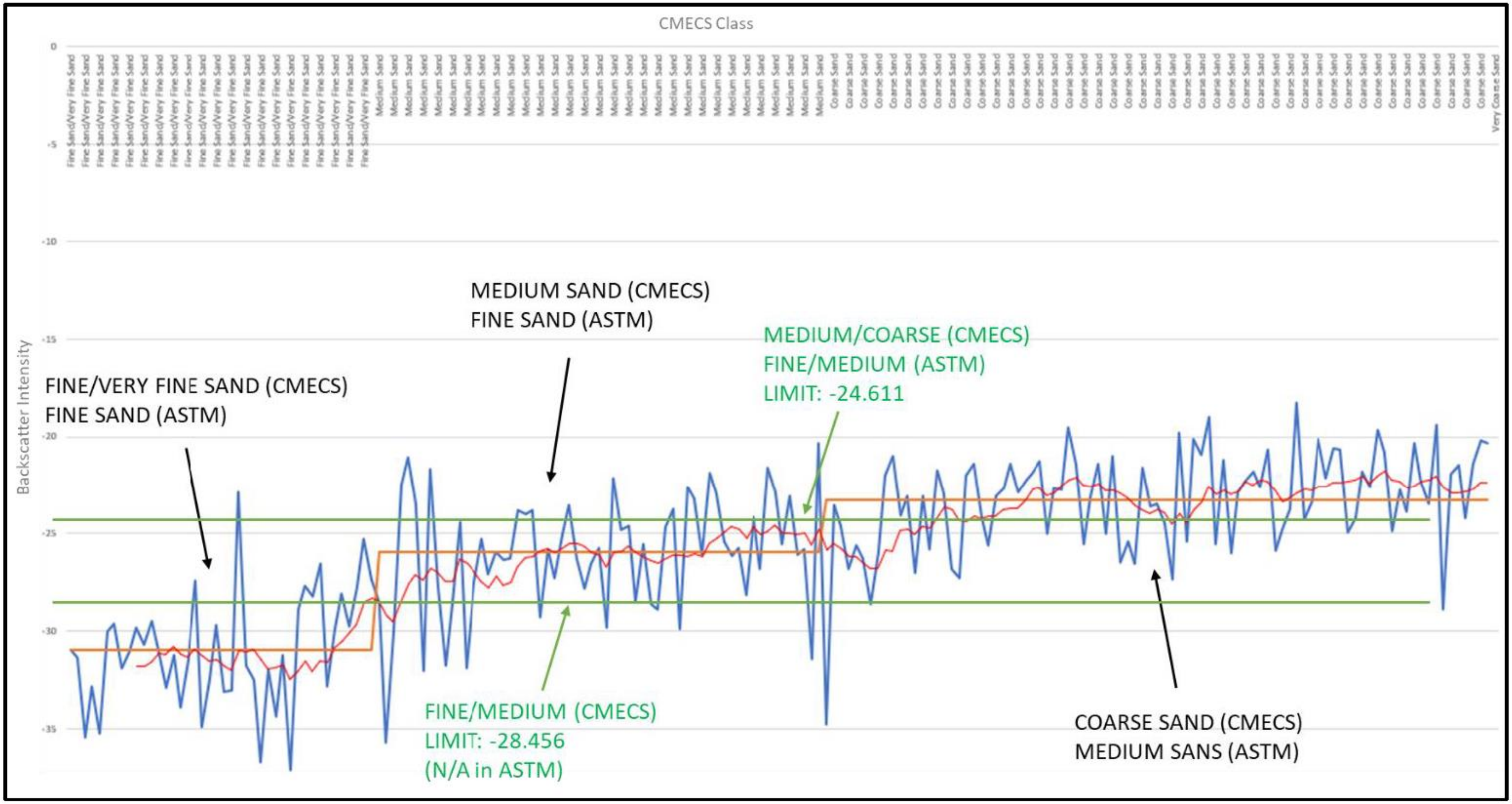

Figure E-4. Grain size and backscatter correlation based on samples classification

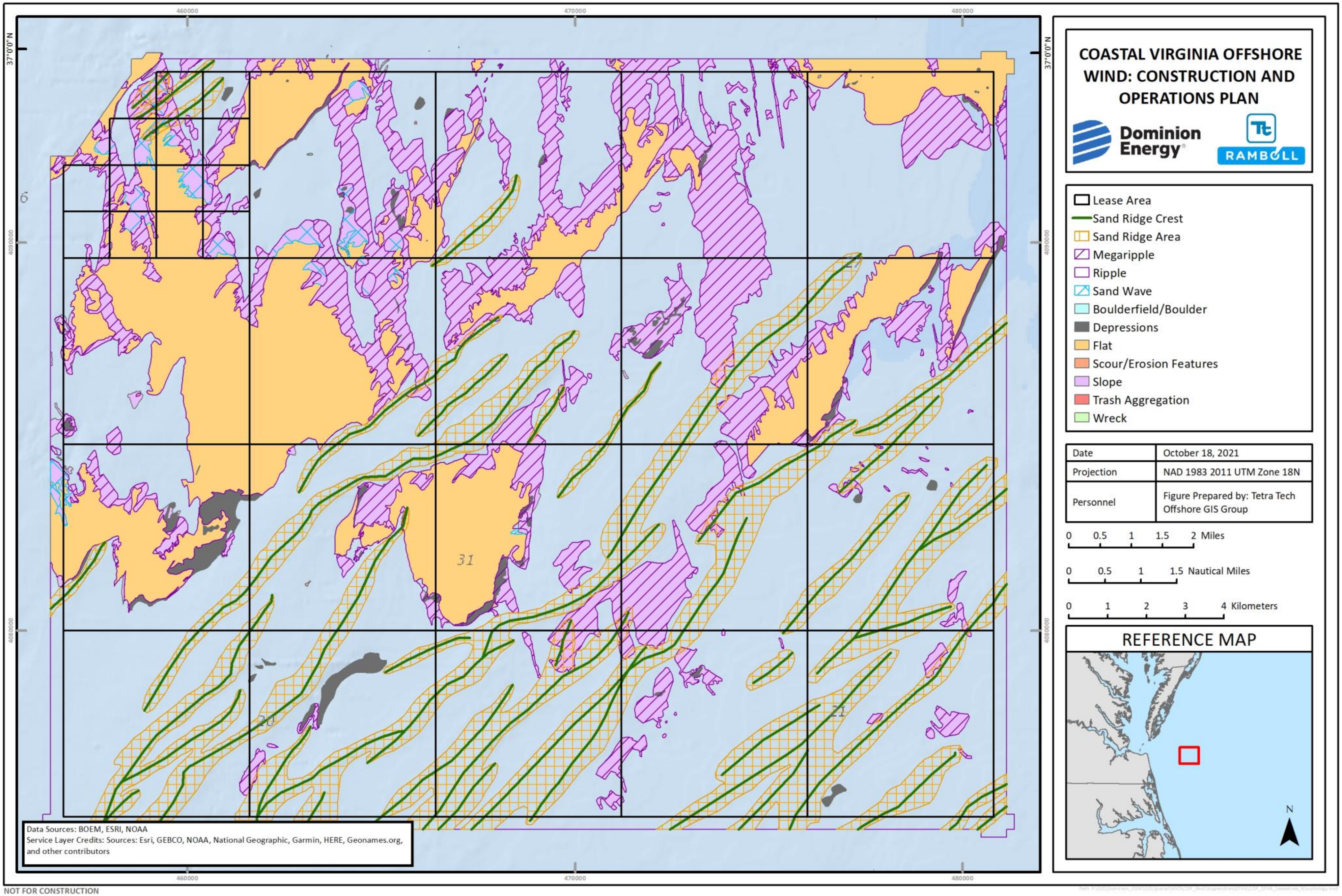

Figure E-5. Seabed Morphology Overview in the Lease Area (TerraSond 2021), See Attachment E-3 for full-scale maps

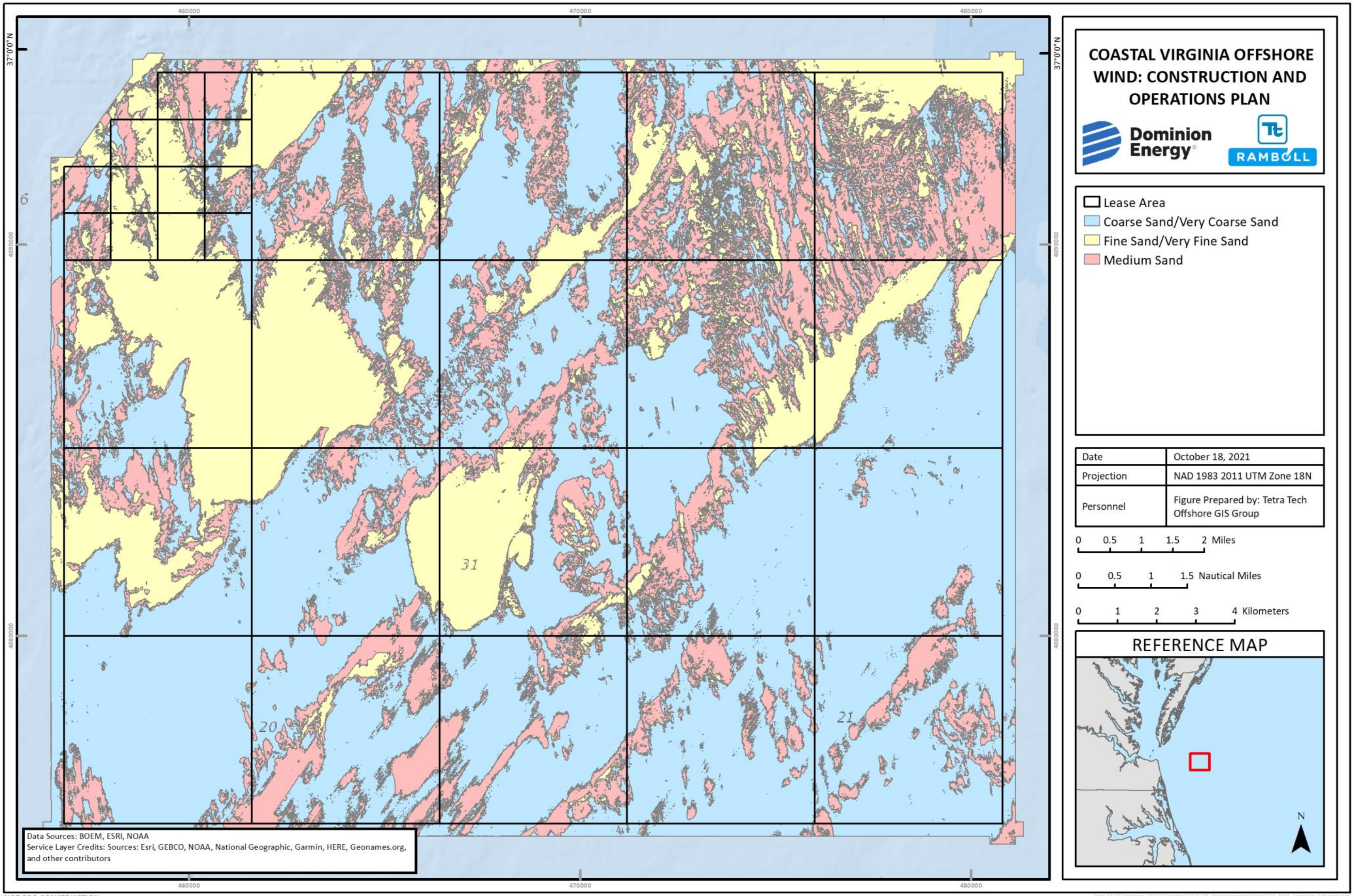

Figure E-6. **Seabed Habitat Interpretation Overview as CMECS in the Lease Area (TerraSond 2021), See Attachment E-3 for full-scale maps**

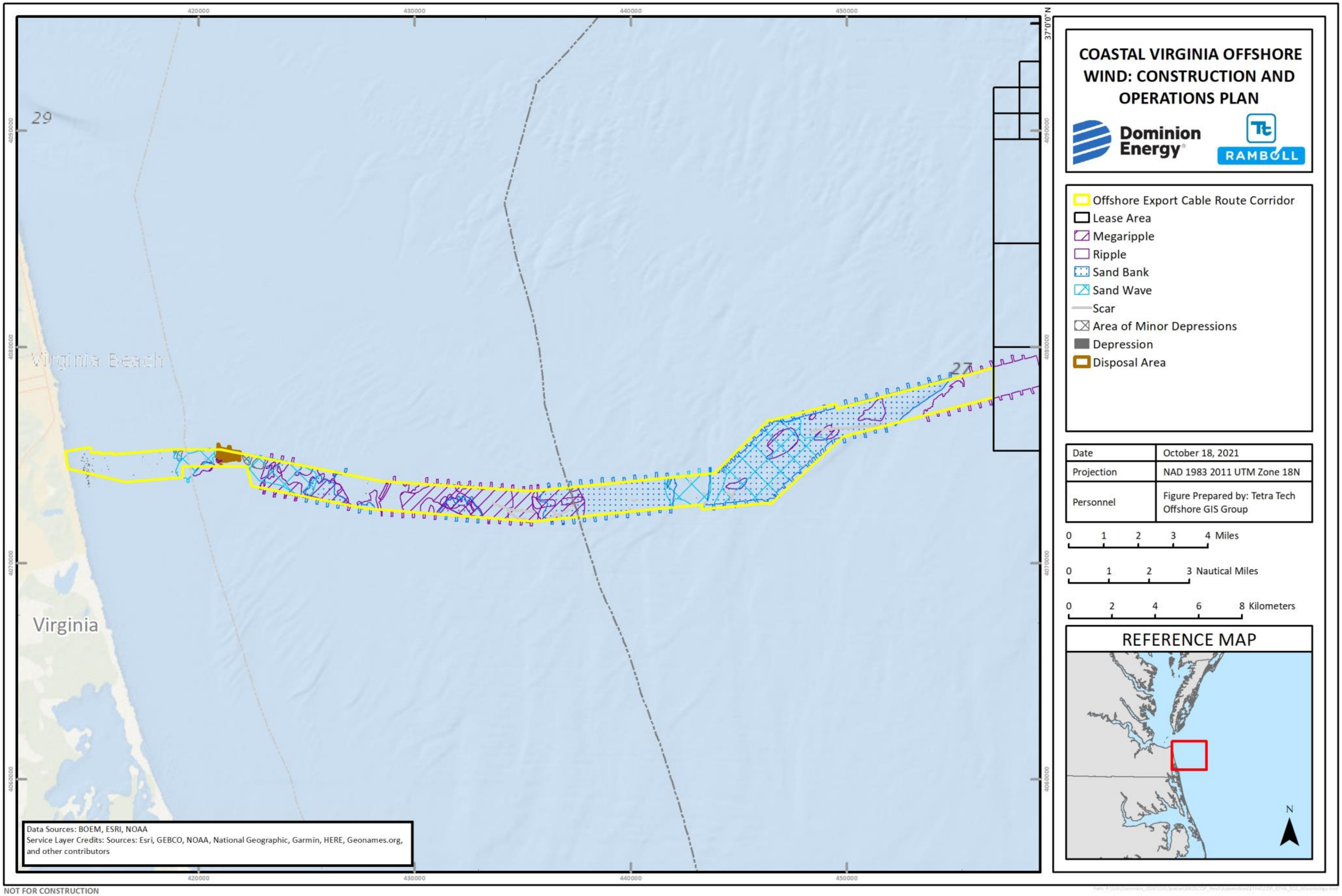

Figure E-7. Seabed Morphology Overview in the Offshore Export Cable Route Corridor (Alpine 2021), See Attachment E-3 for full-scale maps

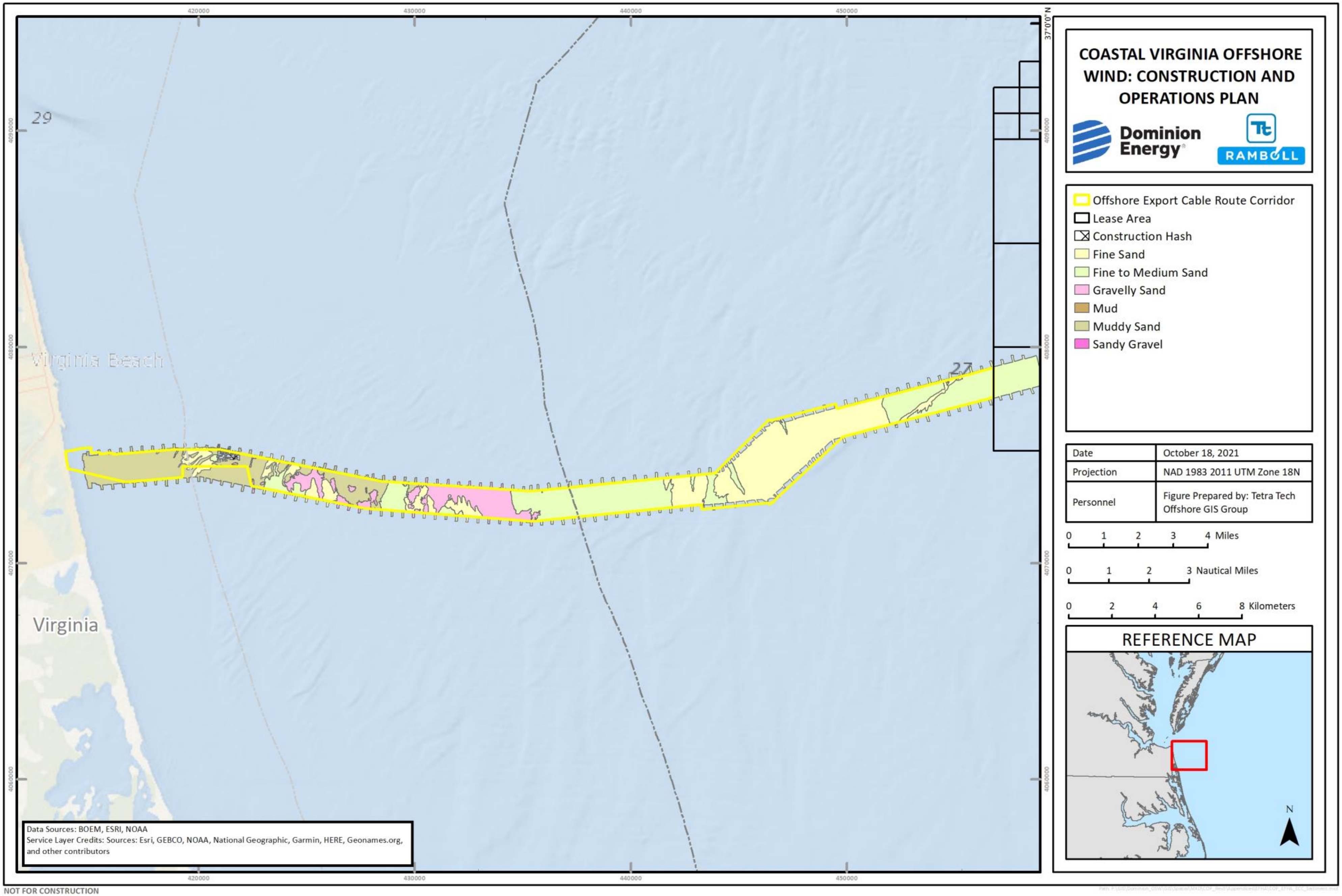

Figure E-8. **Seabed Habitat Interpretation Overview as CMECS in the Offshore Export Cable Route Corridor (Alpine 2021), See Attachment E-3 for full-scale maps**

Benthic resources were further characterized in summer 2020 (Tetra Tech 2021) 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, and benthic infauna to ground-truth the sediment types observed in digital imagery. Mean sediment composition for the 202 grab samples collected during summer and fall 2020 was approximately 97 percent coarse sand or finer, with only 3 percent consisting of granule or pebble (TerraSond 2021). Mean total organic content (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 E-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 Offshore Export Cable Route Corridor from 43 to 98 ft (13 to 30 m) and 98 to 131 ft (30 to 40 m) in the surveyed portion of the Lease Area.

Observed biogenic habitat during the benthic survey was limited to a single mussel bed (*Mytilus edulis*) within the Offshore Export Cable Route Corridor. 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 Offshore Export Cable Route Corridor. Of the managed species with designated EFH in the Lease Area, black sea bass (*Centropristis striata*), butterfish (*Peprilus triacanthus*), clearnose skate (*Raja eglanteria*), and scup (*Stenotomus chrysops*) were observed in digital imagery (Figure E-9) 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. 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 (see Attachment E-1; NEFMC 2017; MAFMC 2017; NOAA Fisheries 2017).

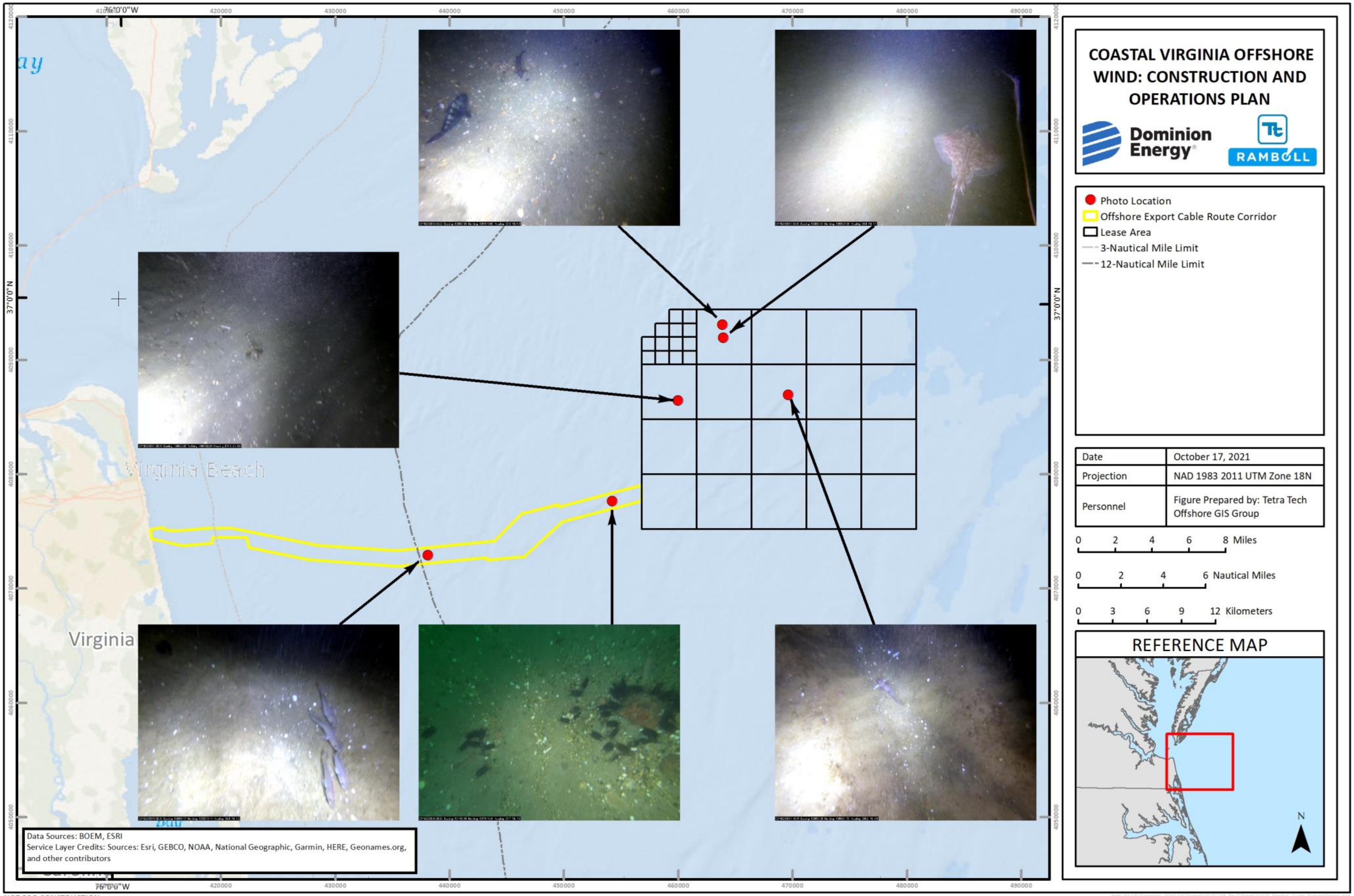

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Figure E-9. Representative Plan View Bottom Images in the Offshore Project Area Collected during Summer 2020 Surveys

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 ft (20 m) in temperatures of 70 to 90°F (21 to 32°C); juveniles and adults prefer even shallower waters (NOAA Fisheries 2017). Witch flounder (*Glyptocephalus cynoglossus*) juveniles and adults, in contrast, exhibit preferences for depths of 66 to 5,135 ft (20 to 1,565 m) 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. 1999).

E.2.3.3 Benthic Habitat: Hardbottom EFH

Naturally occurring hardbottom habitats and structured reefs are rare in the Mid-Atlantic Bight; no hardbottom was detected in the 2020-2021 HRG or benthic surveys in the Offshore Project Area (TerraSond 2021; Alpine 2021; Attachment E-3), 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; Fugro 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 E-10), where several large World War II-era tankers and transport ships, tires, and other structures were placed beginning in the 1970s (Lucy 1983). The VRMC continues to facilitate artificial reef development by adding scuttled cables, tires, and other materials to the Fish Haven (VMRC 2021b).

Artificial reefs 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 Dominion Energy’s 2020 surveys, 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.

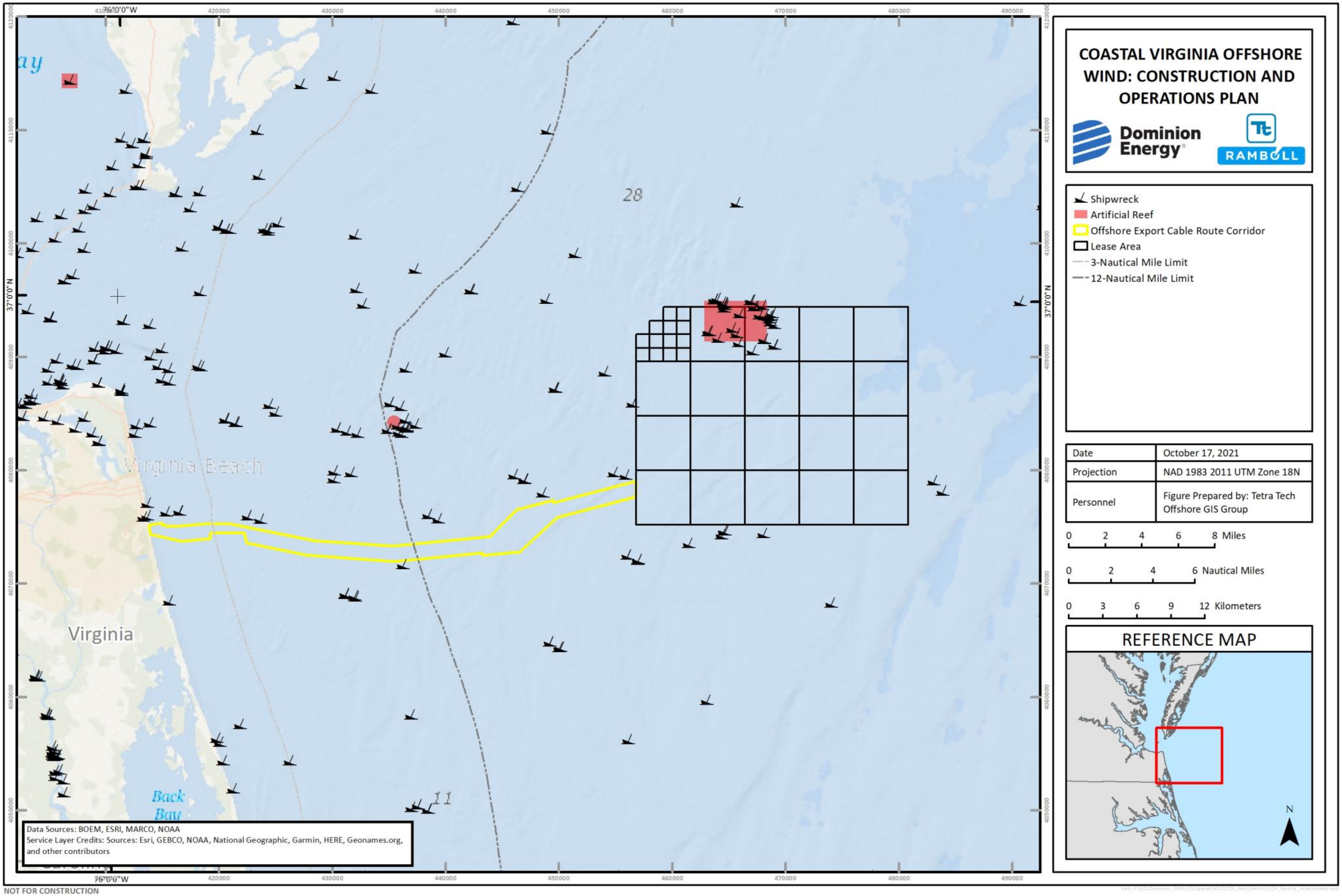

Figure E-10. Publicly Documented Shipwrecks and Artificial Reefs in the Offshore Project Area and Vicinity

E.2.3.4 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 (*Doryteuthis [Amerigo] 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 (*Spisula solidissima*) use softbottom sediments and extend their siphons into the water column to feed on plankton and nutrient-rich detritus (Cargnelli et al. 1999b).

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.

E.2.4 Other NOAA Trust Resources

The ASMFC, 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 the American eel (*Anguilla rostrate*), American shad (*Alosa sapidissima*), Atlantic croaker (*Micropogonias undulatus*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), black drum (*Pogonias cromis*), cobia (*Rachycentron canadum*), horseshoe crab (*Limulus polyphemus*), Jonah crab (*Cancer borealis*), red drum (*Sciaenops ocellatus*), river herring (*Alosa* spp.), spot (*Leiostomus xanthurus*), spotted seatrout (*Cynoscion nebulosus*), tautog (*Tautoga onitis*), and weakfish (*Cynoscion regalis*).

American eel. The American eel occurs along the entire U.S. Atlantic Coast from Maine to Florida and historically comprised more than 25 percent of the total fish biomass of East Coast streams (ASMFC 2018a). The species inhabits fresh, brackish, and coastal waters; eggs are spawned and hatch in the Sargasso Sea and leptocephali larvae are transported by ocean currents to the coasts of North and South America. Eels transit through coastal waters on their way to and from freshwater rivers. The 2012 Benchmark American Eel Stock Assessment found that the American eel population has been depleted by a combination of historical overfishing, habitat loss and alteration, productivity and food web alterations, predation, changing climactic and oceanic conditions, toxins and contaminants, and disease (ASMFC 2014). Though Virginia recorded average counts in 2012, stock assessment updates in 2017 identified downward trends in eel recovery and the stock remains depleted (ASMFC 2014, 2018).

American shad. The anadromous American shad spends most of its life in coastal waters along the North American Atlantic Coast and migrates seasonally to freshwater to spawn. Because the species exhibits high fidelity to its natal streams, each major tributary along the Atlantic Coast has its own discrete spawning stock. In Virginia, shad populations are monitored within the James, Potomac, Rappahannock, and York Rivers. Historically, the state has not had a significant commercial shad fishery, though limited recreational fisheries occur in several Virginia rivers. The 2020 benchmark stock assessment indicates that American shad stocks have continued their decline since the previous two benchmark stock assessments (1998 and 2007) and are currently at all-time lows (ASMFC 2020a). In Virginia, the James River stock status is unknown, the Rappahannock and York River stocks are experiencing sustainable mortalities, and the Potomac River stock is depleted and experiencing unsustainable mortality (ASMFC 2020a).

Atlantic croaker. The Atlantic croaker is a sciaenid species that inhabits demersal estuarine and nearshore waters along the North American Atlantic Coast from the Gulf of Maine to Argentina. The species spawns in pelagic waters in fall and winter months and larvae and juveniles settle in estuaries to mature. The Chesapeake Bay is an important spawning and nursery habitat for croaker. The 2017 Benchmark Stock Assessment was not recommended for management use; however, the report indicated that the Atlantic croaker spawning biomass is increasing and that the species is experiencing sustainable mortality (ASMFC 2017a). The current fishery includes both commercial and recreational fisheries that experience cyclical declines and recoveries

Atlantic menhaden. The Atlantic menhaden is a euryhaline species that inhabits nearshore and inland tidal waters along the North American Atlantic Coast from Nova Scotia to Florida. The species spawns at sea and larvae are carried to estuaries where they mature to juveniles; during winter months, the majority of the adult population migrates to Virginia and North Carolina capes. According to the 2017 Atlantic Menhaden Stock Assessment Update, the species is not overfished based on fishing mortality and fecundity data (ASMFC 2017b). The current commercial fishery is divided into the reduction fishery, which processes Atlantic menhaden to obtain fish oil and fish meal, and the bait fishery, which supplies bait to other fisheries (e.g., blue crab, lobster). Landings for the bait fishery have increased in recent years. However, the reduction fishery, which is the larger component of the commercial fishery, has seen substantial declines and there is currently only one reduction plant along the U.S. Atlantic Coast located in Reedville, VA (ASMFC 2017b).

Striped bass. The anadromous striped bass spends most of its life in coastal estuaries and marine waters but migrates seasonally to freshwater to spawn. The 2018 benchmark stock assessment indicates the Atlantic striped bass stock is overfished and overfishing continues to occur (ASMFC 2019a). The current fishery is predominantly recreational (88 percent of total removals in 2018), and most commercial and recreational landings are sourced from Chesapeake Bay (ASMFC 2019a).

Atlantic sturgeon. The anadromous Atlantic sturgeon spends most its adult life in estuarine and marine waters (Stein et al. 2004; Laney et al. 2007). Five distinct population segments (DPSs, or geographic portions of a species' or subspecies' population) of the Atlantic sturgeon are listed under the ESA and in Virginia, as described in Section 4.2.4 of the COP. In the Mid-Atlantic, mature females generally spawn every 1 to 5 years by migrating upriver from April to May and September to October and deposit more than 400,000 eggs on gravel or other hard substrates (USACE 2015). The nearest Atlantic sturgeon spawning areas to the Offshore Project Area are the James and York Rivers, which provide important habitat for the

Chesapeake Bay DPS (VIMS 2021). The 2017 Atlantic sturgeon stock assessment reported that all DPSs remain depleted relative to historic distributions (ASMFC 2017c). Indices from the New York Bight and Carolina DPSs indicated a greater than 50 percent chance of population increase since 1998, although the index from the Chesapeake Bay DPS only had a 36 percent chance of population increase during the same time (ASMFC 2017c). The Navy, in partnership with BOEM, is conducting ongoing research to determine seasonal presence/absence of Atlantic sturgeon in and around the Virginia WEA and to characterize the habitat use and feeding grounds of observed individuals. To date, several sturgeon have been identified and coordinated through data-sharing networks such as the Atlantic Cooperative Telemetry network. Results will help identify the causal mechanisms for Atlantic sturgeon habitat selection in the offshore environment (Watterson 2020 unpublished).

Black drum. The black drum is a demersal species that inhabits nearshore waters along the North American Atlantic Coast from the Gulf of Maine to Argentina. The species spawns in winter and early spring; recruitment is sporadic, with infrequent but large events. The first Benchmark Stock Assessment for black drum concluded that the species is not overfished or experiencing overfishing (ASMFC 2015). The black drum fishery is growing; Virginia and North Carolina comprise the majority of the commercial fishery.

Cobia. The cobia is a highly migratory pelagic species that occurs in tropical and warm-temperate waters. The species occurs along the North American Atlantic Coast from Nova Scotia to Argentina. The species aggregates inshore to spawn during warm months and overwinters south and offshore. The 2020 Benchmark Stock Assessment determined that the Atlantic stock of cobia is not overfished or subject to overfishing (ASMFC 2020b). While the commercial fishery is small, the Atlantic cobia supports an expanding recreational fishery from the Mid-Atlantic to South Atlantic region.

Horseshoe crab. The horseshoe crab resides in estuaries and on the continental shelf along the North American Atlantic Coast from Maine to the Gulf of Mexico. Spawning coincides with the high tide during the full and new moon, and the Delaware Bay supports the largest spawning population in the world. The 2019 Benchmark Stock Assessment concluded that the Delaware Bay and southeast stocks are in good condition and that the horseshoe crab is not overfished or subject to overfishing (ASMFC 2019). The species is harvested as bait for American eel and conch fisheries; the species also provides blood to the biomedical industry to produce Limulus Amoebocyte Lysate.

Jonah crab. The Jonah crab occurs along the North American Atlantic Coast from Canada to Florida. It has a poorly understood life history, but females are believed to migrate nearshore in spring and summer and overwinter offshore. The status of the fishery remains unknown, as there is no stock assessment for the Jonah crab. Though once considered bycatch, Jonah crab currently support a growing commercial fishery.

Red drum. The red drum resides in estuaries and offshore waters along the North American Atlantic Coast from Massachusetts to Florida. Juveniles and sub-adults reside in nursery estuaries and begin to conduct seasonal inshore-offshore migrations as adults. The 2017 Benchmark Stock Assessment was not recommended for management use but indicates that overfishing may be occurring (ASMFC 2017d). The southern stock is the target of a robust recreational fishery and the northern stock is the target of a smaller commercial fishery centered in North Carolina.

River herring. The term river herring collectively refers to alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), which are anadromous species that spend most of their lives in coastal waters but migrate seasonally to spawn in freshwater rivers. Historically, river herring have spawned in virtually every river and tributary along the North American Atlantic Coast; the alewife spawns in lakes and ponds, while the blueback herring spawns in swift-moving rivers. Currently, the alewife is most abundant in the mid-Atlantic and northeastern states, while blueback herring is most abundant from the Chesapeake Bay south; both species currently occur in all of Virginia's major rivers (ASMFC 2017e). The most recent comprehensive assessment of river herring stocks concluded that both species exhibit signs of overexploitation, including reductions in average age, decreases in percent of repeat spawning, declines in recruitment, and decreases in adult abundance. The Virginia commercial herring fishery collapsed in the 1970s and in 2012 the VMRC implemented a moratorium on river herring in state waters that is currently upheld (ASMFC 2017e).

Spot. The spot is a sciaenid species that resides in estuarine and coastal waters along the North American Atlantic Coast from the Gulf of Maine to Florida. The species migrates to inshore bays and estuaries in the spring and offshore to spawn in late summer and fall. The first Benchmark Stock Assessment was not recommended for management use but indicated that both Mid-Atlantic and South Atlantic stocks are experiencing significant declines (ASMFC 2017f). The species supports a robust fishery in the South Atlantic, though the fishery experiences annual fluctuations in landings.

Spotted seatrout. The spotted seatrout occurs along the U.S. Atlantic Coast from the Florida Keys, Florida, to Cape Cod, Massachusetts, primarily in estuaries and in nearshore ocean waters during cold periods. It is most abundant from Chesapeake Bay southward and exhibits strong site fidelity to natal estuaries. A 2014 stock assessment specific to North Carolina and Virginia indicated that the age structure of the stock had expanded since 2004, but that there was a sharp decline in spawning stock biomass after 2007 and in recruitment after 2010 (ASMFC 2018b). Despite these declines, fishing mortality is below the threshold and the stock is not currently deemed overfished (ASMFC 2018b).

Tautog. The tautog occurs in coastal and estuarine waters along the North American Atlantic Coast from Nova Scotia to Georgia, though it is most abundant from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina. Stocks north of Cape Cod prefer nearshore coastal waters less than 60 ft (18 m) deep, while stocks south of Cape Cod have been found up to 40 mi (64 km) offshore at depths up to 120 ft (37 m) (ASMFC 2017g). The 2016 stock assessment indicates the Delaware-Maryland-Virginia stock remains overfished but that overfishing is not currently occurring. Historically, most commercial fishing for tautog in Delaware-Maryland-Virginia has been based in Virginia, though landings have declined in the last decade (ASMFC 2017g).

Weakfish. The weakfish occurs along the North American Atlantic Coast from Novia Scotia to southeastern Florida, though it is most common from New York to North Carolina. The species spends most of its life in coastal waters but completes a seasonal inshore and northerly migration to spawn in nearshore sounds, bays, and estuaries. Most commercial landings occur in North Carolina and Virginia, while recreational catches are more common in North Carolina and New Jersey (ASMFC 2019c). Commercial landings have declined dramatically since the early 1980s and recreational catches have declined since 1987; the 2017 stock assessment indicates that the stock has been depleted since 2003 (ASMFC 2019c).

Species profiles for managed species with EFH are included in Attachment E-1.

E.3 DESCRIPTION OF THE PROPOSED ACTION

Dominion Energy is proposing to construct, own, and operate the Project to generate energy using renewable wind resources. The purpose of this Project is multifaceted and includes the following: to provide between 2,500 and 3,000 megawatts of clean, reliable offshore wind energy and to increase the amount and availability of that renewable energy to Virginia consumers; to displace electricity generated by fossil fuel-powered plants; and to offer substantial economic and environmental benefits to the Commonwealth of Virginia. Greater detail regarding the purpose and need for the Project is provided in the COP (Section 1, Introduction).

Dominion Energy has adopted a PDE approach to describe Project facilities and activities. A PDE represents "a reasonable range of project designs" associated with various components of the project, including Foundation and WTG options (BOEM 2018). The PDE is used to assess the potential effects on key environmental and human-use resources by focusing on the design parameter (within the defined range) that represents the greatest potential impact (i.e., the "maximum design scenario") for each resource (Rowe et al. 2017). The primary goal of applying a design envelope is to allow for meaningful assessments by the jurisdictional agencies of the proposed project elements and activities. This conservative approach likely overstates the actual effects on resources from the as-built Project, which will include design refinement and implementation of avoidance, minimization, and mitigation measures. Detailed information on the Project Description and PDE is included in Section 3 of the COP.

For the purposes of this EFHA, the design that permanently converts the largest area of benthic substrate to artificial substrate, including WTG and Offshore Substation Foundations, scour protection, and cable armoring, is considered the maximum PDE for benthic habitat and managed demersal fish species. The design that permanently introduces the greatest surface area of hard structure into the water column is considered the maximum design scenario for managed pelagic fish species. The design with the longest duration of pile driving is considered the maximum design scenario for acoustic impacts to all managed species. The parameters provided in Table E-6 represent that maximum potential effect of full build-out of the Project.

Table E-6. Summary of Maximum Design Scenarios for Essential Fish Habitat as Outlined in Project Design Envelope

Parameter	Realistic Maximum Design Scenario	Rationale
Construction		
Wind Turbine Generators (WTGs)	14 megawatts (MW)	Representative of the smallest-sized WTG and therefore the maximum number of structures in the Offshore Project Area: 205 WTGs and 3 Offshore Substations.
WTG Monopile Foundation	*Maximum monopile diameter*: 31 ft (9.5 m) *Maximum monopile area*: 754.77 square feet (ft^2; 70.1 square meters [m^2]) *Maximum base diameter including scour protection*: 230 ft (70 m) *Maximum base area including scour protection*: 41,547.6 ft^2 (3,859.9 m^2)	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 foundation.

Parameter	Realistic Maximum Design Scenario	Rationale
Softbottom habitat loss: WTG Foundations and scour protection	Based on 14 MW WTGs with maximum scour protection (230 ft base diameter) corresponding to the maximum overall footprint in the Offshore Project Area: 205 WTGs x 41,547.6 ft^2 (3,859.9 m^2). *Maximum base area including scour protection:* 8,517,258 ft^2 (791,279.5 m^2)	Representative of the maximum area of softbottom benthic habitat loss due to foundation and scour protection installation, which would result in the greatest total surface area of hardbottom introduced to the Offshore Project Area.
Offshore Substation Piled Jacket Foundations	*Maximum number of piles per jacket foundation*: 4 *Maximum pile diameter*: 9.0 ft (2.8 m) *Base dimensions*: 306.8 ft x 283.8 ft (93.5 m x 86.5 m) *Scour protection diameter per pile*: 230 ft (70 m) *Seafloor footprint without scour protection*: 87,070 ft^2 (8,088 m^2) *Seafloor footprint with scour protection*: 497,092 ft^2 (46,181 m^2)	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 a single Offshore Substation.
Softbottom habitat loss: Offshore Substation Foundations and scour protection	Based on maximum seafloor footprint with scour protection for 3 Offshore Substations corresponding to the maximum overall footprint in the Offshore Project Area: 3 x 497,092 ft^2 (46,181 m^2). *Maximum base area including scour protection*: 1,491,276 ft^2 (138,543 m^2)	Representative of the maximum area of softbottom benthic habitat loss due to foundation and scour protection installation, which would result in the greatest total surface area of hardbottom introduced to the Offshore Project Area.
Inter-Array Cables	*Maximum total length per cable:* 29,961 ft (9,132.1 m) *Maximum burial depth*: 9.8 ft (3 m) *Maximum temporary trench width*: 16.4 ft (5 m) *Maximum temporary seafloor footprint*: 9.5 acres (ac; 3.8 hectares [ha]) *Maximum duration of installation*: 15 months	Representative of the maximum installation length per cable, burial depth, temporary trench width, and maximum temporary seafloor footprint.
Offshore Export Cables	*Maximum burial depth*: 16.4 ft (5 m) *Maximum temporary trench width:* 3,840 ft (1,170 m) *Maximum Offshore Export Cable Route Corridor (width of construction corridor from Offshore Work Area to Offshore Substations)*: 2,892.4 ac (1,170.4 ha). *Maximum temporary area impacted by cable installation*: 4,338.9 ac (1,755.9 ha) *Maximum duration of installation*: 30 months	Representative of the maximum burial depth, Offshore Export Cable Route Corridor area, and maximum temporary seafloor footprint.
Underwater noise: Foundation installation method	Pile driving *Maximum projected blow energy:* 4,000 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 ft (11 m) *Maximum penetration*: 197 ft (60 m) *Maximum hammer energy*: 4,000 kilojoules (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.

Parameter	Realistic Maximum Design Scenario	Rationale
Underwater noise: Project-related vessels	Based on 14 MW WTGs corresponding to the maximum number of structures in the Offshore Project Area (205 WTGs, 3 Offshore Substations, 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 (205 WTGs, 3 Offshore Substations, 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.
Electric and magnetic fields (EMF): Inter-Array Cables	Based on 14 MW WTGs for the maximum number of offshore structures (205 WTGs and 3 Offshore Substations) 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 ft (9,694 m) *Maximum total length of cables*: 265.3 miles (427 km)	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: 42.6 nautical miles (79 km)	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.

Advances in decommissioning methods and technologies are expected to occur throughout the life of the Project. Dominion Energy would submit a full decommissioning plan to BOEM for approval prior to any decommissioning activities, and potential impacts would be evaluated at that time. BOEM currently requires that infrastructure be fully removed or severed 15 ft (4.6 m) below the sediment surface. Predictive ecosystem modeling indicates that the site-specific benthic-pelagic coupling relationships established during the O&M stage of the Project would be decoupled and regional connectivity would return to pre-construction conditions (van der Molen et al. 2018).

E.4 EFFECTS OF THE PROJECT ON EFH

The MSA requires federal agencies to consult with NOAA Fisheries on proposed activities that may adversely affect EFH, where an adverse effect is defined as "any impact which reduces the quality and/or quantity of essential fish habitat" (NOAA Fisheries 2004). Direct and indirect physical, chemical, and biological alterations of EFH and subsequent injury to or mortality of managed species and their forage base may constitute adverse effects. These are not restricted to site-specific stressors and may extend beyond the designated EFH in the Offshore Project Area.

Stressors potentially resulting from Project construction and O&M were identified based on a review of the following literature:

- EFHAs for similar projects by other proponents;
- EFH consultations and biological opinions prepared by NOAA Fisheries for similar projects;

- EFH source documents, FMPs, and stock assessments prepared by NOAA Fisheries and FMCs; and
- Peer-reviewed articles examining site-specific and cumulative effects on benthic and pelagic habitats and species in the U.S. and worldwide.

Most FMPs identify and describe potential fishing and non-fishing activities that may impact EFH. Commercial fishing pressures may impact managed species through gear interactions with EFH (e.g., hydraulic clam dredging, bottom trawling) and intense fishing pressures on unmanaged forage species, which could alter habitat ranges and feeding habits of managed species (MAFMC 2017; NEFMC 2017; NOAA Fisheries 2017). Non-fishing impacts to EFH include both climactic and anthropogenic stressors. Largescale regional changes to physiochemical oceanic conditions (e.g., increased sea surface and bottom temperatures, changes in pH, variations in current dynamics) have been connected to shifts in community assemblages along the U.S. Atlantic Coast, including the Mid-Atlantic Bight. These stressors are described in further detail in the COP (see Section 4.2.4, Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat). Anthropogenic impacts to EFH that may compound climactic stressors include seismic surveys, dredging and dredged material disposal, mining, ocean dumping, cooling water intake and discharge, impounding and diverting of coastal hydrology, and point and non-point source pollution and sedimentation from coastal infrastructure and agriculture (NOAA Fisheries 2008; MAFMC 2017; NEFMC 2017; NOAA Fisheries 2017).

Offshore renewable energy developments were included in the list of non-fishing anthropogenic activities that may impact EFH. These alternative energy efforts include wind, wave, solar, underwater current, and hydrogen. Construction, O&M, and decommissioning of these activities have been determined to potentially impact managed species and EFH by disturbing benthic and pelagic habitat quality and introducing sound and vibrations into the environment (MAFMC 2017; NOAA Fisheries 2017). This EFHA has been conducted in the context of these identified impacts.

The potential effects of the Project on EFH would vary by species, life stage, and habitat type. Dominion Energy assessed potential effects of construction and O&M of the Project on water column, softbottom, and hardbottom habitats designated as EFH. The text below discusses groups of managed species based on their relative probability of exposure to Project impacts (e.g., least likely to be affected [Section E.4.1], most likely to be a affected by Construction or O&M [Section E.4.2]).

E.4.1 Species Least Likely to be Affected by the Project

Project construction and O&M activities would be least likely to affect water column EFH and pelagic life stages of managed species. Most Project-related stressors are oriented toward benthic habitats; exposure of pelagic organisms to benthic disturbance would be limited to physical interactions with construction vessels and equipment; localized temporary turbidity; and sediment deposition. Mobile pelagic organisms are expected to avoid exposure to excessive sound by temporarily vacating the ensonified area. Construction and O&M are not expected to cause substantial changes to pelagic or benthic prey. Encrusting algal and invertebrate species would likely increase in the area as WTG Foundations are colonized, but such changes would be localized.

The life stages of managed species listed in Table E-7 are least likely to experience impacts from the Project. Potential effects to these life stages would be temporary and reversible following construction activities.

Table E-7. Managed Species and Life Stages Least Likely to be Affected by the Project

Species	Life Stages with Water Column EFH in the Offshore Project Area
Atlantic cod	E, L
Atlantic herring	J, A
Atlantic sea scallop	L
monkfish	E, L
pollock	L
windowpane flounder	E, L
witch flounder	E, L
yellowtail flounder	L
Atlantic butterfish	E, L, J, A
Atlantic mackerel	E, J, A
black sea bass	L
bluefish	E, L, J, A
longfin inshore squid	J, A
summer flounder	E, L

Notes:
A Adult (including Sub-Adult)
E Egg
L Larva
J Juvenile

E.4.2 Species and Life Stages Most Likely to be Affected by the Project

Benthic organisms and EFH are most likely to experience short-term direct effects of physical interactions with construction equipment (including entrainment), burial by sediments, and pile driving noise and vibration. The sessile, demersal, or benthic-dependent life stages of managed species in Table E-8 are expected to experience short-term impacts during construction or O&M (see Attachment E-2 for expanded descriptions).

Table E-8. Managed Species and Life Stages Most Likely to be Adversely Affected by Construction and O&M

Species	Benthic Life Stages Likely Affected in the Offshore Project Area		
	Construction	O&M	Require Softbottom
Atlantic sea scallop	E, J, A	E, J, A	✓
clearnose skate	J, A	J, A	✓
monkfish	J, A	-	-
red hake	A	-	-
windowpane flounder	J, A	J, A	✓
winter skate	J	J	✓
Atlantic surfclam	J, A	J, A	✓
black sea bass	J, A	-	-
longfin inshore squid	E	-	-
scup	J, A	-	-
summer flounder	J, A	J, A	✓

Notes:
A Adult
E Egg
J Juvenile
\- Does not apply

Some managed species/life stages with EFH in the Offshore Project Area use hardbottom substrate and artificial structures for settlement, protection from predators and energy-draining currents, and foraging opportunities (see Attachment E-1). The species in Table E-9 are expected to aggregate, or become concentrated, around complex structure and hardbottom provided by foundations and scour protection.

Table E-9. Managed Species and Life Stages Attracted to Artificial Structures

Species	Life Stages with EFH in the Offshore Project Area	
	Attaches to Hard Substrate	Associates with Hardbottom/Structure
Atlantic sea scallop	L	-
monkfish	-	J, A
red hake	-	A
black sea bass	-	J, A
longfin inshore squid	E	-
scup	-	J, A
spiny dogfish	-	A
All HMS	-	ALL (in water column)

Notes:
A Adult (including Sub-Adult)
E Egg
HMS Highly Migratory Species
L Larva (or neonate if shark species)
J Juvenile
\- Does not apply

Project-related stressors and potential short- and long-term effects of construction and O&M are discussed in the following sections, with an emphasis on the species most likely to be affected.

E.4.3 Analysis of Potential Construction Impacts

Construction activities (e.g., pre-lay grapnel runs, cable installation and armoring, pile driving, and scour protection placement) would temporarily disturb benthic EFH such as bedforms, sand waves, megaripples, and ripples in the Offshore Project Area. These bedforms are dynamic by nature and would naturally reform within days to weeks under the influence of the same physical conditions that formed them initially. Construction activities would alter pelagic EFH by creating a sediment plume, increasing turbidity, and potentially introducing chemical contamination into the water column.

These potential stressors were analyzed in the COP (see Section 4.2.4) and determined unlikely to occur at a magnitude that would adversely affect managed species or EFH in the Offshore Project Area. The COP findings are considered applicable to this EFHA and are not considered further in this section. The most substantial construction-related impacts would be those that cause direct injury to/mortality of managed organisms or their softbottom prey. The impacts described in this section have been determined to cause minimal, moderate, or less than substantial adverse effects on managed species or EFH.

E.4.3.1 Disturbance, Injury, or Mortality of Managed Species

Construction activities disrupting softbottom habitat may injure or kill sessile or slow-moving organisms (listed in Table E-8). Direct seafloor disturbance would crush or bury Atlantic sea scallop eggs and juveniles, Atlantic surfclam juveniles and adults, and longfin inshore squid egg mops located directly in the footprint of pile driving or scour protection placement.

Prior to installation of Offshore Export and Inter-Array Cables, pre-lay grapnel runs would clear debris from the cable corridors; physical effects on benthic habitats would be similar to bottom dredges and trawls, minus the collection of organisms (Hiddink et al. 2017). Construction vessel anchors and spud cans may similarly cause injury or mortality to sessile organisms. However, Dominion Energy would require any necessary anchors and spud cans to be placed within previously cleared and disturbed areas to the extent possible to reduce the spatial extent of direct effect. Consistent with NOAA Fisheries (2015) analysis of benthic impacts of the Block Island Wind Farm, Dominion Energy estimated that each vessel anchor would temporarily disturb an area of 0.12 ac (0.05 ha).

Jet plowing, jet trenching, chain cutting, trench forming, hydroplowing, mechanical plowing, pre-trenching, and mechanical trenching methods are all considered in the PDE for Inter-Array and Offshore Export Cable burial following pre-lay clearing and grapnel runs. Each of these methods would involve the creation of a temporary trench into which the cable would be fed as the equipment is towed along the seabed. Cable installation equipment is slow-moving and would allow time for most mobile organisms to escape injury or mortality (Table E-8); such equipment would continuously move through installation corridors and would therefore represent a minor, short-term impact on managed species and EFH at any given point. Any displacement of demersal organisms would be temporary.

Sessile organisms in or immediately adjacent to the temporary trenches would likely be buried, injured, or killed by these activities. Atlantic surfclams that burrowed deeper into sediments in response to pre-lay activities would be displaced by the cable-laying equipment. Surfclam mortality associated with clam dredging ranges from 1 to 12 percent, largely due to the impacts of dredge teeth (Sabatini 2007; Kuykendall et al. 2019). Of the equipment under consideration for cable-laying activities, only chain cutting involves the use of metal teeth; other equipment types would avoid the same level of mortality. Surfclams would subsequently reposition themselves at suitable depths in the sediment following completion of Inter-Array and Offshore Export Cable installation. Chain cutting would be used only as a last resort in locations where the substrate is too hard for other cable installation tools to be effective. Surf clams would not be expected to occur in any such areas because they require unconsolidated sediments for burial. No long-term population-level impacts on surf clam are expected to result from cable installation.

Studies have demonstrated that cables typically result in minimal damage to resident biota. Andrulewicz et al. (2003) found no difference in benthic diversity, abundance, or biomass on a cable route buried in soft-bottom substrate in the Baltic Sea one year after installation. Kogan et al. (2003, 2006) found no difference in abundance and distribution of 17 benthic taxa within 100 m of a surface-laid coaxial cable and no difference in infaunal communities in 138 sediment cores of varying distances from the cable. In areas of high energy and large sediment supply (e.g., up to 80 m water depth on the continental shelf), benthic habitats typically recover rapidly (several weeks to 2 years) after cable installation by plowing. Installation by water-jetting causes greater disturbance that may take up to 5 years to be recovered. Repeated surveys suggest that evidence of physical habitat recovery is a good predictor of biotic community recovery. In most cases studied, benthic habitats and communities recover completely with no signs of long-term impacts of cable burial studied (Kraus and Carter 2018). Due to the localized nature of cable activity, the overall biological impact is likely to be negligible, particularly if the habitat distribution throughout the wider area is homogenous (Vize et al. 2008). A recent BOEM study evaluating recovery of benthic assemblages on the outer continental shelf concluded that sessile species inhabiting sand and gravel substrates where natural disturbances are common generally recover quickly from sand mining and other anthropomorphic disturbances (Niedoroda et al. 2014). Mobile epifauna such as *Cancer* crab and dog whelk (*Nucella* spp.) were displaced by the initial surge created by a large dump of dredged material, but returned to the area about 20 minutes later (Roegner et al. 2021).

Monopiles have been selected as the WTG Foundations for this Project (see Section E.3, Table E-6). The maximum design scenario assumes rock or other hard material would be placed within a 230 ft (70 m) diameter surrounding each foundation, corresponding to a maximum footprint of 41,547.6 ft^2 (3,859.9 m^2) to prevent bottom scour. Additional protective rock or other hard material would be placed atop approximately 0.1 percent of the Offshore Export Cable for added protection where cable burial is insufficient (Dominion Energy does not currently anticipate the need for additional cable protection on Inter-Array Cables). Armoring material would be lowered or released to the seafloor by a construction vessel stabilized by dynamic positioning, spuds, or anchors. Mobile life stages of managed species would be expected to vacate the area to avoid physical disturbance, but organisms that consume demersal prey (e.g., flounders, monkfish, red hake, skates) would likely return to scavenge sessile or infaunal organisms injured by the construction activity (Table E-8; Vallejo et al. 2017; ICF 2020). Any displacement of demersal organisms would be temporary.

E.4.3.2 Burial of Organisms by Sediment Deposition

To predict the duration of sediment suspension and area of likely deposition associated with construction activities, Dominion Energy modeled sediment transport in the Offshore Project Area (see COP Appendix J, Sediment Transport Analysis).

Sediments would be suspended in the water column within the Offshore Project Area during seafloor clearing and preparation, pile-driving, foundation placement, Inter-Array Cable and Offshore Export Cable installation, scour protection and cable armor placement. Most sediment deposition following cable burial activities has been shown to occur within tens of meters of the disturbed bottom (Vize et al. 2008; NIRAS 2015). Coarser sediments (e.g., sand, gravel) settle relatively quickly and close to the origin of disturbance, while finer sediments (e.g., clay, silt) may remain suspended for longer times and thus travel farther from their place of origin. The sandy sediments of the Offshore Project Area would settle to the seafloor near the point of disturbance. The height of sediment deposits above the bottom would be influenced by bottom currents and particle size (see COP Appendix J). Modeled deposition thicknesses were less than 0.27 inch (0.69 centimeter) within 82 ft (25 m) of the cable trench centerline during flood tides and less than 0.09 inch (0.25 centimeter) within that distance during ebb tides.

Sediment deposition may bury some Atlantic sea scallop eggs and juveniles and Atlantic surfclam juveniles and adults; while this may cause mortality in younger life stages, adults would likely move vertically to accommodate the presence of additional sediment. For example, surfclams are capable of very rapid recovery following sedimentation, reburying to desired depths within minutes of disturbance by experimental trawls (Sabatini 2007). Both *Crepidula fornicata* (Powell-Jennings and Callaway 2018) and *Mytilus edulis* (Hutchison et al. 2016) were shown to recover from burial beneath 2 cm of sediment, more than double the depth of sedimentation predicted by the model (see COP Appendix J). Squid egg mops may be dusted with a fine layer of sediment but are not likely to be completely buried except within the narrow footprint of placed structures. Mobile organisms are expected to vacate the area to avoid burial. Following deposition, mobile demersal consumers (e.g., flounders, monkfish, red hake, skates) would likely return to scavenge benthic prey displaced or injured by sediment disturbance (Table E-8; Kaiser and Hiddink 2007; Vallejo et al. 2017; ICF 2020).

E.4.3.3 Entrainment of Plankton and Ichthyoplankton

Planktonic organisms may be entrained by the intake pumps of cable installation equipment. Pelagic eggs and larvae of the following species are expected to occur in the Offshore Export Cable Route Corridor: Atlantic cod, monkfish, pollock, windowpane flounder (*Scophthalmus aquosus*), yellowtail flounder (*Limanda ferruginea*), Atlantic butterfish, Atlantic mackerel, black sea bass, bluefish, and summer flounder (*Paralichthys dentatus*) (see Attachment E-1; NOAA Fisheries 2021). Risks to these organisms from entrainment include injury from movement through the pump and high-pressure discharge into the seafloor. As no data are available on the probability of survival of entrained organisms in cable installation equipment, mortality of all entrained individuals is assumed. This represents an overestimate of entrainment-induced mortality on managed species in the Offshore Project Area.

Water jetting installation equipment would operate within a narrow centerline of each of the Offshore Export Cables, disturbing a negligible fraction of sediment and water column. Individuals immediately surrounding the intake pumps as the equipment moved continuously along the corridor would be at risk of entrainment. The volume of water withdrawn by the pump is expected to be approximately 7,925 gallons per minute (approximately 30 m^3 per minute) depending on the type of cable burial tool used (NYSERDA 2021). The targeted nature of such cable burial tools would result in water being pumped from a small zone surrounding the pump intake and would only temporarily affect plankton in a given area, since the cable burial tool is continuously moving while in use. Ichthyoplankton of EFH species in the immediate vicinity of the jet plow water intake may be subject to entrainment during cable installation activities. Some unknown portion of the organisms entrained through the jet plow pumps would likely result in mortality.

Actual entrainment estimates are influenced by season, cable installation tool, water depth, time of day, and other highly dynamic oceanic variables that cannot be predicted at this time. However, mortality resulting from entrainment would represent a negligible loss against the naturally high mortality of planktonic organisms and would not be detectable within the background of existing sources of entrainment in the Offshore Project Area (e.g., commercial vessels, military vessels, hydraulic clam dredges). The water intake rate of the jet plow (approximately 7,925 gallons per minute [30 m3 per minute]) is equivalent to the lower range of a single transit of commercial/military vessels that routinely transit the Offshore Project Area. For comparison, the cooling water intakes of such vessels are approximately; 6,840 gpm (gallons per minute, 26 m3 per minute) for an in-transit oceanographic research vessel, 38,889 gpm (147 m3 per minute) for a liquefied natural gas carrier vessel, and 170,000 gpm (644 m3 per minute) for an in-transit aircraft carrier (EPA 1999). The cooling water intake rate of an onshore power plant that utilizes once-through cooling typically ranges from 86,000 to 690,000 gpm (325 to 2,612 m3 per minute). Furthermore, while cable installation is a one-time activity, repeated tows of hydraulic clam dredges across the same seafloor area are common and compound the effect of ichthyoplankton entrainment in such areas (Stevenson et al. 2004). The de minimis effect of cable installation on entrainment mortality of ichthyoplankton is consistent with findings at Vineyard Wind (BOEM 2019). Likewise, South Fork Wind Farm estimated that zooplankton and ichthyoplankton entrained by jet plows installing inter-array cables amount to no more than 0.001

percent of the total populations in the area, based on data from NOAA's Marine Resource Monitoring, Assessment and Prediction Program and Ecosystem Monitoring sampling (BOEM 2021b).

E.4.3.4 Disturbance from Pile-driving Noise and Vibration

The type and size of piling and the method of driving determine the level of underwater noise and seafloor vibrations generated. Dominion Energy modeled monopile installation with a maximum impact hammer energy of 4,000 kilojoules (see COP Appendix Z) as the worst-case scenario of acoustic stressors in the PDE. The modeling parameters were set to overestimate noise and vibration by assuming the maximum rated hammer energy; during actual construction, some energy would be lost to heat and friction.

The biological effects of underwater noise on fishes and invertebrates are influenced by the magnitude of the sound, distance of the organism from the sound origin, and the physiology of the organism. Many fishes are sensitive to sound pressure and particle motion, or the sound-induced oscillation of water molecules; fishes with swim bladders connected to the ear are most sensitive to these pressures (Popper et al. 2014; Popper and Hawkins 2019; ICF 2020). To better understand acoustic sensitivity in the marine environment, NOAA Fisheries initiated a Working Group on Effects of Sound on Fish and Turtles, which established interim threshold criteria finalized under the ANSI report (Popper et al. 2014). The Working Group developed general guidelines for predicting acoustic impacts according to basic morphological traits of marine organisms and established quantitative thresholds for temporary threshold shifts, recoverable injury, and mortality (Table E-10). Categories of sensitive fish included species lacking swim bladders (e.g., flounders, monkfish, skates), species with swim bladders involved in hearing, and species with swim bladders not involved in hearing. Injury thresholds for young life stages, including eggs and larvae, were based on thresholds for fishes with swim bladders not connected to the ear (Popper et al. 2014). See also, COP Appendix Z for additional discussion of Project-specific modeling approaches used for this analysis.

Table E-10. Acoustic Threshold Levels for Fishes in Response to Impulsive Noise

Hearing Group	Impulsive Sounds		
	Mortality and Potential Mortal Injury	Recoverable Injury	Temporary Threshold Shift
Fish without swim bladders	> 213 dB (L_{PK}) > 219 dB SEL_{cum}	> 213 dB (L_{PK}) > 216 dB SEL_{cum}	>> 186 dB SEL_{cum}
Fish with swim bladder not involved in hearing	207 dB (L_{PK}) 210 dB SEL_{cum}	207 dB (L_{PK}) 203 dB SEL_{cum}	186 dB SEL_{cum}
Fish with swim bladder involved in hearing	207 dB (L_{PK}) 207 dB SEL_{cum}	207 dB (L_{PK}) 203 dB SEL_{cum}	186 dB SEL_{cum}
Eggs and larvae	207 dB (L_{PK}) 210 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Source: Popper et al. (2014)
Notes:
dB: decibel; L_{PK}: peak sound pressure (dB re 1 μPa); F: far (1,000s of meters); I: intermediate (100s of meters); μPa: micropascal; N: near (10s of meters); N/A: not applicable; PTS: permanent threshold shift; SEL_{cum}: sound exposure level (dB re 1 $\mu Pa^2 \cdot s$); SPL RMS: root mean square sound pressure (dB re 1 μPa)

In reality, mobile organisms vulnerable to impact pile driving would likely reduce their exposure to injurious noise by moving away from the pile driving. Acoustic stress of pile driving at the Block Island Wind Farm was determined to be unlikely to adversely affect the Atlantic sturgeon or its prey (NOAA Fisheries 2015). Underwater acoustic measurement results obtained during the CVOW Pilot Project pile installation activities were also incorporated into the underwater acoustic impact assessment. The bubble curtain technology used for the CVOW Pilot Project will also be incorporated for this Project, accounting for feedback received during consultation with NOAA Fisheries and BOEM (see Appendix Z, Underwater Acoustic Assessment). The highly mobile Atlantic sturgeon would be injured by noise only if it remained for some time in the vicinity of the pile during installation. These findings can reasonably be extrapolated to mobile life stages of other managed species that are not endangered.

Pile-driving in the Lease Area would expose benthic invertebrates to sound pressure, particle motion, and substrate vibrations. The interim criteria developed by the Working Group did not include consideration of particle motion and sediment vibration impacts on invertebrates, in part because conditions determining the probability of detection and response to particle motion in the field cannot be replicated in a laboratory setting (Roberts et al. 2016; Hawkins and Popper 2017). Although few studies have examined the effect of sound-generated vibrations of sediment on marine invertebrates (Andersson et al. 2017; Popper and Hawkins 2019), and some evidence of behavioral effects has been reported. The Atlantic sea scallop, Atlantic surfclam, and longfin inshore squid could be vulnerable to such effects. Juvenile and adult scallops and surfclams would likely respond to the impact hammer sounds and vibrations by “flinching,” or closing their valves, which prevents feeding (Day et al. 2017). They would likely resume feeding immediately after the disturbance; the short-term interruption of foraging would not affect the health of individuals or decrease abundance of the local populations of bivalves.

In most species of squid, statocysts and lateral lines aid in the detection of particle motion (Mooney et al. 2010; Solé et al. 2013). However, squid behavioral responses to construction-related noise may vary by species, life stage, and even by individual. A variety of body pattern changes, inking, jetting, and startle responses have been observed in the longfin inshore squid in response to pile-driving, making it difficult to predict potential impacts to the species in advance of construction (Jones et al. 2020). Ichthyoplankton cannot avoid auditory stressors by fleeing the area, because of their limited directional-swimming abilities (Pineda et al. 2007). Recovery capabilities of damaged squid sensory cells remain unknown, although the damaged sensory hair cells of some larval fishes can regenerate within a few weeks (Solé et al. 2013). Survival and abundance of monkfish and cod eggs were unaffected by seismic sounds similar to those that affected squid hatchlings (Carroll et al. 2017).

Dominion Energy’s underwater acoustic modeling of maximum project design elements is presented in COP Appendix Z. No population-level effect on fishes, squid, or other invertebrates is expected to occur given the limited temporal and spatial extent of pile driving, relative to available habitat for these species. Most mobile species would move outside the ensonified construction areas for a short time. A small fraction of the overall range of managed species in the Lease Area would be affected by pile-driving noise; therefore, impacts would be temporary and localized. These conclusions are consistent with modeling and field measurements for other Greater Atlantic offshore wind projects that reported only short-term adverse effects on fishes, invertebrates, and EFH exposed to pile-driving (BOEM 2020b). Dominion Energy would commit to using soft-start procedures and noise mitigation systems to avoid or minimize impacts to managed species.

E.4.4 Analysis of Potential Operations and Maintenance Impacts

O&M-related activities would alter EFH in the Offshore Project Area by introducing EMF in the vicinity of Inter-Array and Offshore Export Cables; potentially facilitating spread of non-indigenous species; increasing artificial lights, underwater noise, and vibrations; and degrading water quality via incidental fuel and chemical spills. These potential stressors were analyzed and determined unlikely to adversely affect managed species or EFH in the Offshore Project Area (see COP Section 4.2.4). The COP findings are considered applicable to this EFHA.

Although the installation of hard structures occurs during the construction phase, the development of artificial reefs in areas that were previously softbottom is a result of long-term presence of the Project (i.e., occurs during the O&M phase). The conversion of softbottom to hardbottom habitat represents the most notable effect of the Project in the Offshore Project Area. During the life of the Project, the loss of softbottom habitat and development of artificial reefs on foundations, scour protection, and cable mattresses is likely to have minimal, moderate, or less than substantial adverse effects on managed species and EFH.

E.4.4.1 Loss of softbottom habitat

Installation and O&M of Offshore Project Components would cause long-term disturbance, displacement, and/or modification of softbottom EFH. Foundation types and associated scour protection vary in the extent to which they modify benthic substrate. The 31 ft (9.5 m) diameter monopile WTG foundations and Offshore Substation piled jacket foundations and associated scour protection would convert the largest area of softbottom habitat to artificial hardbottom within the Offshore Project Area (Section E.3, Table E-6). Under this maximum design scenario, approximately 204 ac (83 ha) of softbottom in the Offshore Project Area would be permanently converted to hardbottom by foundations, scour protection, and Offshore Export Cable armoring. Of the demersal species with EFH intersecting the Offshore Project Area, EFH source documents indicate that the Atlantic sea scallop, Atlantic surfclam, clearnose and winter skates, and summer and windowpane flounders rely on softbottom habitats (Attachment E-1). Sea scallops aggregate in beds on sand and gravel substrates, while surfclams bury in unconsolidated substrates to depths of up to 3 ft (1 m) below the water/sediment interface (Cargnelli et al. 1999b; Packer et al. 1999a). Flounder and skate species rely on softbottom prey assemblages that include infaunal and epifaunal invertebrates, such as polychaetes, amphipods, decapods, gastropods, and bivalves (Chang et al. 1999; Packer et al. 1999b; Packer et al. 2003a; Packer et al. 2003b). These species would be displaced laterally following loss of softbottom habitats and prey sources.

However, the area of softbottom habitat replaced by hardbottom represents the less than 0.1 percent of total softbottom EFH in the Offshore Project Area. The managed species that would be laterally displaced during O&M would have access to ample, comparable EFH within and around the Offshore Project Area. Monitoring of the Block Island Wind Farm indicates that softbottom macrofaunal communities directly adjacent to WTGs have not exhibited declines in quality during O&M; polychaetes remain the dominant taxa in softbottom sediments within 98 to 295 ft (30 to 90 m) distance bands surrounding the monitored WTGs (Hutchison et al. 2020). Because changes to softbottom habitat are expected to be restricted to areas directly covered by Offshore Project Components, which represent a small fraction of the total softbottom EFH in the Offshore Project Area, effects of O&M on managed species are expected to be minor.

E.4.4.2 Long-term conversion of softbottom to artificial hardbottom habitat and introduction of vertical infrastructure to the water column

Under the maximum design scenario (Section E.3, Table E-6), approximately 204 ac (83 ha) of softbottom in the Offshore Project Area would be converted to hardbottom by foundations, scour protection, and Offshore Export Cable armoring. This area would provide new hardbottom habitat for a variety of structure-associated species.

Biogenic reefs would rapidly develop on underwater surfaces of WTG and Offshore Substation Foundations, scour protection, and cable protection as encrusting and attaching organisms emigrated from adjacent habitats or recruited from the plankton (Degraer et al. 2018) (e.g., algae, amphipods, anemones, anthozoans, barnacles, bryozoans, hydroids, mussels, sponges, tubeworms, tunicates [Steimle and Zetlin 2000; Steimle et al. 2002; Langhamer et al. 2009; Langhamer 2012; Causon and Gill 2018; ICF 2020]). These pioneer organisms would create secondary habitat for mobile fishes and invertebrates by increasing foraging and refuge opportunities (Causon and Gill 2018; ICF 2020). Monitoring at Block Island Wind Farm showed dense aggregations of mussels attached to some but not all the piled jacket foundations. Mussels and other epifauna were attached to the vertical structure from the water surface to the sea floor. The enriched organic sediment beneath the turbine was assumed to support the mussels, which in turn attracted mobile fauna such as sea stars (HDR 2020).

Foundation types vary in their potential to support habitat for benthic and demersal species. Monopile foundations provide smooth and mostly vertical walls for attachment. In contrast, the varied orientations of components of piled jacket foundations provide more complex habitat, including shaded undersides of horizontal elements, narrow crevices, and other sheltering opportunities (ICF 2020). Foundation types also vary in the extent to which they modify light levels, water motion, and sedimentation rates; variability in these features can increase the abundance and diversity of marine community assemblages (Bué et al. 2020). In the North Sea, physical complexity of jacket foundations supported more species and greater abundances than relatively simple monopile foundations (Causon and Gill 2018). Jacket foundation types are therefore expected to create a stronger artificial reef effect and support more diverse assemblages of fishes and invertebrates than monopiles. A 12-year study of colonization of an offshore renewable energy project reported additional habitat value of complex infrastructure features such as holes and ridges, especially for benthic crabs (Bender et al. 2020).

Studies of epifaunal communities on operational WTGs provide evidence of the potential reef effect of the Project. Monopile foundations in the North Sea accumulated 23 species within the first few months and 55 species within four years; associated scour protection accumulated 35 species within the same timeframe (Bouma and Lengkeek 2012). Monopiles of the Baltic Sea were colonized by red and green algae, hydroids, and sessile bivalves; after seven years of succession, assemblages on the foundations were similar to those on a nearby lighthouse (Andersson and Öhman 2010). Within four years, epifaunal communities on jacket foundation types in the North Sea included red and green algae, anemones, barnacles, mussels, sea stars, and urchins (Causon and Gill 2018). These findings are consistent with the observed epifaunal communities that have already been established on the CVOW Pilot Project foundations installed in 2020.

The timing of installation can influence the type of species that initially colonize new substrates because colonizers are recruited from whatever suitable species are in the plankton at the time. The Labrador Current carries ichthyoplankton from the north and the Gulf Stream carries different species from the south to create a dynamic planktonic larval assemblage in the Offshore Project Area. Furthermore, the quasi-decadal shift in the latitude of the Gulf Stream is reported to cause a corresponding northward shift of warm temperate species that follow bottom temperature isotherms (Davis et al. 2017). Because planktonic larval assemblages vary seasonally in the Offshore Project Area, initial colonization patterns of individual foundations and armoring material would reflect the season during which each foundation was installed (Krone et al. 2013, 2017). Over time, assemblages on all foundations would reach similar mature successional stages that reflect ambient conditions (e.g., water depth, temperature, currents).

The presence of Project infrastructure would not interfere with the dispersion of ichthyoplankton in the region. Monopiles would represent a relatively narrow physical intrusion into the benthic and pelagic habitats of the Lease Area. For ichthyoplankton, presence of hard substrate is one of several environmental indicators responsible for the initiation or delay of settlement; other signals include stage of larval development, temperature, prey availability, and chemical signature of conspecifics (Pineda et al. 2007; McManus et al. 2016). Operational WTGs in the North Sea have not exhibited the expected recruitment levels, perhaps due to one or more of these environmental indicators (Degraer et al. 2016). The introduction of foundations and scour protection in the Offshore Project Area would not negatively affect the regional abundances of any species with planktonic life forms.

Colonization of foundations may exhibit vertical zonation. In addition to generating novel hardbottom habitat, installation of WTGs introduces novel intertidal habitat at the sea surface. In the North Sea, the highest number of nonindigenous species (e.g., Pacific oyster [*Crassostrea gigas*], marine splash midge [*Telmatogeton japonicus*], barnacle [*Balanus perforates*] were found in this novel intertidal and splash zone (Glasby et al. 2007; De Mesel et al. 2015; Degraer et al. 2020). In some studies, monopile foundations have been colonized more heavily at the seafloor than at the sea surface, possibly because reef-building species rely on sediments suspended just above the seafloor to construct tubes (Kerckhof et al. 2010; Bouma and Lengkeek 2012). On all foundation types studied, red and green algae and barnacles were more common near the intertidal sea surface while sessile reef-forming blue mussels dominated the base (Andersson and Öhman 2010; Causon and Gill 2018). The solid bases of monopile foundations attract mobile fishes and invertebrates near the seafloor, perhaps because these structures provide some shelter from bottom currents and easy access to adjacent soft-bottom forage areas (Bouma and Lengkeek 2012; Krone et al. 2013; Causon and Gill 2018). In contrast, jacket foundations tend to attract mobile fishes and invertebrates throughout the water column, with less evidence of vertical zonation (ICF 2020). For example, steel jackets in the German Bight were dominated by adult crabs (*Cancer* spp.) at their base and larval edible crabs at upper levels (Krone et al. 2013, 2017). Vertical epifaunal zonation has not been observed on Block Island Wind Farm WTGs in the four years since its construction, suggesting that intermediary succession may persist for several years (Hutchison et al. 2020). Piled jacket foundations at Block Island Wind Farm were reported to be colonized by mussels, anemones, and sponges in the water column, and the *Astrangia poculata* coral near the sea floor. The tunicate *Didemnun vexillium*, a common invasive species, also occurs on the foundations (HDR 2020).

Enriched organic matter (i.e., littoral fall) and empty invertebrate shells accumulate beneath and immediately adjacent to all foundation types as the associated organisms grow, feed, and ultimately die (Goddard and Love 2010; Coates et al. 2014; Causon and Gill 2018; ICF 2020). The enriched area is typically favored by small mobile organisms seeking shelter in the discarded mollusk shells (e.g., juvenile black sea bass, red hake, scup, skate species) and organisms that can derive nutrients from the rain of detritus (e.g., larval fishes, burrowing amphipods, polychaetes, other forage infauna) (ICF 2020). The enriched area around offshore structures generally supports more species per unit area than flat softbottom habitat without structures (Coen and Grizzle 2007). In areas with limited bottom currents, decomposing organic matter can increase biological oxygen demand, resulting in anoxic areas at foundation bases (ICF 2020). Bottom currents in the Offshore Project Area are expected to maintain adequate oxygen to support marine life (see Section 4.1.2, Water Quality).

Benthic enrichment associated with littoral fall around operational oil and gas platforms in the Baltic Sea and North Sea was spatially limited, extending only 3 to 16 ft (1 to 5 m) from foundation bases (Wilhelmsson et al. 2006; Bergstrom et al. 2014). The spatial effects are especially notable at monopile foundations, where organic carbon enrichment decreased measurably with distance from the foundations, while grain size increased (Andersson and Öhman 2010; Bouma and Lengkeek 2012; Coates et al. 2014). The spatial patterns may be generated by accelerated water movement around the structures (i.e., wake effect), which causes turbulence and reduces current strength (ICF 2020). As current strength is reduced, pockets of substrate with smaller organically enriched sediment particles and greater abundance of larval recruits can form immediately down-current from the foundation bases; such enriched areas may subsequently attract mobile predators (Bouma and Lengkeek 2012; Coates et al. 2014; ICF 2020). Conversely, jacket foundations do not cause bottom currents to slow. Because water moves through rather than around the open structure, no low-flow pockets form, and spatial gradients are less apparent (Coates et al. 2014; Degraer et al. 2016). However, once jacket foundations are heavily colonized by epifauna, currents may behave more as they do when solid foundations are encountered (HDR 2020).

Increased productivity around WTG foundations may alter local distributional patterns of managed species (Rein et al. 2013; Degraer et al. 2016). Stomach contents of demersal fishes collected near operational wind farms in softbottom habitats in the Baltic and North Seas were characterized by hardbottom prey associated with the foundations (Andersson and Öhman 2010; Degraer et al. 2016). With the exception of the Fish Haven, and the existing CVOW Pilot Project monopile foundations, the Offshore Project Area presently offers little habitat for structure-associated species. Of the demersal species with EFH intersecting the Offshore Project Area, EFH source documents indicate that black sea bass, monkfish, red hake, scup, and spiny dogfish would benefit from the complex habitat offered by structured hardbottom. These species are known to associate with artificial structures (Table E-9; Appendix E-1).

The black sea bass exhibits particularly strong site fidelity to specific reefs and is known to aggregate around artificial reefs along the eastern seaboard from Massachusetts (Rousseau 2008; Barber et al. 2009; Harrison and Rousseau 2020) to Florida (Powers et al. 2003). Structure-associated managed species have been observed aggregating around artificial reefs and other infrastructure in Rhode Island (Wilber et al. 2022a; Hutchison et al. 2020), New York (NYSDEC 2020), New Jersey (Figley et al. 2001), Delaware (Steimle et al. 2002), Maryland (Loftus and Stone 2007; Cullen and Stevens 2017), North Carolina (Bangley and Rulifson 2014; Lemoine et al. 2019), South Carolina (Kolmos 2007), and elsewhere throughout the Mid-Atlantic Bight (Steimle and Zetlin 2000; Ross and Rhode 2016). These artificial reefs have also been frequented by Atlantic cod, bluefish, pollock, and other softbottom-dependent species (e.g., summer and winter flounder). Benefits of complex habitat provided by introduced WTGs may not extend to meso- and epipelagic species. While increased vertical mixing and subsequent transport of nutrients to the sea surface have been observed at WTGs in the North Sea, changes to primary production did not yield notable changes to the distribution of resident pelagic fishes (Floeter et al. 2017).

The positive effects of European wind farms on distributions of demersal fishes and invertebrates are well known, and limited observations of U.S. wind farms supports this finding. In a Biological Opinion for the Block Island Wind Farm, NOAA Fisheries concluded that increased prey associated with WTG structures would benefit Atlantic sturgeon transiting through the area (NOAA Fisheries 2015). Recent observations of the Block Island Wind Farm have noted aggregations of more than 100 black sea bass individuals per WTG, with additional sightings of scup, monkfish, bluefish, and smooth dogfish (Hutchison et al. 2020). In contrast, telemetry studies in the Maryland Wind Energy Area, where no infrastructure yet exists, reported low densities of black sea bass and other structure-associated species (Secor et al. 2020).

Two species of nonindigenous Indo-Pacific lionfish (*Pterois volitans* and *P. miles*) are associated with artificial reefs and offshore platforms throughout the Gulf of Mexico (Campbell et al. 2022), leading some researchers to predict that offshore wind infrastructure may support this species in the Atlantic Ocean as well. However, lionfish first colonized the natural hardbottom of the west Florida shelf, reportedly associating preferentially with sponges on hardbottom substrates, several years before moving into the western Gulf; lionfish have since been captured in all habitats except mud, silt, and clay (Campbell et al. 2022). Moreover, lionfish have already spread up the eastern seaboard as far north as New York despite the absence of major offshore infrastructure (USGS 2022). The successful range expansion of lionfish has been attributed to their lack of predators, rapid growth rates, broad prey base, nonspecific habitat use, large home ranges, and indeterminate fecundity (i.e., females contain developing eggs of various stages and can spawn repeatedly as each batch of eggs becomes mature) (Bacheler et al. 2022; Mouchlianitis et al. 2022; Green et al. 2021; Fogg et al. 2017). These and other features (such as the venomous spines) facilitate the establishment of lionfish throughout the Caribbean, Gulf of Mexico, and Western Atlantic Ocean. It is expected that lionfish will come to be associated with infrastructure in the Offshore Project Area in much the same ways reported elsewhere.

In the North Sea, the secondary habitat created by colonizing species on foundations and scour protection provide additional foraging opportunities for fishes and nurseries for crabs (Stenberg et al. 2015; Krone et al. 2017). In Belgium's offshore waters, increased foraging opportunities near foundations have been linked to increases in Atlantic cod and pout abundance and productivity (Reubens et al. 2014). In the Netherlands, abundances of sand eel were higher near foundations and scour protection than on surrounding softbottom sediments (Wilhelmsson et al. 2006; Bergstrom et al. 2013, 2014).

According to a recent meta-analysis of data from offshore wind farms in Europe, fishes occur at greater abundances within operational wind farm areas than at nearby reference locations (Methratta and Dardick 2019). It remains unclear whether artificial structures increase regional biomass, redistribute existing biomass, or have some effect on both processes (Powers et al. 2003; Brickhill et al. 2005; Rein et al. 2013, Smith et al. 2015). The incidence of fishing pressure also must be accounted for, as many European wind farms are closed to fishing vessels (Coates et al. 2016). At some wind farms in the North and Baltic Seas, no measurable differences in community abundances within and outside of wind farms were observed (Degraer et al. 2016; Langhamer et al. 2018). Conversely, a dual analysis of gut content and stable isotopes in benthopelagic and benthic fishes showed extensive foraging on organisms unique to offshore artificial infrastructure (Mavraki et al. 2021). In the U.S., neither the distribution, abundance, nor condition of individual fishes was reported to be altered by installation of WTGs at Block Island Wind Farm, despite predicted impacts to demersal fishes and American lobster communities (Wilber et al. 2018, 2022).

Offshore structures of all types (e.g., fixed, floating) attract many highly migratory fishes, including tunas (e.g., albacore, Atlantic bluefin, Atlantic skipjack, and Atlantic yellowfin tunas) and sharks (e.g., Atlantic angel, Atlantic sharpnose, blacktip, common thresher, dusky, sand tiger, sandbar, smoothhound, and tiger sharks) (see Attachment E-1). These highly migratory species also may use offshore structures as navigational landmarks (Taormina et al. 2018).

While foundations would introduce some habitat variability to the relatively uniform sandy substrate in the Lease Area, only a small fraction of the Offshore Project Area would be subject to a reef effect. The 205 monopile WTG foundations (with maximum 230 ft [70 m] diameter scour protection) and three piled jacket Offshore Substation foundations (with maximum 230 ft [70 m] diameter scour protection) would convert a maximum of 204 ac (83 ha) of softbottom to hardbottom under the maximum design scenario (see Table E-6). Foundations offering greater structural complexity (e.g., piled jackets) would support more complex attached species assemblages than smooth vertical foundation types (e.g., monopiles) (Wilhelmsson and Langhamer 2014; Bué et al. 2020).

Ultimately, effects of foundations on managed species and EFH in the Offshore Project Area may be adverse, beneficial, or mixed, depending on the species (NOAA Fisheries 2015; van der Stap et al. 2016). Effects on most managed benthic and pelagic organisms would be neutral or beneficial (Hooper et al. 2017). The conversion of softbottom to hardbottom around each foundation would reduce the amount of softbottom habitat in the Offshore Project Area for softbottom-reliant species (e.g., Atlantic sea scallop, Atlantic surfclam, clearnose skate [*Raja eglanteria*] and winter skate [*Leucoraja ocellata*], summer and windowpane flounders); however, softbottom habitat is not a limiting resource in the Mid-Atlantic Bight or in coastal Virginia. Structure-associated species (e.g., monkfish, red hake, black sea bass, scup, spiny dogfish [*Squalus acanthias*], tunas and sharks) may benefit from the Project because the foundations are expected to provide shelter and prey resources (Wilber et al. 2022b; HDR 2020; Hutchison et al. 2020). Influences of the Project on local distributions of fishes and invertebrates would be limited to the Offshore Project Area and no population-level impacts are expected.

E.5 SUMMARY OF EFFECTS TO EFH

The analyses presented in this EFHA and in the COP support Dominion Energy's determination of effects for managed species and EFH. Expected impacts for managed species with EFH intersecting the Offshore Project Area are detailed in Attachment E-2 and summarized briefly in this section. Effects on other NOAA Trust Resources (see Section E.2.4) would parallel those for managed species with similar habitat and prey requirements.

E.5.1 Summary of Effects on Water Column, Plankton, and Ichthyoplankton

Some EFH designated in the water column of the Offshore Project Area would temporarily be affected during construction and decommissioning of the Project. Potential stressors from these stages would include localized increases in turbidity from sediment plumes, inadvertent fuel releases from Project vessels and equipment, ichthyoplankton entrainment by cable installation equipment, and introduction of noise and vibration from impact pile driving. Water column EFH would not be subject to measurable O&M-related stressors.

During cable installation, equipment would move continuously through the installation corridor and pose a temporary entrainment threat to ichthyoplankton in any one location. Water would be drawn from the water column into the intake pumps of jetting tools, thus avoiding demersal eggs and larvae. The volume of water withdrawn by the pumps would be a small fraction of available pelagic habitat; mortality from entrainment would not be detectable relative to naturally high mortality of plankton. Therefore, the potential loss of ichthyoplankton to entrainment during construction would be temporary and localized in the Offshore Project Area.

During pile driving, noise and vibration introduced into the Offshore Project Area could result in behavioral changes, temporary or permanent threshold shifts, injury, or limited instances of mortality in managed species. Vulnerability to these impacts increases in species with swim bladders, particularly when the swim bladder is involved in hearing. However, mobile life stages of managed species vulnerable to impact pile driving are expected to reduce exposure to injurious noise by temporarily avoiding the area of impact. Given the limited spatial and temporal extent of Project-related pile driving, no population-level effect on managed fishes, squid, or bivalves is expected to occur.

E.5.2 Summary of Effects on Softbottom Substrate

A maximum of 204 ac (83 ha) of softbottom benthic habitat in the Offshore Project Area would be converted to hardbottom (WTG Foundations, Offshore Substation Foundations, scour protection) for the life of the Project (Table E-6). Short-term stressors to softbottom benthic EFH related to construction and decommissioning would include direct disturbance by construction equipment and potential burial, injury, or mortality of managed species. Bedforms such as sand waves, megaripples, and ripples would be temporarily disturbed and would reform within days to weeks under the influence of the same physical conditions that formed them initially. Long-term stressors to softbottom benthic EFH related to O&M would include the introduction of EMF in the benthic environment and the conversion of softbottom to hardbottom habitat.

Pre-lay grapnel runs and trench forming for Inter-Array and Offshore Export Cable installation would affect sessile life stages of managed species located directly in the path of construction. Mobile life stages of managed species would be expected to temporarily vacate the impacted area to avoid injurious interactions with construction equipment. Species that consume infaunal and epibenthic forage species would likely return rapidly after construction to scavenge organisms injured by the activity. Direct impacts to managed benthic and demersal species would be temporary and localized.

Long-term loss of softbottom habitat during O&M would be most likely to adversely affect managed species reliant on softbottom habitat for refuge and forage opportunities. These species would be directly impacted by the introduction of hardbottom substrate by being laterally displaced; they would also be indirectly impacted by the displacement of their preferred prey species. However, the area of softbottom habitat replaced by Offshore Project Components comprises less than 0.1 percent of total softbottom EFH in the Offshore Project Area. Monitoring of the Block Island Wind Farm indicates that softbottom macrofaunal communities directly adjacent to WTGs have not exhibited strong changes during O&M, implying that long-term changes to softbottom EFH would be restricted to areas directly covered by the Project (Hutchison et al. 2020).

E.5.3 Summary of Effects on Hardbottom Substrate

Hardbottom substrate (WTG Foundations, Offshore Substation Foundations, scour protection, cable protection) would be introduced in up to 204 ac (83 ha) of the Offshore Project Area for the life of the Project (Table E-6). Novel underwater surfaces would rapidly be colonized by encrusting and attaching organisms, which would create biogenic habitat for structure-associated species. Benthic areas surrounding WTG foundations would be enriched by littoral fall from these communities; discarded shells would serve as another form of hard substrate offering refuge for small mobile organisms. Certain managed species with EFH in the Offshore Project Area may benefit from the introduction of complex habitat and associated increased productivity, including both resident species and highly migratory sharks and tunas. While foundations would introduce some habitat variability to the relatively uniform softbottom substrates of the Lease Area, only a small fraction of the Offshore Project Area would be subject to reef effect. Influences of novel structure on local distributions of managed organisms would be limited to the Offshore Project Area and no population-level impacts are expected.

E.5.4 Avoidance, Minimization, and Mitigation Measures

Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate the potential impact-producing factors to managed species and EFH (Table E-11). Additional discussion of potential mitigation measures will be presented in the Long-term Monitoring Plan or as part of the EFH Conservation Recommendations that may result from the EFH Consultation process.

Table E-11. Project Impact-Producing Factors and Proposed Avoidance, Minimization, and Mitigation Measures

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
Construction; Decommissioning	Offshore Project Area	Disturbance of softbottom EFH habitat Disturbance, injury, or mortality of benthic and pelagic organisms Change in water quality, including turbidity, sediment deposition, and chemical contamination Entrainment of plankton and ichthyoplankton	• Dominion would establish a horizontal buffer of at least 164 ft (50 m) around identified artificial reefs, shipwrecks, and other mapped hardbottom habitat in the Fish Haven area. No other hardbottom or sensitive habitat is known or expected to occur in the Offshore Project Area. Dominion Energy would further micro-site within the Offshore Export Cable Route Corridor to avoid softbottom EFH habitats where feasible to minimize the probability of adverse interactions with sensitive benthic resources;

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
		Increase in underwater noise and vibration	• The release of non-toxic drilling muds during Trenchless Installation activities is possible but unlikely. Dominion Energy would develop and implement an Inadvertent Release Plan that would include pollution prevention measures and spill response procedures covered by the Stormwater Pollution Prevention Plan; and • Dominion Energy would commit to using a soft-start procedure and noise mitigation systems such as bubble curtain technologies to avoid or minimize impacts to managed species. During pile-driving activities, Dominion Energy will implement near-field and/or far-field noise mitigation systems to minimize underwater sound propagation. Examples of near-field noise mitigation systems include the Hydro Sound Damper, the Noise Mitigation Sleeve or the AdBm Noise Mitigation System. Dominion Energy is committed to the use of a double big bubble curtain for far field noise mitigation.
Operations and Maintenance	Offshore Project Area	Long-term conversion of softbottom to artificial hardbottom habitat and introduction of vertical infrastructure to the water column Habitat creation for nonindigenous species such as *Didemnun vexillium* (invasive tunicate) Increase in shading and artificial lights Change in water quality, including fuel and chemical spills Introduction of Project-related electric and magnetic fields (EMF)	• Dominion Energy does not expect the installation of hard structure to introduce nonindigenous species to the Project Area; however, existing species in the area may colonize or become associated with the structures once they are installed (e.g., lionfish). • As required for navigational safety, Dominion Energy would install artificial lights on all Project structures. These lights would be directed parallel to the sea surface to increase the visibility of structures to mariners; they would not be directed into the water; • Dominion Energy would develop and implement an Oil Spill Response Plan describing measures to avoid accidental spills and protocols to be implemented should a spill occur. Dominion Energy also would require all Project-related vessels to operate in accordance with laws regulating at-sea discharges of vessel-generated waste to minimize impacts to managed species; and • Dominion Energy would commit to burying Project-related cables wherever feasible to minimize EMF detectable by managed species.

Dominion Energy will 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 flexible and protective mitigation measures. In addition to these specific measures, Dominion Energy and all Project-related vessels would abide by applicable laws and regulations, including but not limited to reducing marine debris, managing ballast water, preventing spills of fuels and other hazardous materials, and complying with vessel speed restrictions.

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ATTACHMENT E-1: PROFILES OF MANAGED SPECIES

CONSTRUCTION AND OPERATIONS PLAN

Coastal Virginia Offshore Wind Commercial Project

Appendix E, Attachment E-1
Profiles of Managed Species in the Offshore Project Area

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
EFH	Essential Fish Habitat
FMP	Fisheries Management Plan
ft	feet
HMS	Highly Migratory Species
Lease Area	Renewable Energy Lease Area OCS-A 0483
m	meters
MAFMC	Mid-Atlantic Fishery Management Council
NEFMC	New England Fishery Management Council
NOAA Fisheries	National Oceanographic and Atmospheric Administration National Marine Fisheries Service
Offshore Project Area	Project Components in Lease Area and Offshore Export Cable Route Corridor
ppt	parts per thousand
Project	Coastal Virginia Offshore Wind Commercial Project
U.S.	United States
YOY	young-of-year

E-1.1 MANAGED SPECIES IN THE OFFSHORE PROJECT AREA

The present Essential Fish Habitat (EFH) Assessment (EFHA) analyzes the potential effects of construction, operations and maintenance, and decommissioning of the Coastal Virginia Offshore Wind Commercial Project (Project) on managed fishery resources. Species with EFH in the Offshore Project Area were identified using the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) EFH Mapper (2021), New England Fishery Management Council (NEFMC) Omnibus Amendment 2 (2017), Mid-Atlantic Fishery Management Council (MAFMC) Fisheries Management Plans, NOAA Fisheries Highly Migratory Species (HMS) Amendment 10 (2017), and NOAA Fisheries EFH source documents. Managed species with designated EFH intersecting the Offshore Project Area are listed in Table E-1-1.

Table E-1-1. Managed Species with Designated EFH in the Offshore Project Area

Common Name	Scientific Name	Essential Fish Habitat (EFH) Life Stages Designated within the Offshore Project Area
New England Fishery Management Council (NEFMC)		
Atlantic cod	Gadus morhua	Egg, Larva
Atlantic herring a/	Clupea harengus	Juvenile, Adult
Atlantic sea scallop	Placopecten magellanicus	ALL
clearnose skate	Raja eglanteria	Juvenile, Adult
monkfish b/	Lophius americanus	ALL
pollock	Pollachius virens	Larva
red hake	Urophycis chuss	Adult
windowpane flounder	Scophthalmus aquosus	ALL
winter skate	Leucoraja ocellata	Juvenile
witch flounder	Pseudopleuronectes americanus	Egg, Larva
yellowtail flounder	Limanda ferruginea	Larva
Mid-Atlantic Fishery Management Council (MAFMC)		
Atlantic butterfish	Peprilus triacanthus	ALL
Atlantic mackerel	Scomber scombrus	Egg, Juvenile, Adult
Atlantic surfclam	Spisula solidissima	Juvenile, Adult
black sea bass a/	Centropristis striata	Larva, Juvenile, Adult
bluefish a/	Pomatomus saltatrix	ALL
longfin inshore squid	Doryteuthis [Amerigo] pealeii	Egg, Juvenile, Adult
scup a/	Stenotomus chrysops	Juvenile, Adult
spiny dogfish a/ b/	Squalus acanthias	Sub-adult Female, Adult Female, Adult Male
summer flounder a/	Paralichthys dentatus	ALL
NOAA Fisheries—Highly Migratory Species (HMS)		
albacore tuna	Thunnus alalunga	Juvenile
Atlantic angel shark	Squatina dumeril	ALL
Atlantic bluefin tuna	Thunnus thynnus	Juvenile, Adult
Atlantic sharpnose shark	Rhizoprionodon terraenovae	Juvenile, Adult
Atlantic Skipjack tuna	Katsuwonus pelamis	Juvenile, Adult
Atlantic Yellowfin tuna	Thunnus albacares	Juvenile, Adult
blacktip shark	Carcharhinus limbatus	Juvenile, Adult
common thresher shark	Alopias vulpinus	ALL
dusky shark	Carcharhinus obscurus	ALL
sand tiger shark	Carcharias taurus	ALL
sandbar shark	Carcharhinus plumbeus	ALL
smoothhound shark complex (smooth dogfish)	Mustelus canis	ALL

Common Name	Scientific Name	Essential Fish Habitat (EFH) Life Stages Designated within the Offshore Project Area
tiger shark	Galeocerdo cuvier	Juvenile, Adult

Notes:
a/ Joint management with Atlantic States Marine Fisheries Commission
b/ Joint management by NEFMC and MAFMC

EFH is described in Section E-1.2, Managed Species in the Offshore Project Area for the 33 species with designated EFH for one or more life stages in the Offshore Project Area. For the purpose of this assessment, the Offshore Project Area includes the portions of the Project Components located in the designated Renewable Energy Lease Area OCS-A 0483 (Lease Area) and Offshore Export Cable Route Corridor (Figure E-1-1). The species-specific acreages of EFH within the Offshore Project Area were calculated using geographic information system tools that measure the intersection of EFH and Offshore Project Area shapefiles.

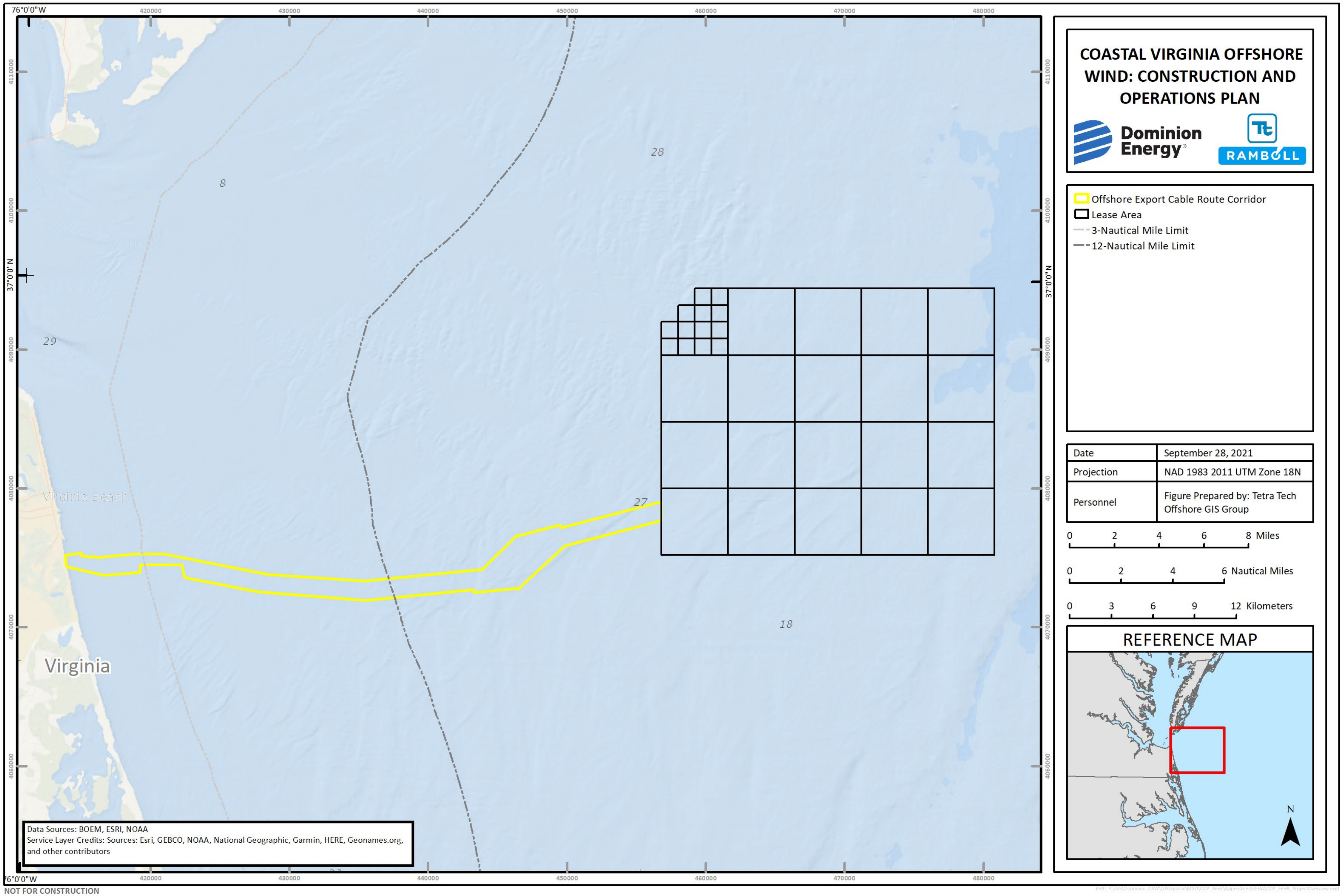

Figure E-1-1. CVOW Commercial Offshore Project Area Overview

E-1.2 PRESENCE OF EFH IN THE PROJECT AREA BY SPECIES AND LIFE STAGE

Managed species with EFH in the Offshore Project Area are described in the following sections. Species-specific EFH acreages are presented in tables and visualized in shapefiles intersecting the Offshore Project Area. All EFH portrayed in EFH Mapper shapefile downloads (NOAA Fisheries 2021) was assumed present, regardless of the geographic boundaries described in EFH source documents; therefore, the acreages presented in the following sections represent a conservative overestimate of functional EFH in the Offshore Project Area.

E-1.2.1 Atlantic Cod (*Gadus morhua*)

Atlantic cod egg EFH is designated in both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-2; Figure E-1-2). In the Mid-Atlantic Bight, Atlantic cod eggs are found in pelagic marine habitats and in the high salinity zones of regional bays and estuaries (NEFMC 2017). They typically occur in the upper 33 feet (ft; 10 meters [m]) of the water column, but spring rainfalls can locally reduce salinities and allow eggs to sink to lower depths (Fahay et al. 1999a; Lough 2004). Designated EFH for Atlantic cod eggs spans the fall to spring spawning season in the upper 230 feet (ft) (70 meters [m]) of the water column, where temperatures do not exceed 54 degrees Fahrenheit (°F; 12 degrees Celsius [°C]) and salinities are within 32 to 33 parts per thousand (ppt) (Fahay et al. 1999a; Lough 2004).

Table E-1-2. Atlantic Cod (*Gadus morhua*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Egg	0	1,659	1,652
Larva	50,842	5,021	0
Percent of Project Area Covered by EFH by Life Stage			
Egg	0.0%	11.7%	100.0%
Larva	45.1%	35.3%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Egg	0.000%	0.007%	0.007%
Larva	0.182%	0.018%	0.000%

Sources: Fahay et al. 1999a; Lough 2004; NEFMC 2017

Atlantic cod larva EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-2; Figure E-1-2). Atlantic cod larvae are found in pelagic marine habitats and in the high salinity zones of regional bays and estuaries (NEFMC 2017). Young larvae typically occur in the upper 246 ft (75 m) of the water column and descend as they age to depths of 689 ft (210 m); they migrate vertically in reaction to light (Fahay et al. 1999a; Lough 2004). Designated EFH for Atlantic cod larvae is in temperatures of 39 to 46°F (4 to 8°C) in winter and spring and 45 to 54°F (7 to 12°C) in summer and fall, where salinities are within 32 to 33 ppt (Fahay et al. 1999a; Lough 2004).

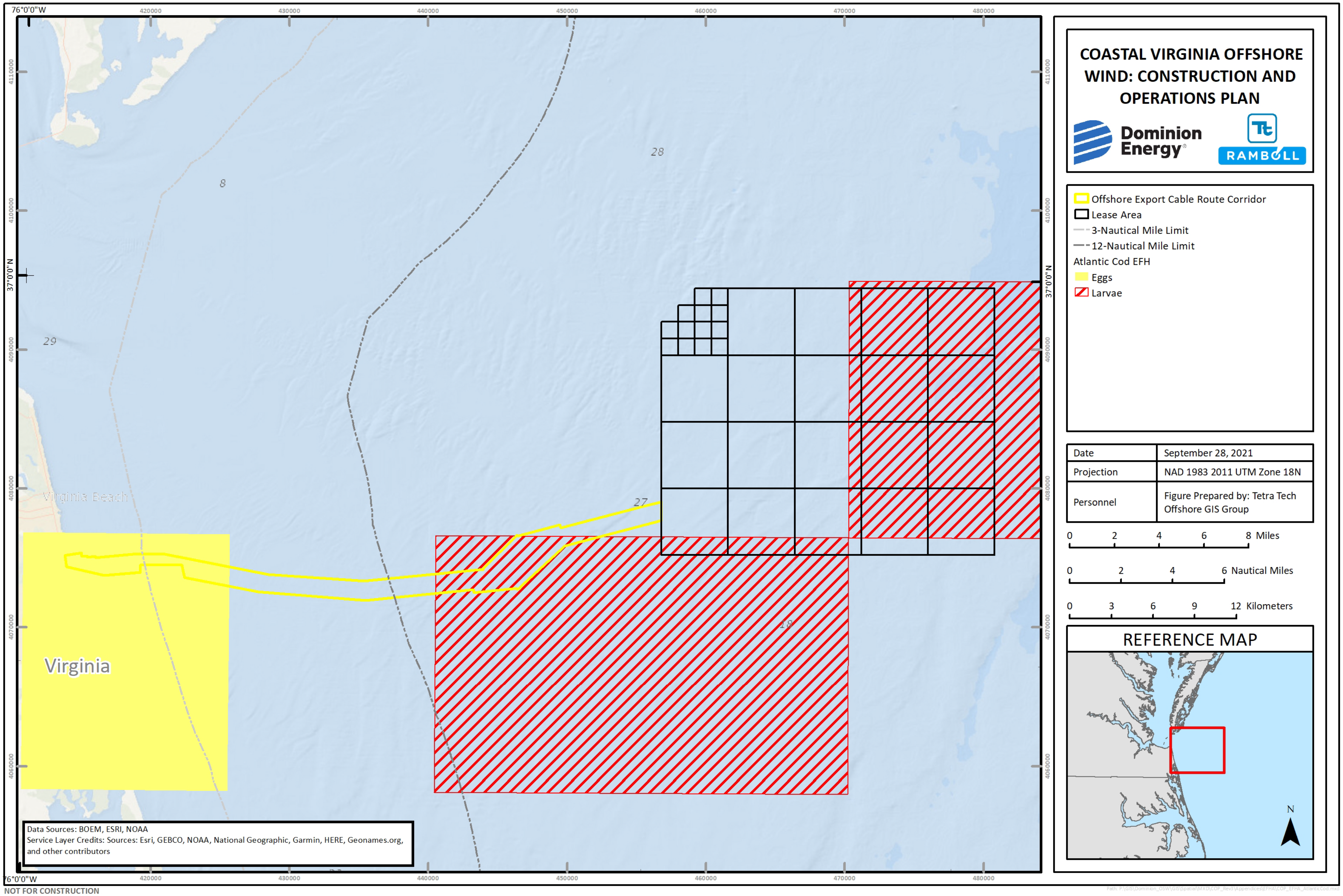

Figure E-1-2. Atlantic Cod (*Gadus morhua*) Designated EFH in the Offshore Project Area

No Atlantic cod juvenile or adult EFH is designated in the Offshore Project Area.

The Atlantic cod is managed as two stocks under the NEFSC Northeast Multispecies Fisheries Management Plan (FMP): the Gulf of Maine stock and the Georges Bank stock. Both fishery stocks are currently overfished and subject to overfishing (NOAA Fisheries 2019).

E-1.2.2 Atlantic Herring (*Clupea harengus*)

No Atlantic herring egg or larva EFH is designated in the Offshore Project Area.

Atlantic herring juvenile EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-3; Figure E-1-3). In the Mid-Atlantic Bight, Atlantic herring juveniles are found in intertidal and subtidal pelagic marine habitats and in the high salinity zones of regional bays and estuaries (NEFMC 2017). Juveniles exhibit diel vertical migrations; one- and two-year-old individuals form large schools to complete limited seasonal inshore-offshore migrations. Young-of-year (YOY) can tolerate low salinities but exhibit increasing preference for high salinities as they age (NEFMC 2017). They feed on up to 15 groups of zooplankton, including copepods, decapod larvae, barnacle larvae, cladocerans, and molluscan larvae (Stevenson and Scott 2005). Designated EFH for Atlantic herring juveniles is in the upper 984 ft (300 m) of the water column, where temperatures span 37 to 72°F (3 to 22°C) and salinities are within 28 to 32 ppt (Reid et al. 1999; Stevenson and Scott 2005; NEFMC 2017).

Table E-1-3. Atlantic Herring (*Clupea harengus*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Juvenile	112,799	12,575	0
Adult	112,799	14,234	1,652
Percent of Project Area Covered by EFH by Life Stage			
Juvenile	100.0%	88.3%	0.0%
Adult	100.0%	100.0%	100.0%
Percent of Total Species EFH Area Covered by Project Area			
Juvenile	0.189%	0.021%	0.000%
Adult	0.209%	0.026%	0.003%

Sources: Reid et al. 1999; Stevenson and Scott 2005; NEFMC 2017

Atlantic herring adult EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-3; Figure E-1-3). Atlantic herring adults are found in subtidal pelagic marine habitats and in the high salinity zones of regional bays and estuaries (NEFMC 2017). They exhibit diel vertical migrations and complete extensive seasonal migrations between northern spawning grounds in summer and fall and southern overwintering areas; though pelagic, they spawn on the seafloor on a variety of substrates in depths of 16 to 295 ft (5 to 90 m) (NEFMC 2017). Adults prefer well-mixed waters and transition zones between stratified and unstratified waters (Reid et al. 1999; Stevenson and Scott 2005). They feed primarily on euphausiids, chaetognaths, and copepods (Stevenson and Scott 2005). Designated EFH for Atlantic herring adults is in the upper 984 ft (300 m) of the water column, where temperatures span 39 to 45°F (4 to 7°C) in spring and 41 to 57°F (5 to 14°C) in summer and fall and salinities are within 27 to 35 ppt (Reid et al. 1999; Stevenson and Scott 2005).

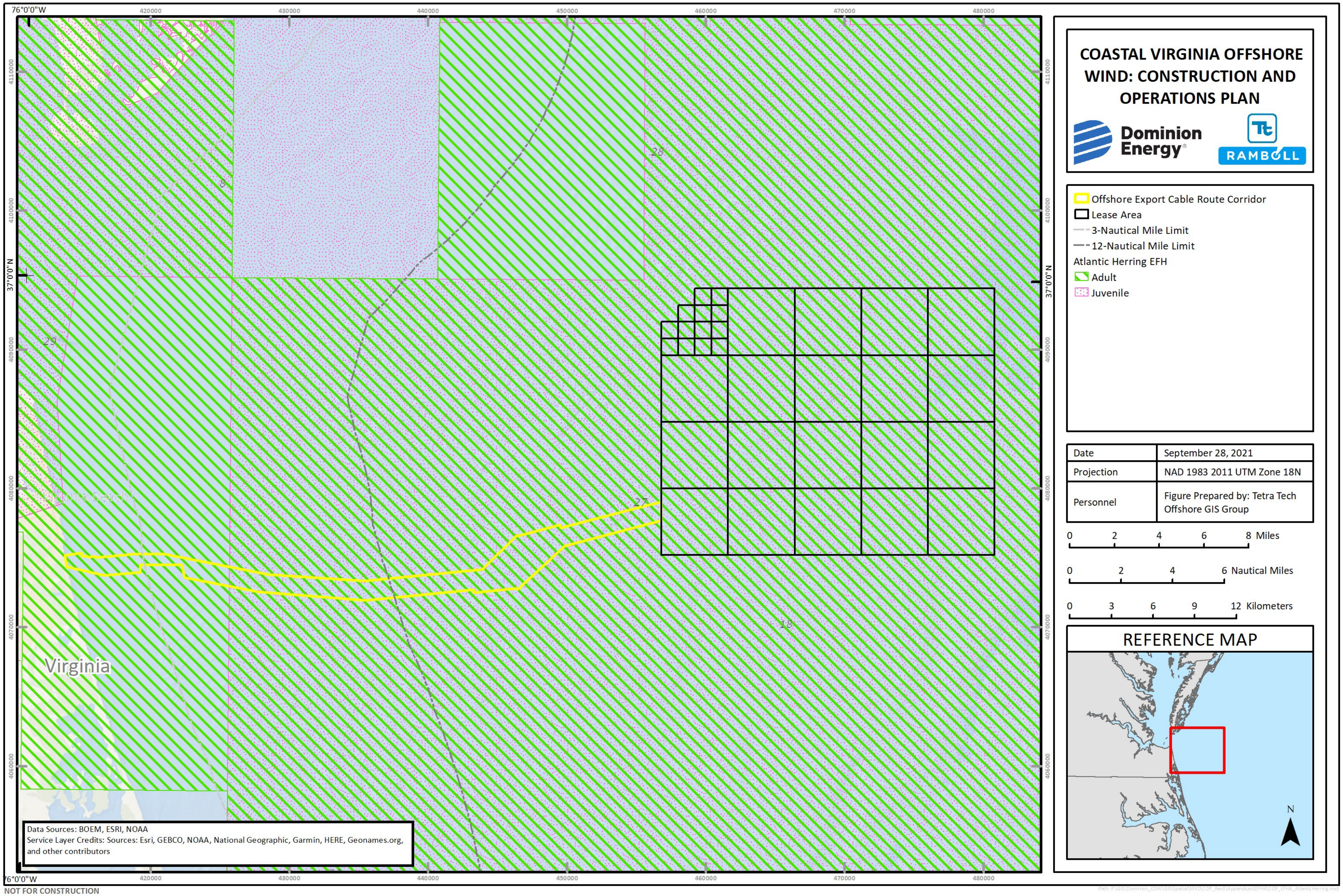

Figure E-1-3. **Atlantic Herring (*Clupea harengus*) Designated EFH in the Offshore Project Area**

The Atlantic herring is managed under the NEFMC Atlantic Herring FMP as a single stock: the Northwestern Atlantic Coast stock. The fishery stock is not currently overfished or subject to overfishing (NOAA Fisheries 2019).

E-1.2.3 Atlantic Sea Scallop (*Placopecten magellanicus*)

Atlantic sea scallop EFH for all life stages is designated in the Lease Area; there is no designated Atlantic sea scallop EFH in federal or state waters of the Offshore Export Cable Route Corridor (Table E-1-4; Figure E-1-4). They are suspension or filter feeders that feed primarily on phytoplankton, diatoms, microscopic animals, and detritus (Packer et al. 1999a). Feeding habits do not change markedly across life stages.

Table E-1-4. Atlantic Sea Scallop (*Placopecten magellanicus*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
ALL	46,601	0	0
Percent of Project Area Covered by EFH by Life Stage			
ALL	41.3%	0.0%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
ALL	0.140%	0.000%	0.000%

Sources: Packer et al. 1999a; NEFMC 2017

In the Mid-Atlantic Bight, Atlantic sea scallop eggs are found in inshore benthic marine habitats and on the continental shelf in the vicinity of adult scallops (NEFMC 2017). Eggs remain on the seafloor for four to five weeks prior to developing into the first free-swimming larval stage. Designated EFH for Atlantic sea scallop eggs is on the seafloor in temperatures spanning 55 to 63°F (13 to 17°C) (Packer et al. 1999a).

Atlantic sea scallop larvae are found in pelagic marine habitats in inshore and offshore areas during their two planktonic stages (trochophore and veliger stages) (NEFMC 2017). Planktonic larvae exhibit diel vertical migrations and are carried by currents for more than a month before demersal spat settle on hard surfaces including gravel, pebbles, shells, macroalgae, and other organisms such as hydroids (NEFMC 2017). Spat attached to hardbottom have higher survival rates than spat settled on shifting sand. Designated EFH for Atlantic sea scallop larvae is in the upper 33 ft (10 m) of the water column during planktonic stages and on the seafloor as spat, where temperatures span 54 to 64°F (12 to 18°C) and salinities are within 16.9 to 30 ppt (Packer et al. 1999a).

Atlantic sea scallop juveniles are found in benthic marine habitats attached by byssal threads to gravel, pebble, cobble, and shells (NEFMC 2017). Older juveniles lose their byssal attachments and become active swimmers but remain demersal; they prefer habitats with low concentrations of suspended inorganic material for feeding purposes (Packer et al. 1999a; NEFMC 2017). Designated EFH for Atlantic sea scallop juveniles is in depths of 59 to 361 ft (18 to 110 m), where temperatures span 34 to 59°F (1.2 to 15°C) and salinities exceed 25 ppt (Packer et al. 1999a; NEFMC 2017).

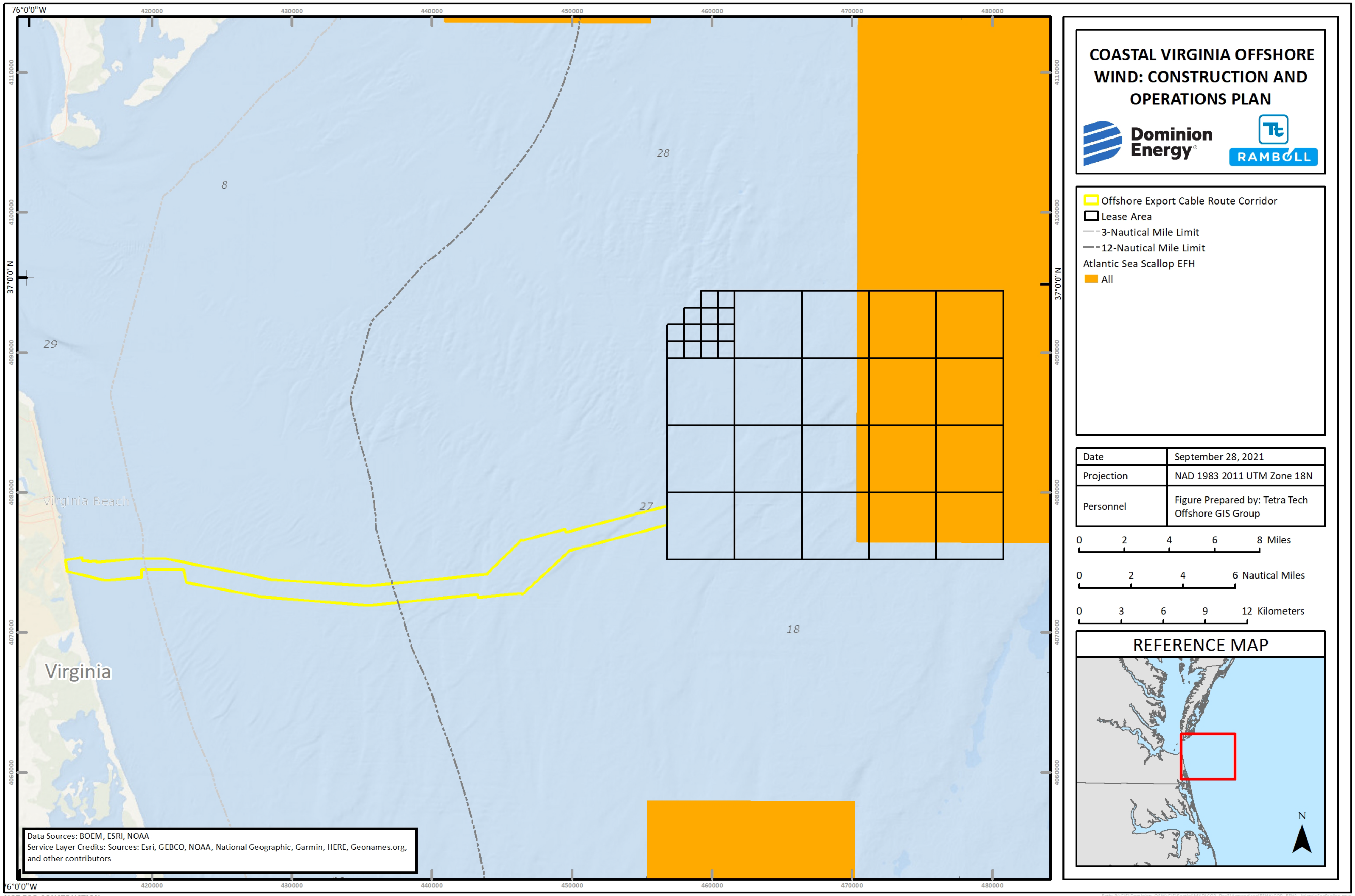

Figure E-1-4. Atlantic Sea Scallop (*Placopecten magellanicus*) Designated EFH in the Offshore Project Area

Atlantic sea scallop adults are found in benthic marine habitats on coarse sand and gravel substrates containing shell fragments, often aggregating in beds; oceanographic features may impact scallop bed duration by increasing larval retention or dispersion (NEFMC 2017). They prefer habitats with low concentrations of suspended inorganic material for feeding purposes (Packer et al. 1999a). Designated EFH for Atlantic sea scallop adults is in depths of 59 to 361 ft (18 to 110 m), where temperatures span 50 to 59°F (10 to 15°C) and salinities are within 32 to 33 ppt (Packer et al. 1999a; NEFMC 2017).

The Atlantic sea scallop is managed under the NEFMC Atlantic Sea Scallop FMP as a single stock: the Northwestern Atlantic Coast stock. The fishery stock is not currently overfished or subject to overfishing (NOAA Fisheries 2019).

E-1.2.4 Clearnose Skate (*Raja eglanteria*)

No clearnose skate egg EFH is designated in the Offshore Project Area; no larval stage exists for skates.

Clearnose skate juvenile EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-5; Figure E-1-5). In the Mid-Atlantic Bight, clearnose skate juveniles are found in subtidal benthic marine habitats in coastal and inner continental shelf waters and in the high salinity zones of regional bays and estuaries (NEFMC 2017). They prefer mud and sand but may also be found on gravel and hardbottom substrates (NEFMC 2017). Juveniles feed on polychaetes, amphipods, mantis and mysid shrimps, and a variety of small crabs, squids, and fishes (e.g., sole, weakfish, butterfish, scup) (Packer et al. 2003a). Designated EFH for clearnose skate juveniles is benthic habitats from the shoreline to depths of 984 ft (300 m) during spring and 262 ft (80 m) during fall, where temperatures span 39 to 70°F (4 to 21°C) in spring and 45 to 81°F (7 to 27°C) in fall and salinities are within 26 to 36 ppt (Packer et al. 2003a).

Table E-1-5. Clearnose Skate (*Raja eglanteria*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Juvenile	109,609	14,234	1,652
Adult	112,799	14,234	1,652
Percent of Project Area Covered by EFH by Life Stage			
Juvenile	97.2%	100.0%	100.0%
Adult	100.0%	100.0%	100.0%
Percent of Total Species EFH Area Covered by Project Area			
Juvenile	0.516%	0.067%	0.008%
Adult	0.682%	0.086%	0.010%

Sources: Packer et al. 2003a; NEFMC 2017

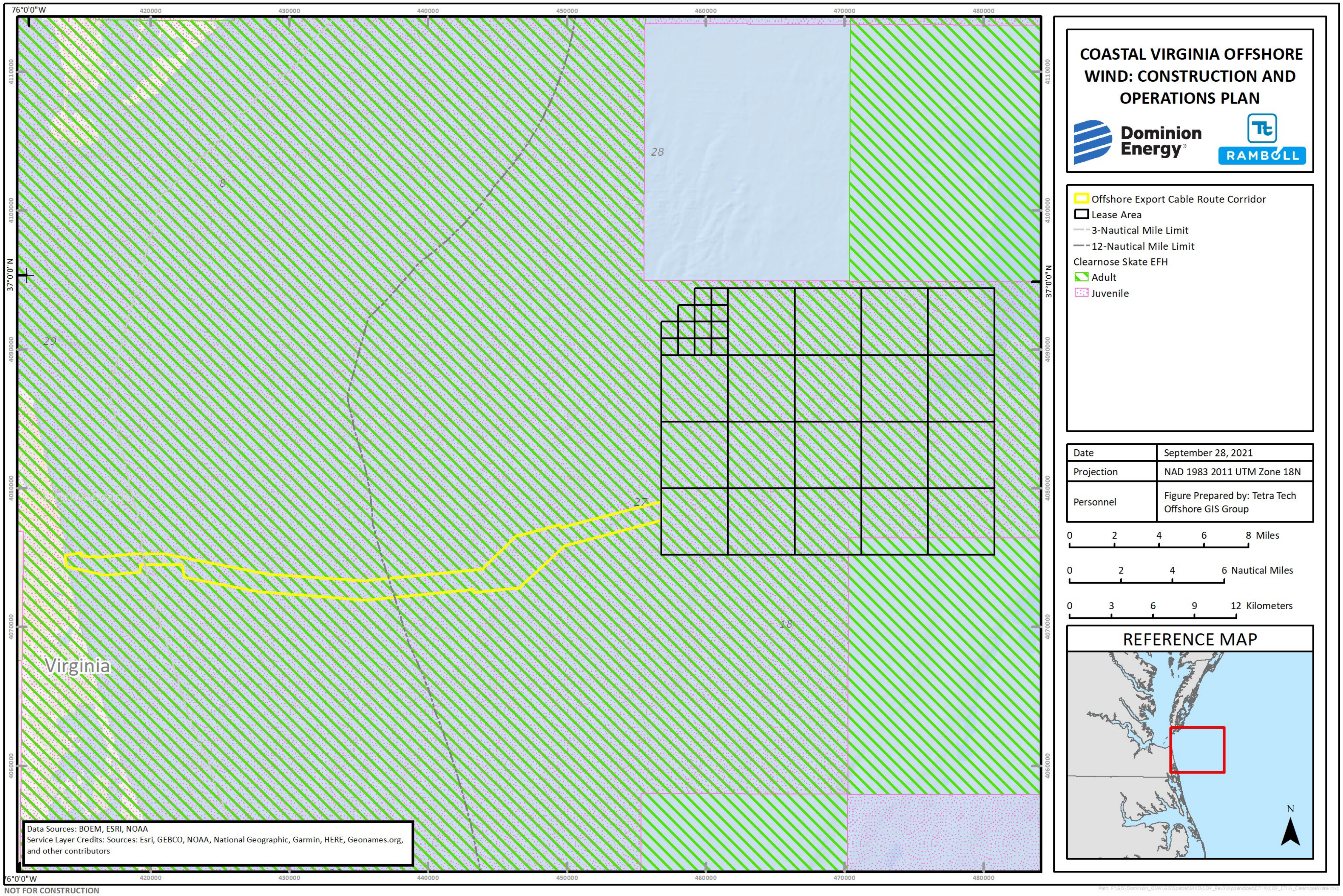

Figure E-1-5. **Clearnose Skate (*Raja eglanteria*) Designated EFH in the Offshore Project Area**

Clearnose skate adult EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-5; Figure E-1-5). Clearnose skate adults are found in subtidal benthic marine habitats in coastal and inner continental shelf waters and in the high salinity zones of regional bays and estuaries (NEFMC 2017). They prefer mud and sand but may also be found on gravel and hardbottom substrates (NEFMC 2017). Adults consume the same prey as juveniles. Designated EFH for clearnose skate adults is in benthic habitats from the shoreline to depths of 984 ft (300 m) during spring and 164 ft (50 m) during fall, where temperatures span 39 to 72°F (4 to 22°C) in spring and 50 to 77°F (10 to 25°C) in fall and salinities are within 26 to 36 ppt (Packer et al. 2003a).

The clearnose skate is managed under the NEFMC Northeast Skate Complex FMP as a single stock: the Southern New England/Mid-Atlantic stock. The fishery stock is not currently overfished or subject to overfishing (NOAA Fisheries 2019).

E-1.2.5 Monkfish (*Lophius americanus*)

Monkfish egg EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-6; Figure E-1-6). In the Mid-Atlantic Bight, monkfish eggs are shed in large, buoyant mucoidal egg veils that float on or near the surface in pelagic marine habitats of inshore areas and on the continental shelf and slope (NEFMC 2017). Designated EFH for monkfish eggs spans March to September from the surface to depths of 3,280 ft (1,000 m), where temperatures span 39 to 64°F (4 to 18°C) (Steimle et al. 1999a; MAFMC 2017; NEFMC 2017).

Table E-1-6. Monkfish (*Lophius americanus*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Egg/Larva	54,001	13,770	1,652
Juvenile	50,823	0	0
Adult	0	1,656	1,652
Percent of Project Area Covered by EFH by Life Stage			
Egg/Larva	47.9%	96.7%	100.0%
Juvenile	45.1%	0.0%	0.0%
Adult	0.0%	11.7%	100.0%
Percent of Total Species EFH Area Covered by Project Area			
Egg/Larva	0.100%	0.026%	0.003%
Juvenile	0.164%	0.000%	0.000%
Adult	0.000%	0.005%	0.005%

Sources: Steimle et al. 1999a; MAFMC 2017; NEFMC 2017

Monkfish larva EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-6; Figure E-1-6). Monkfish larvae are found in pelagic marine habitats in inshore areas and on the continental shelf and slope (NEFMC 2017). As with eggs, larvae occur over a wide depth range up to a maximum depth of 4,921 ft (1,500 m) (NEFMC 2017). They feed on zooplankton, including copepods, crustacean larvae, and chaetognaths (Steimle et al. 1999a). Designated EFH for monkfish larvae spans March to September from the surface to depths of 3,280 ft (1,000 m), where temperatures span 43 to 68°F (6 to 20°C) (Steimle et al. 1999a; MAFMC 2017; NEFMC 2017).

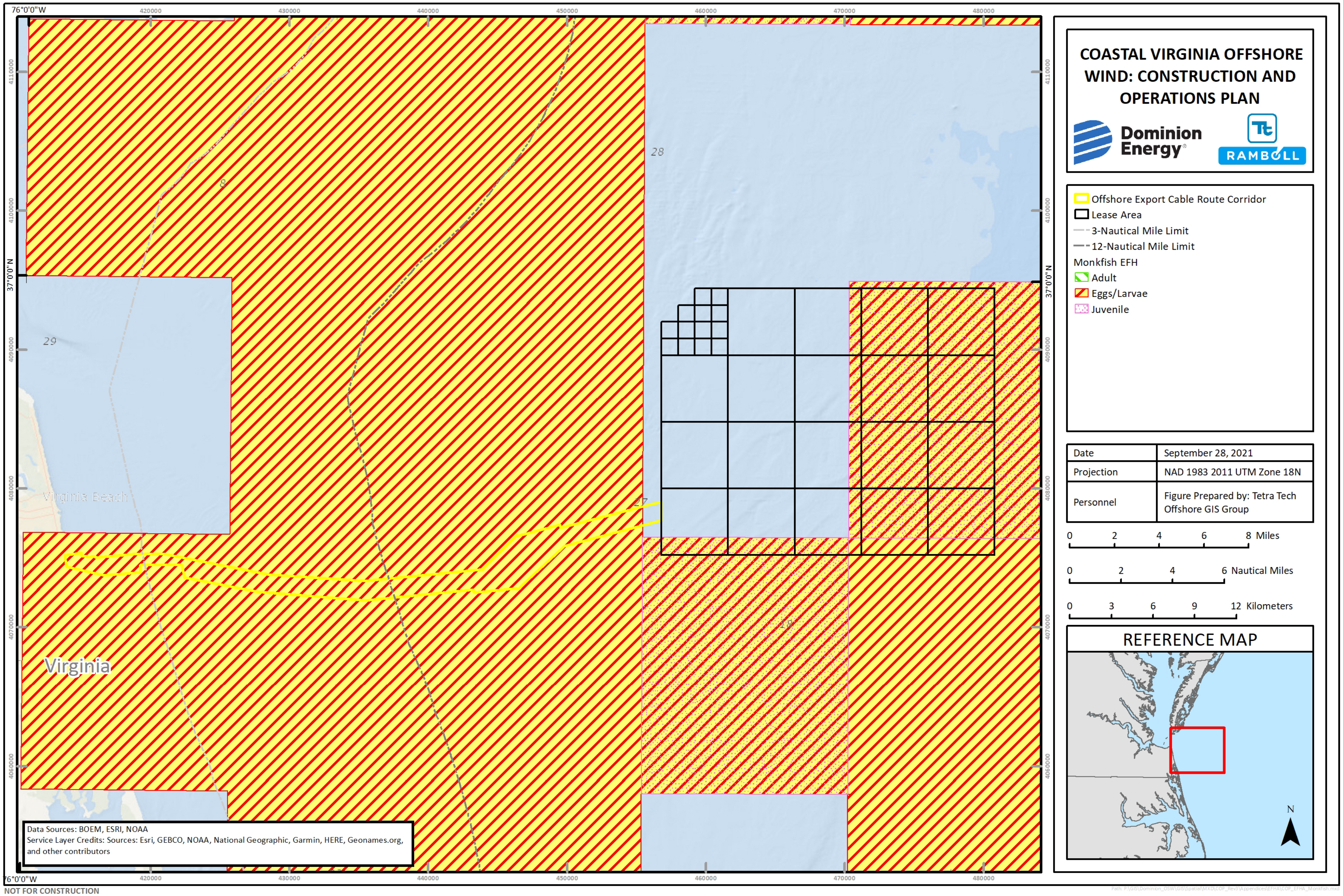

Figure E-1-6. **Monkfish (*Lophius americanus*) Designated EFH in the Offshore Project Area**

Monkfish juvenile EFH is designated in the Lease Area (Table E-1-6; Figure E-1-6). Monkfish juveniles are found in subtidal benthic marine habitats over a range of substrates, including soft mud, sand, gravel, pebbles, shell fragments, and structurally complex rock outcroppings with attached macroalgae (NEFMC 2017). They exhibit seasonal inshore-offshore migrations but most commonly occur on the outer shelf down to a maximum depth of 3,280 ft (1,000 m) (Steimle et al. 1999a; NEFMC 2017). Juveniles feed on small fishes (e.g., sand lance), red shrimp, and squid (Steimle et al. 1999a). Designated EFH for monkfish juveniles is in benthic habitats in depths of 66 to 1,312 ft (20 to 400 m), where temperatures span 36 to 75°F (2 to 24°C) and salinities are within 30 to 36 ppt (Steimle et al. 1999a).

Monkfish adult EFH is designated in both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-6; Figure E-1-6). Monkfish adults are found in subtidal benthic marine habitats over a range of substrates, including soft mud, sand, gravel, pebbles, and shell fragments (NEFMC 2017). They prefer soft sediments, forage at the edges of structurally complex rock outcroppings, and most commonly occur on the outer shelf down to a maximum depth of 3,280 ft (1,000 m) (NEFMC 2017). Adults are opportunistic feeders and consume a variety of benthic and pelagic crustaceans, squid, and fishes (Steimle et al. 1999a). Designated EFH for monkfish adults is in benthic habitats from the shoreline to depths of 2,625 ft (800 m), where temperatures span 32 to 75°F (0 to 24°C) and salinities are within 30 to 36 ppt (Steimle et al. 1999a).

The monkfish is co-managed by the NEFMC and MAFMC under the Monkfish FMP as two separate stocks: the Gulf of Maine/Northern Georges Bank stock and the Southern Georges Bank/Mid-Atlantic stock. Neither stock is currently overfished or subject to overfishing (NOAA Fisheries 2019).

E-1.2.6 Pollock (*Pollachius virens*)

No pollock egg, juvenile, or adult EFH is designated in the Offshore Project Area.

Pollock larva EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-7; Figure E-1-7). In the Mid-Atlantic Bight, pollock larvae are found in pelagic inshore and offshore marine habitats and in the high salinity zones of regional bays and estuaries (NEFMC 2017). The planktonic larval stage lasts approximately three to four months, during which time they are dispersed from spawning grounds by currents; youngest larvae are found nearest the surface (Cargnelli et al. 1999a). Young larvae feed primarily on larval copepods and shift their diets to adult copepods as they increase in size (Cargnelli et al. 1999a). Large larvae metamorphose into harbor pollock and migrate inshore to rocky subtidal and intertidal zones (Cargnelli et al. 1999a). Designated EFH for pollock larvae is in depths of 33 to 4,101 ft (10 to 1,250 m), where temperatures span 36 to 63°F (2 to 17°C) (Cargnelli et al. 1999a).

Table E-1-7. Pollock (*Pollachius virens*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Larva	7,387	5,032	0
Percent of Project Area Covered by EFH by Life Stage			
Larva	6.5%	35.4%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Larva	0.038%	0.026%	0.000%

Sources: Cargnelli et al. 1999a; NEFMC 2017

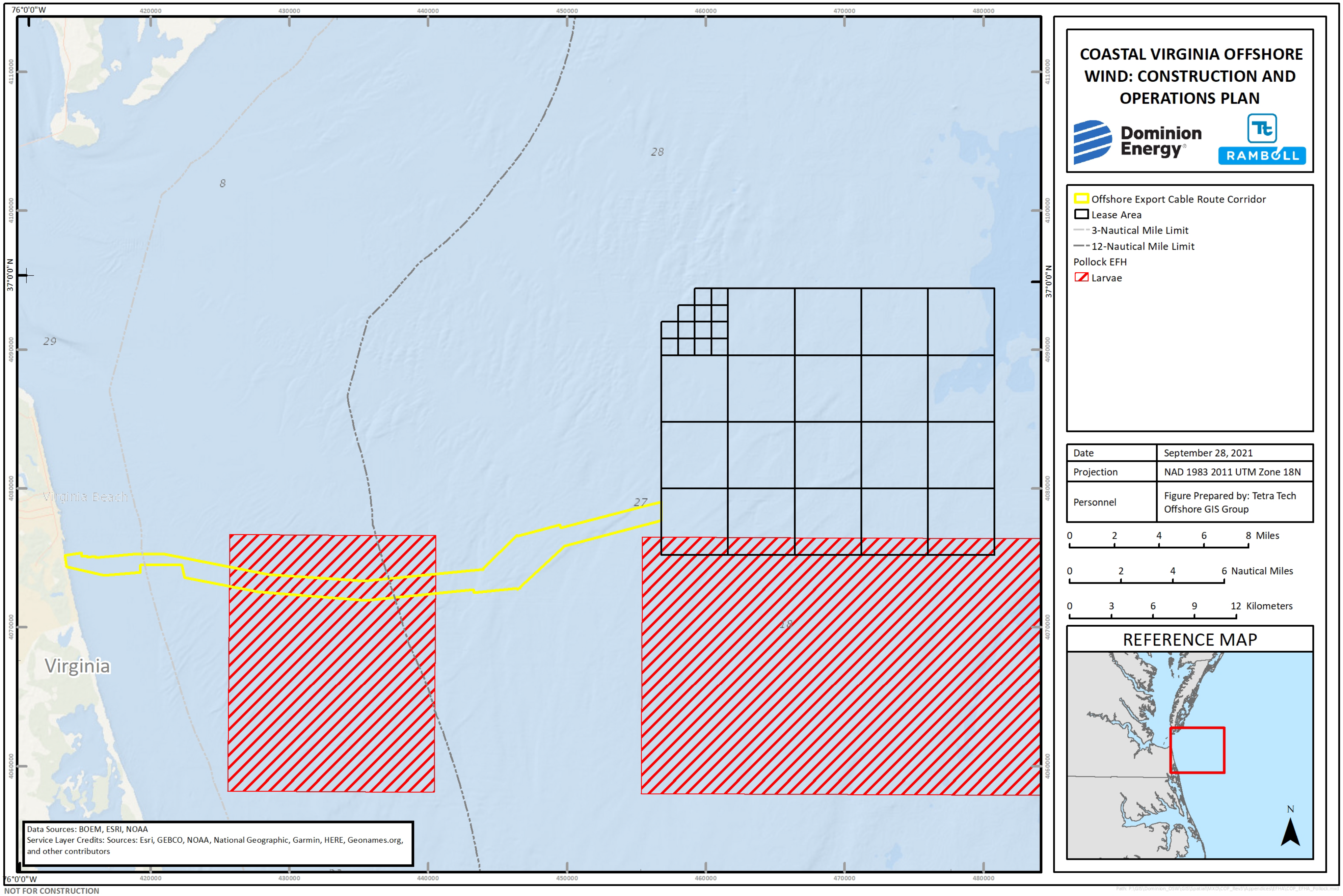

Figure E-1-7. Pollock (*Pollachius virens*) Designated EFH in the Offshore Project Area

The pollock is managed under the NEFMC Northeast Multispecies FMP as a single stock: the Gulf of Maine/Georges Bank stock. The fishery stock is not currently overfished or subject to overfishing (NOAA Fisheries 2019).

E-1.2.7 Red Hake (*Urophycis chuss*)

No red hake egg, larva, or juvenile EFH is designated in the Offshore Project Area.

Red hake adult EFH is designated in the Lease Area (Table E-1-8; Figure E-1-8). In the Mid-Atlantic Bight, red hake adults are found in benthic marine habitats on the outer continental shelf and slope and in high salinity zones of regional bays and estuaries (NEFMC 2017). Adults prefer depressions of soft mud and sand substrates, shell beds, and complex reef structure (NEFMC 2017). They exhibit seasonal migrations, preferring inshore waters in spring and fall and offshore waters in summer and winter. Adults feed on crustaceans and a variety of demersal and pelagic fishes and squids (Steimle et al. 1999b). Designated EFH for red hake adults is benthic habitat in depths of 16 to 2,461 ft (5 to 750 m), where temperatures span 36 to 72°F (2 to 22°C) and salinities exceed 20 ppt (Steimle et al. 1999b).

Table E-1-8. Red Hake (*Urophycis chuss*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Adult	7,504	0	0
Percent of Project Area Covered by EFH by Life Stage			
Adult	6.7%	0.0%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Adult	0.013%	0.000%	0.000%

Sources: Steimle et al. 1999b; NEFMC 2017

The red hake is managed under the NEFMC Northeast Multispecies FMP as a single stock: the Southern Georges Bank/Mid-Atlantic stock. The fishery stock is currently overfished and subject to overfishing (NOAA Fisheries 2019).

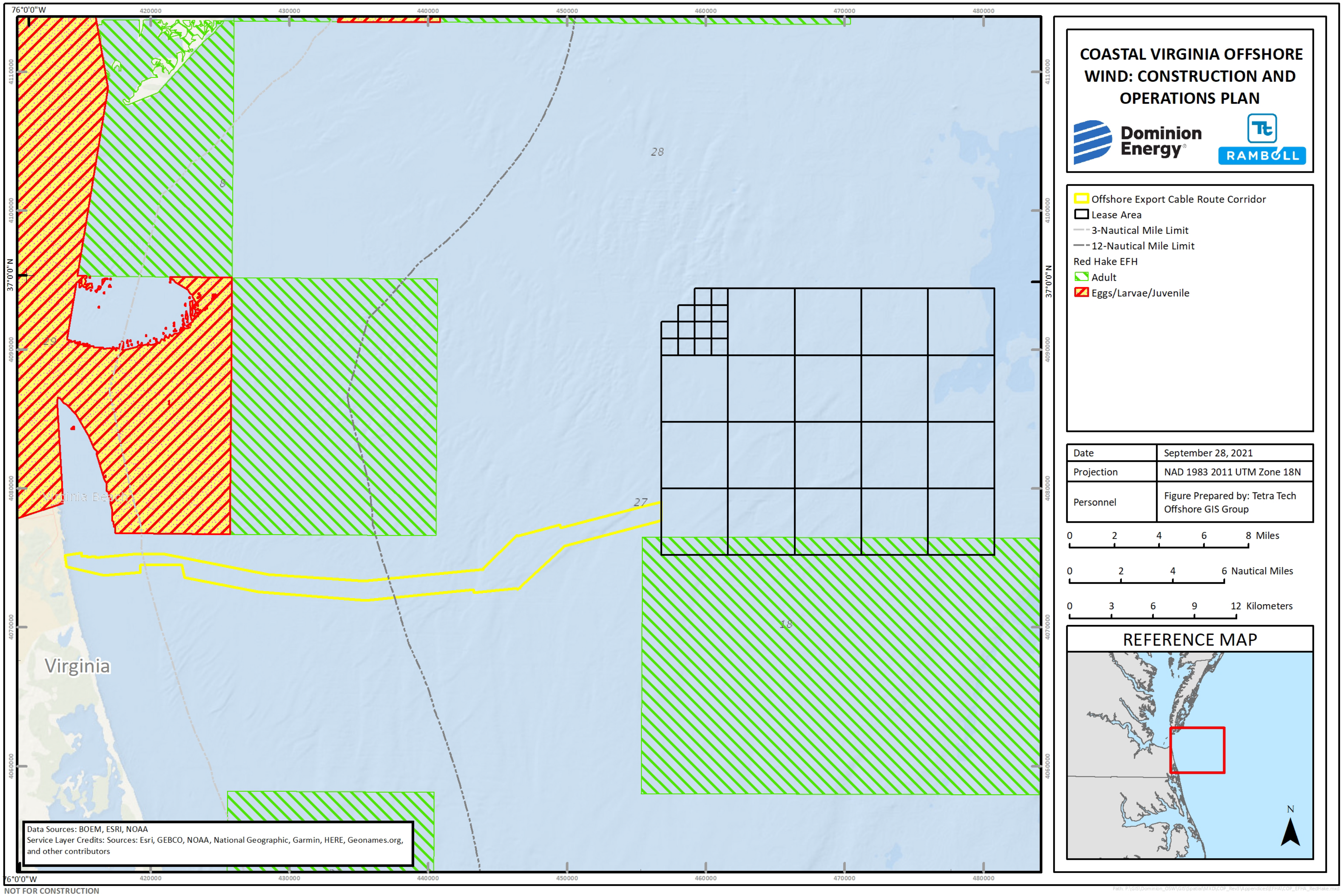

Figure E-1-8. Red Hake (*Urophycis chuss*) Designated EFH in the Offshore Project Area

E-1.2.8 Windowpane Flounder (*Scophthalmus aquosus*)

Windowpane flounder egg EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-9; Figure E-1-9). In the Mid-Atlantic Bight, windowpane flounder eggs are found in pelagic marine habitats and in mixed and high salinity zones of regional bays and estuaries (NEFMC 2017). Designated EFH for windowpane flounder eggs is pelagic habitat in the upper 230 ft (70 m) of the water column, where temperatures span 43 to 57°F (6 to 14°C) in spring, 50 to 61°F (10 to 16°C) in summer, and 57 to 68°F (14 to 20°C) in fall (Chang et al. 1999).

Table E-1-9. Windowpane flounder (*Scophthalmus aquosus*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Egg	50,823	13,770	1,652
Larva	109,623	7,565	0
Juvenile	108,587	14,234	1,652
Adult	111,403	12,575	0
Percent of Project Area Covered by EFH by Life Stage			
Egg	45.1%	97.7%	100.0%
Larva	97.2%	53.1%	0.0%
Juvenile	96.3%	100.0%	100.0%
Adult	98.8%	88.3%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Egg	0.234%	0.063%	0.008%
Larva	0.473%	0.033%	0.000%
Juvenile	0.276%	0.036%	0.004%
Adult	0.297%	0.034%	0.000%

Sources: Chang et al. 1999; NEFMC 2017

Windowpane flounder larva EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-9; Figure E-1-9). Windowpane flounder larvae are found in pelagic marine habitats and in mixed and high salinity zones of regional bays and estuaries; they consume planktonic prey (NEFMC 2017). Larvae descend to the seafloor upon reaching 0.4 inches (10 millimeters) in length; spring-spawned larvae settle in estuaries and on the shelf, while autumn-spawned larvae primarily settle on the shelf (Chang et al. 1999). Designated EFH for windowpane flounder larvae is pelagic habitat in the upper 230 ft (70 m) of the water column, where temperatures span 37 to 57°F (3 to 14°C) in spring, 50 to 63°F (10 to 17°C) in summer, and 55 to 66°F (13 to 19°C) in fall (Chang et al. 1999).

Windowpane flounder juvenile EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-9; Figure E-1-9). Windowpane flounder juveniles are found in intertidal and subtidal benthic habitats in estuarine, coastal marine, and continental shelf waters, including mixed and high salinity zones in regional bays and estuaries (NEFMC 2017). YOY prefer sand substrates, while older juveniles occur on both mud and sand substrates (NEFMC 2017). They feed on small crustaceans (e.g., mysid and decapod shrimps) and fish larvae (e.g., hakes, cod, and other windowpane flounders) (Chang et al. 1999). Designated EFH for windowpane flounder juveniles is benthic habitat in nearshore bays and estuaries from the shoreline to depths of 246 ft (75 m), where temperatures span 32 to 75°F (0 to 24°C) and salinities are within 15 to 33 ppt (Chang et al. 1999).

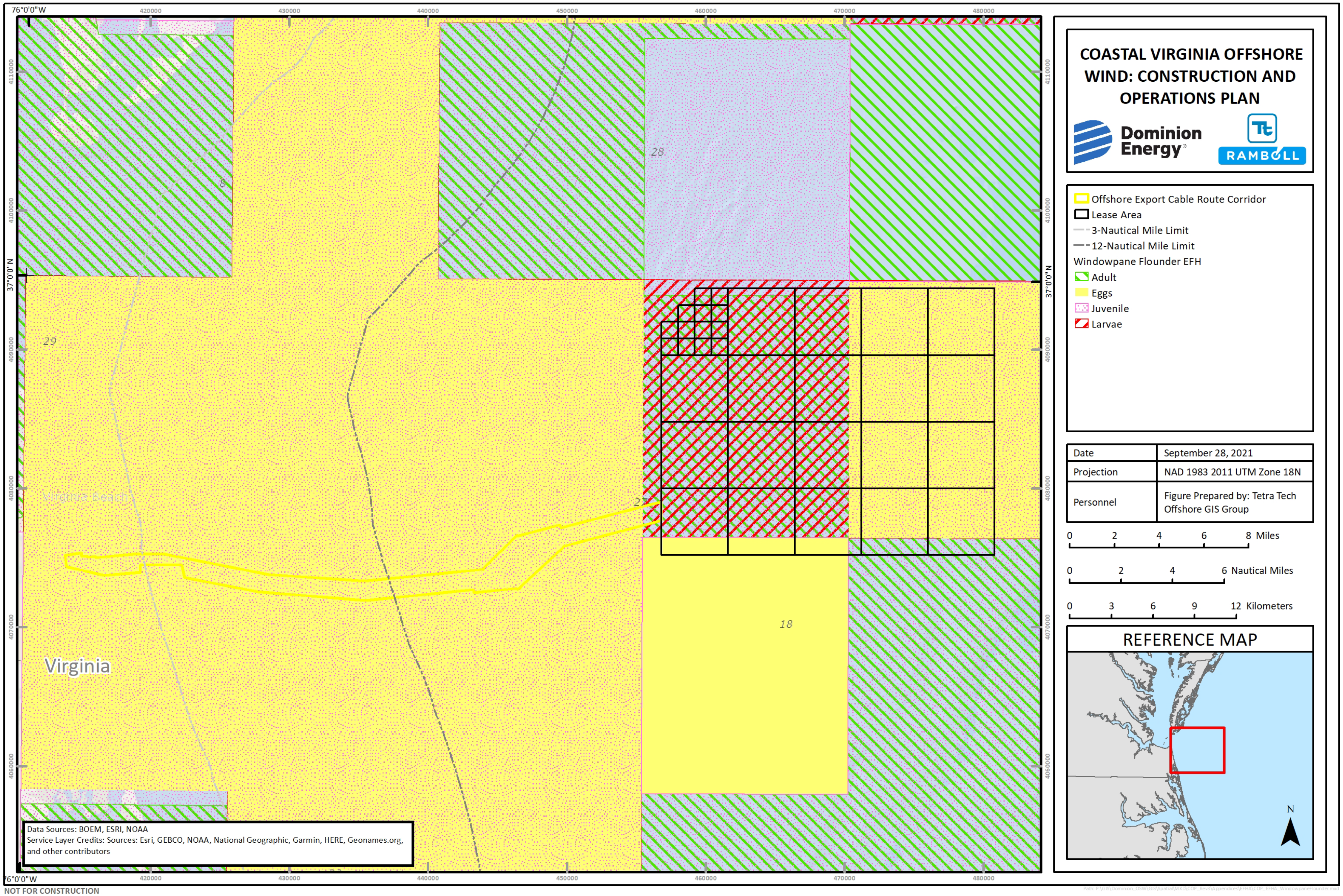

Figure E-1-9. **Windowpane flounder (*Scophthalmus aquosus*) Designated EFH in the Offshore Project Area**

Windowpane flounder adult EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-9; Figure E-1-9). Windowpane flounder adults are found in intertidal and subtidal benthic habitats in estuarine, coastal marine, and continental shelf waters, including mixed and high salinity zones in regional bays and estuaries (NEFMC 2017). Adults prefer mud and sand substrates (NEFMC 2017). They consume the same prey as juveniles. Designated EFH for windowpane flounder adults is benthic habitat in nearshore bays and estuaries from the shoreline to depths of 246 ft (75 m), where temperatures span 32 to 75°F (0 to 24°C) and salinities are within 15 to 33 ppt (Chang et al. 1999).

The windowpane flounder is managed under the NEFMC Northeast Multispecies FMP as two separate stocks: the Gulf of Maine/Georges Bank stock and the Southern New England/Mid-Atlantic stock. While the Southern New England/Mid-Atlantic stock is not overfished, the Gulf of Maine/Georges Bank stock is currently overfished; neither stock is subject to overfishing (NOAA Fisheries 2019).

E-1.2.9 Winter Skate (*Leucoraja ocellata*)

No winter skate egg or adult EFH is designated in the Offshore Project Area; there is no larval stage for skates.

Winter skate juvenile EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-10; Figure E-1-10). In the Mid-Atlantic Bight, winter skate juveniles are found in subtidal benthic marine habitats on the continental shelf and in the high salinity zones of regional bays and estuaries (NEFMC 2017). Juveniles reside in sediment depressions during the day (primarily on sand and gravel substrates, but occasionally on mud substrates) and are more active at night (Packer et al. 2003b; NEFMC 2017). They feed on polychaetes, amphipods, decapods, isopods, bivalves, and fishes (Packer et al. 2003b). Designated EFH for winter skate juveniles is benthic habitat from the shoreline to 1,217 ft (371 m), where temperatures span 30 to 66°F (-1.2 to 19°C) and salinities are within 28 to 35 ppt (Packer et al. 2003b).

Table E-1-10. Winter Skate (*Leucoraja ocellata*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Juvenile	46,611	2,068	0
Percent of Project Area Covered by EFH by Life Stage			
Juvenile	41.3%	14.5%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Juvenile	0.140%	0.006%	0.000%

Sources: Packer et al. 2003b; NEFMC 2017

The winter skate is managed under the NEFMC Northeast Skate Complex as a single stock: the Georges Bank/Southern New England stock. The fishery stock is not currently overfished or subject to overfishing (NOAA Fisheries 2019).

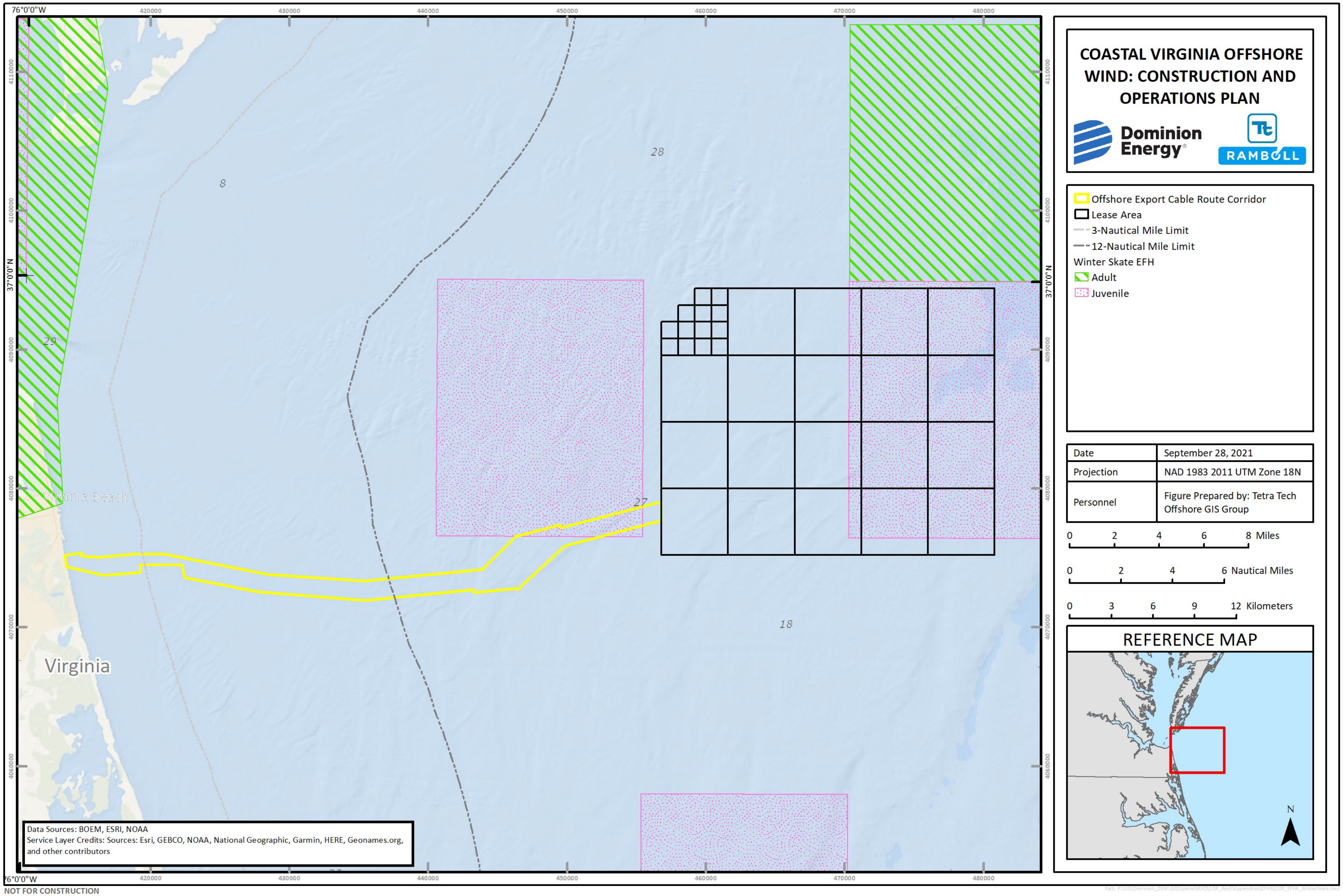

Figure E-1-10. Winter Skate (*Leucoraja ocellata*) Designated EFH in the Offshore Project Area

E-1.2.10 Witch Flounder (*Glyptocephalus cynoglossus*)

Witch flounder egg EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-11; Figure E-1-11). In the Mid-Atlantic Bight, witch flounder eggs are found in pelagic marine habitats on the continental shelf (NEFMC 2017). They are buoyant and often occur near the surface above deep waters but have been found at depths of 16,404 ft (5,000 m). Designated EFH for witch flounder eggs spans March to October in depths of 33 to 558 ft (10 to 170 m), where temperatures range from 39 to 63°F (4 to 17°C) and salinities are high (Cargnelli et al. 1999b).

Table E-1-11. Witch Flounder (*Glyptocephalus cynoglossus*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Egg	50,823	8,759	1,652
Larva	105,324	464	0
Percent of Project Area Covered by EFH by Life Stage			
Egg	45.1%	61.5%	100.0%
Larva	93.4%	3.3%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Egg	0.369%	0.064%	0.012%
Larva	0.617%	0.003%	0.000%

Sources: Cargnelli et al. 1999b; NEFMC 2017

Witch flounder larva EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-11; Figure E-1-11). Witch flounder larvae are found in pelagic marine habitats on the continental shelf; they feed on planktonic prey (NEFMC 2017). Larvae undergo extended planktonic stages from four months to one year, during which time smaller larvae are found near the surface and sink to lower depths as they increase in size (Cargnelli et al. 1999b). Designated EFH for witch flounder larvae is in the upper 820 ft (250 m) of the water column, where temperatures span 39 to 61°F (4 to 16°C) and salinities are high (Cargnelli et al. 1999b).

No witch flounder juvenile or adult EFH is designated in the Offshore Project Area.

The witch flounder is managed by the NEFMC Northeast Multispecies FMP as a single stock: the Northwestern Atlantic Coast stock. The fishery stock is overfished but is not currently subject to overfishing (NOAA Fisheries 2019).

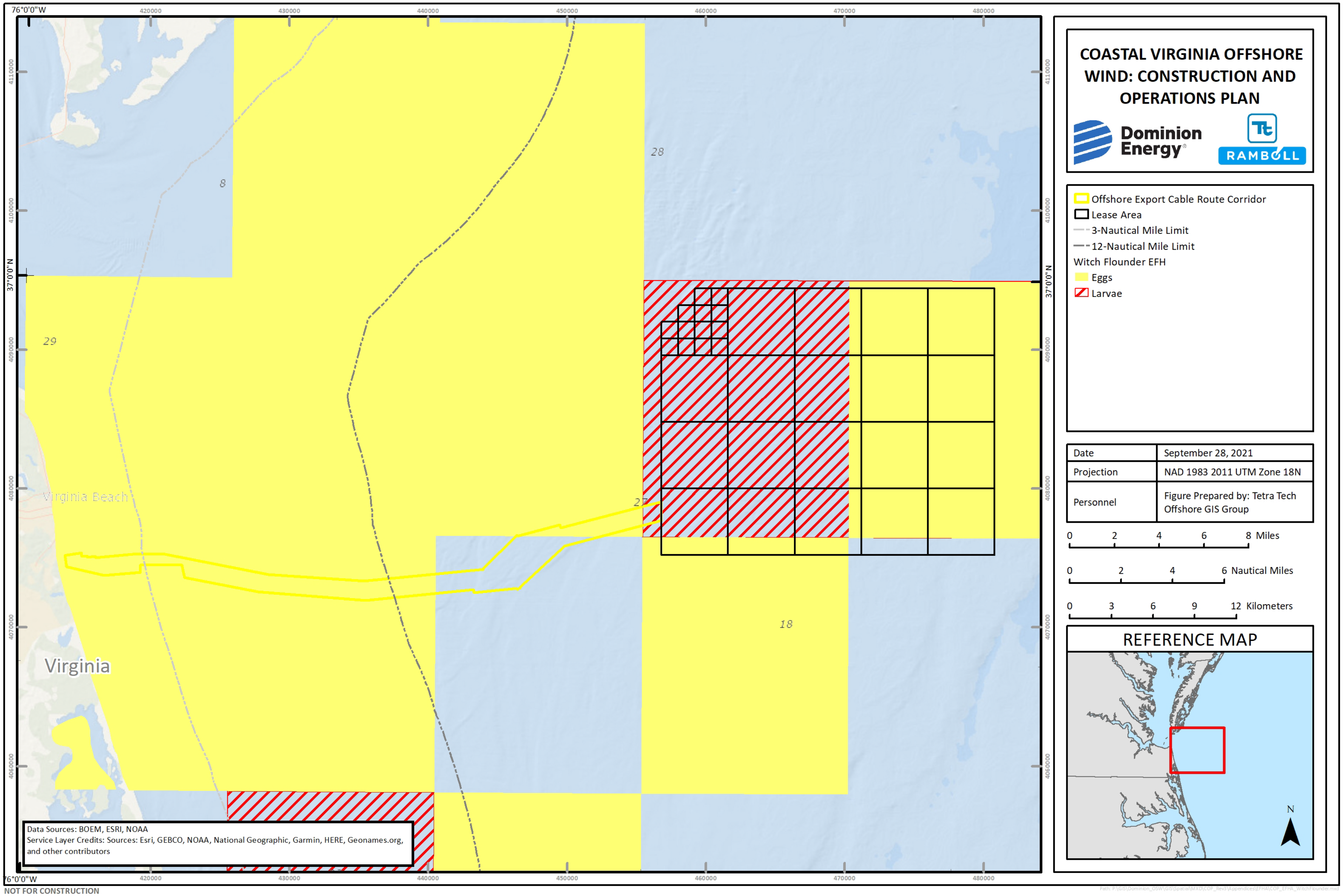

Figure E-1-11. **Witch Flounder (*Glyptocephalus cynoglossus*) Designated EFH in the Offshore Project Area**

E-1.2.11 Yellowtail Flounder (*Limanda ferruginea*)

No yellowtail flounder egg, juvenile, or adult EFH is designated in the Offshore Project Area.

Yellowtail flounder larva EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-12; Figure E-1-12). In the Mid-Atlantic Bight, yellowtail flounder larvae are found in coastal and continental shelf pelagic marine habitats and in the high salinity zones of regional bays and estuaries; they feed on planktonic prey (NEFMC 2017). Larvae complete diel migrations and exhibit a vertical abundance peak at 33 ft (10 m) at night and 66 ft (20 m) during daytime (Johnson et al. 1999). They are planktonic until they reach approximately 0.5 to 0.7 inches (12 to 16 millimeters) in length, at which point they descend to the seafloor and metamorphose into juveniles (Johnson et al. 1999). Designated EFH for yellowtail flounder larvae is in depths of 33 to 2,460 ft (10 to 1,250 m), where temperatures span 41 to 63°F (5 to 17°C) and salinities are within 32 to 34 ppt (Johnson et al. 1999).

Table E-1-12. Yellowtail Flounder (*Limanda ferruginea*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Larva	4,211	2,068	0
Percent of Project Area Covered by EFH by Life Stage			
Larva	3.7%	14.5%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Larva	0.022%	0.011%	0.000%

Sources: Johnson et al. 1999; NEFMC 2017

The yellowtail flounder is managed under the NEFMC Northeast Multispecies FMP as two separate stocks: the Cape Cod/Gulf of Maine stock and the Southern New England/Mid-Atlantic stock. The Southern New England/Mid-Atlantic stock is overfished, and the Cape Cod/Gulf of Maine stock is rebuilding; neither stock is currently subject to overfishing (NOAA Fisheries 2019).

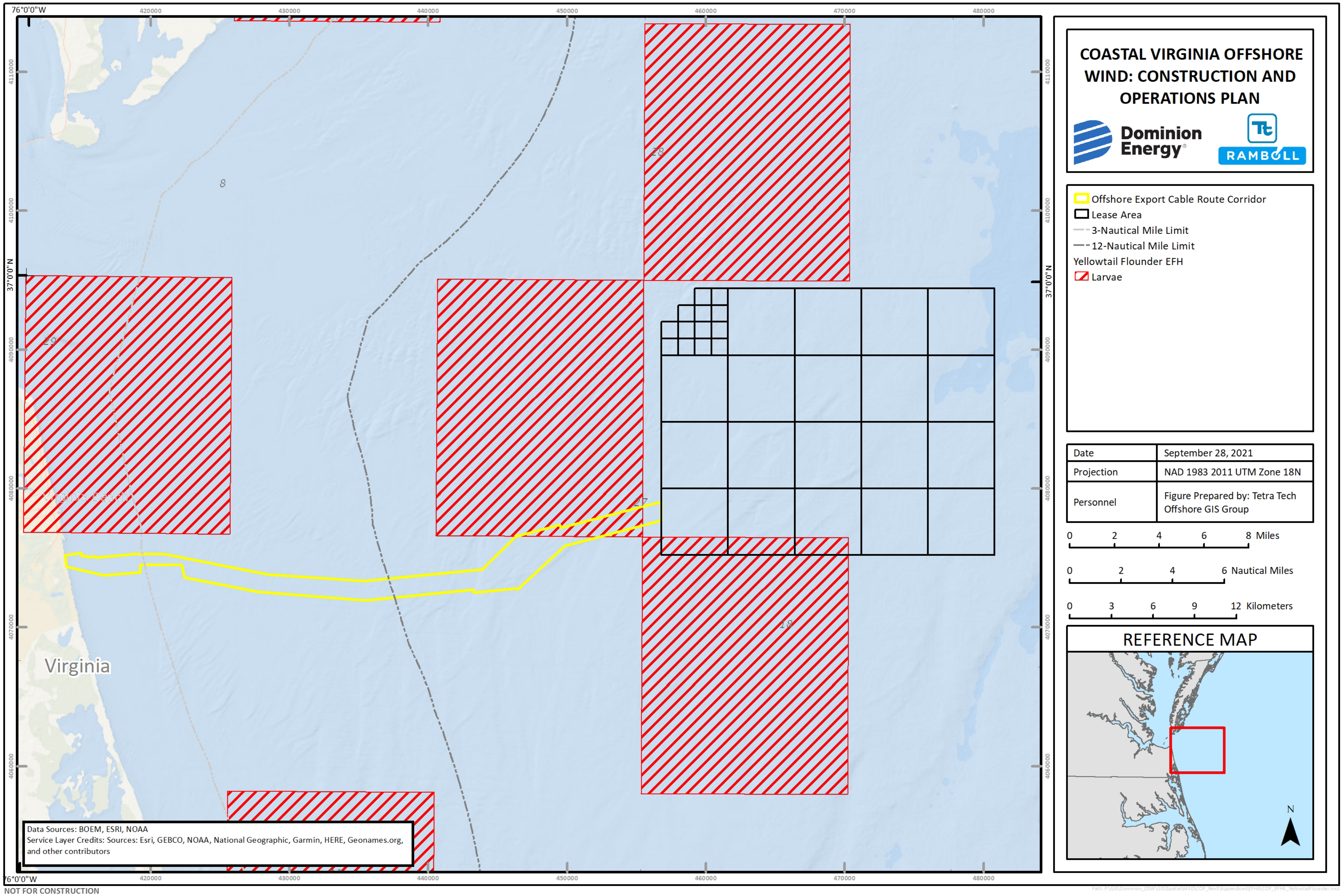

Figure E-1-12. **Yellowtail Flounder (*Limanda ferruginea*) Designated EFH in the Offshore Project Area**

E-1.2.12 Atlantic Butterfish (*Peprilus triacanthus*)

Atlantic butterfish egg EFH is designated in federal waters of the Offshore Export Cable Route Corridor (Table E-1-13; Figure E-1-13). In the Mid-Atlantic Bight, Atlantic butterfish eggs are found in pelagic marine habitats on the continental shelf and slope and in the high salinity zones of inshore estuaries and embayments (MAFMC 2011). Designated EFH for Atlantic butterfish eggs is in the upper 656 ft (200 m) of the water column over depths of 4,921 ft (1,500 m), where temperatures span 43 to 79°F (6 to 26°C) and salinities are within 25 to 33 ppt (Cross et al. 1999; MAFMC 2011).

Table E-1-13. Atlantic Butterfish (*Peprilus triacanthus*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Egg	0	2,066	0
Larva	49,785	0	0
Juvenile	109,618	14,234	1,646
Adult	4,216	6,691	1,646
Percent of Project Area Covered by EFH by Life Stage			
Egg	0.0%	14.5%	0.0%
Larva	44.1%	0.0%	0.0%
Juvenile	97.2%	100.0%	99.6%
Adult	3.7%	47.0%	99.6%
Percent of Total Species EFH Area Covered by Project Area			
Egg	0.000%	0.011%	0.000%
Larva	0.213%	0.000%	0.000%
Juvenile	0.278%	0.036%	0.004%
Adult	0.010%	0.015%	0.004%

Sources: Cross et al. 1999; MAFMC 2011

Atlantic butterfish larva EFH is designated in the Lease Area (Table E-1-13; Figure E-1-13). Atlantic butterfish larvae are found in pelagic marine habitats on the continental shelf and in the high salinity zones of inshore estuaries and embayments; they feed on planktonic prey (MAFMC 2011). Larvae exhibit diel migrations, occurring in deeper waters during day and migrating to surface waters at night (Cross et al. 1999). Designated EFH for Atlantic butterfish larvae is in the upper 656 ft (200 m) of the water column over depths of 5,741 ft (1,750 m), where temperatures span 45 to 79°F (7 to 26°C) and salinities are within 6 to 38 ppt (Cross et al. 1999; MAFMC 2011).

Atlantic butterfish juvenile EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-13; Figure E-1-13). Atlantic butterfish juveniles are found in pelagic marine habitats in the inner and outer continental shelf and in the high salinity zones of inshore estuaries and embayments (MAFMC 2011). They are common in inshore areas, including the surf zone, and larger individuals are found over sandy and muddy substrates (Cross et al. 1999). Juveniles tolerate a wide range of temperatures and salinities. They feed primarily on pelagic prey including thaliaceans, mollusks, crustaceans, coelenterates, polychaetes, small fishes, and ctenophores (Cross et al. 1999). Designated EFH for Atlantic butterfish juveniles is in depths of 33 to 1,083 ft (10 to 330 m), where temperatures span 45 to 86°F (7 to 30°C) and salinities are within 3 to 37 ppt (Cross et al. 1999; MAFMC 2011).

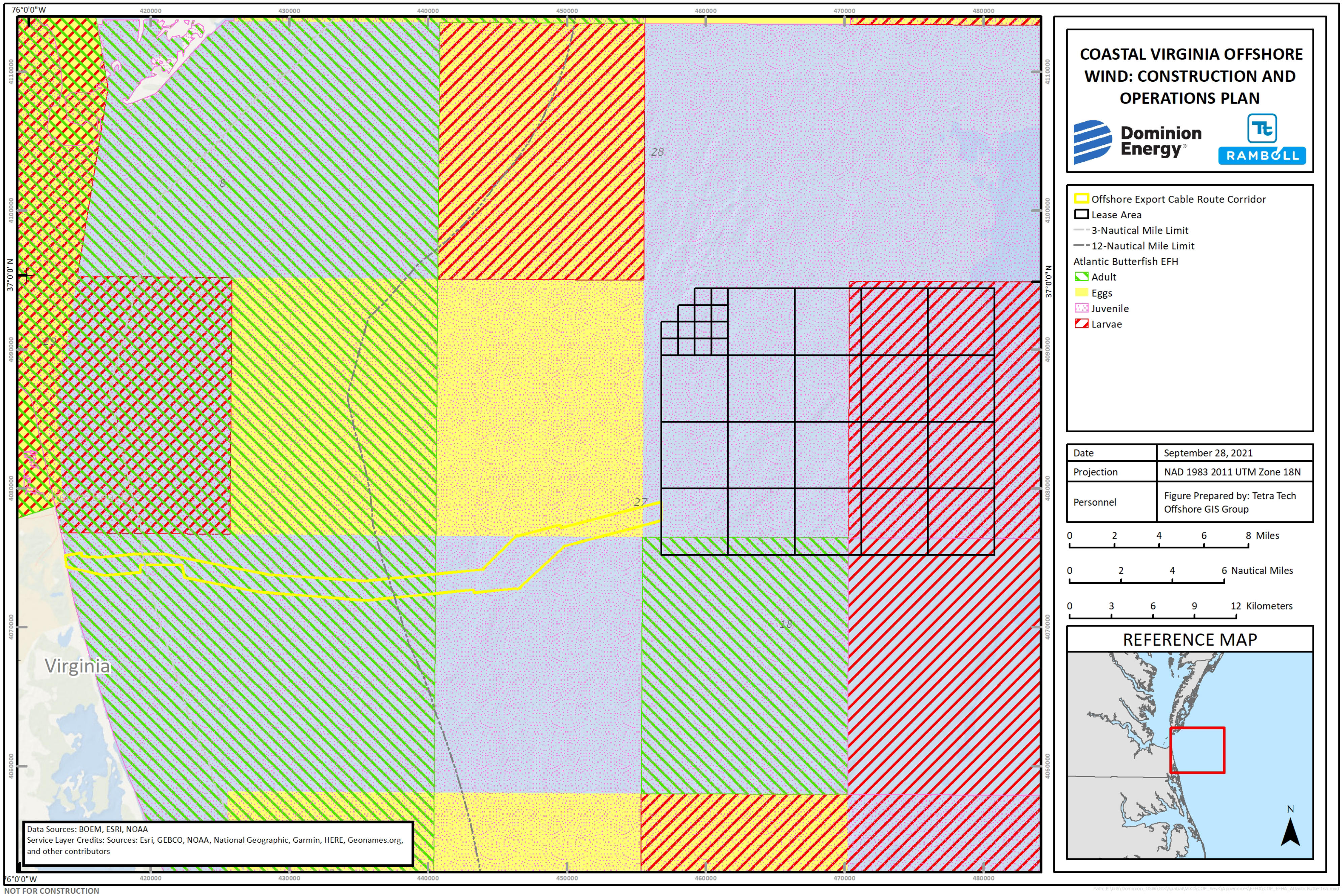

Figure E-1-13. Atlantic Butterfish (*Peprilus triacanthus*) Designated EFH in the Offshore Project Area

Atlantic butterfish adult EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-13; Figure E-1-13). Atlantic butterfish adults are found in pelagic marine habitats on the inner and outer continental shelf and in the high salinity zones of inshore estuaries and embayments (MAFMC 2011). As with juveniles, adults are eurythermal and euryhaline and primarily consume pelagic prey. Designated EFH for Atlantic butterfish adults is from surface waters to depths of 1,378 ft (420 m), where temperatures span 41 to 82°F (5 to 28°C) and salinities are within 4 to 33 ppt (Cross et al. 1999; MAFMC 2011).

The Atlantic butterfish is managed under the MAFMC Atlantic Mackerel, Squid, and Butterfish FMP as a single stock: the Gulf of Maine/Cape Hatteras stock. The fishery stock is not currently overfished or subject to overfishing (NOAA Fisheries 2019).

E-1.2.13 Atlantic Mackerel (*Scomber scombrus*)

Atlantic mackerel egg EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-14; Figure E-1-14). In the Mid-Atlantic Bight, Atlantic mackerel eggs are found in pelagic marine habitats on the continental shelf and in the high salinity zones of inshore estuaries and embayments (MAFMC 2011). Eggs exhibit seasonal variations in depth and generally occur in depths of 33 to 98 ft (10 to 30 m) in April, 98 to 164 ft (30 to 50 m) in May, and 98 to 230 ft (30 to 70 m) in June through August. Designated EFH for Atlantic mackerel eggs is in depths of 33 to 1,066 ft (10 to 325 m), where temperatures span 41 to 73°F (5 to 23°C) in salinities within 25 to 34 ppt (Studholme et al. 1999).

Table E-1-14. Atlantic Mackerel (*Scomber scombrus*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Egg	58,798	464	0
Juvenile	112,799	7,562	0
Adult	112,799	14,234	1,646
Percent of Project Area Covered by EFH by Life Stage			
Egg	52.1%	3.3%	0.0%
Juvenile	100.0%	53.1%	0.0%
Adult	100.0%	100.0%	99.6%
Percent of Total Species EFH Area Covered by Project Area			
Egg	0.353%	0.003%	0.000%
Juvenile	0.356%	0.024%	0.000%
Adult	0.373%	0.047%	0.005%

Sources: Studholme et al. 1999; MAFMC 2011

No Atlantic mackerel larva EFH is designated in the Offshore Project Area.

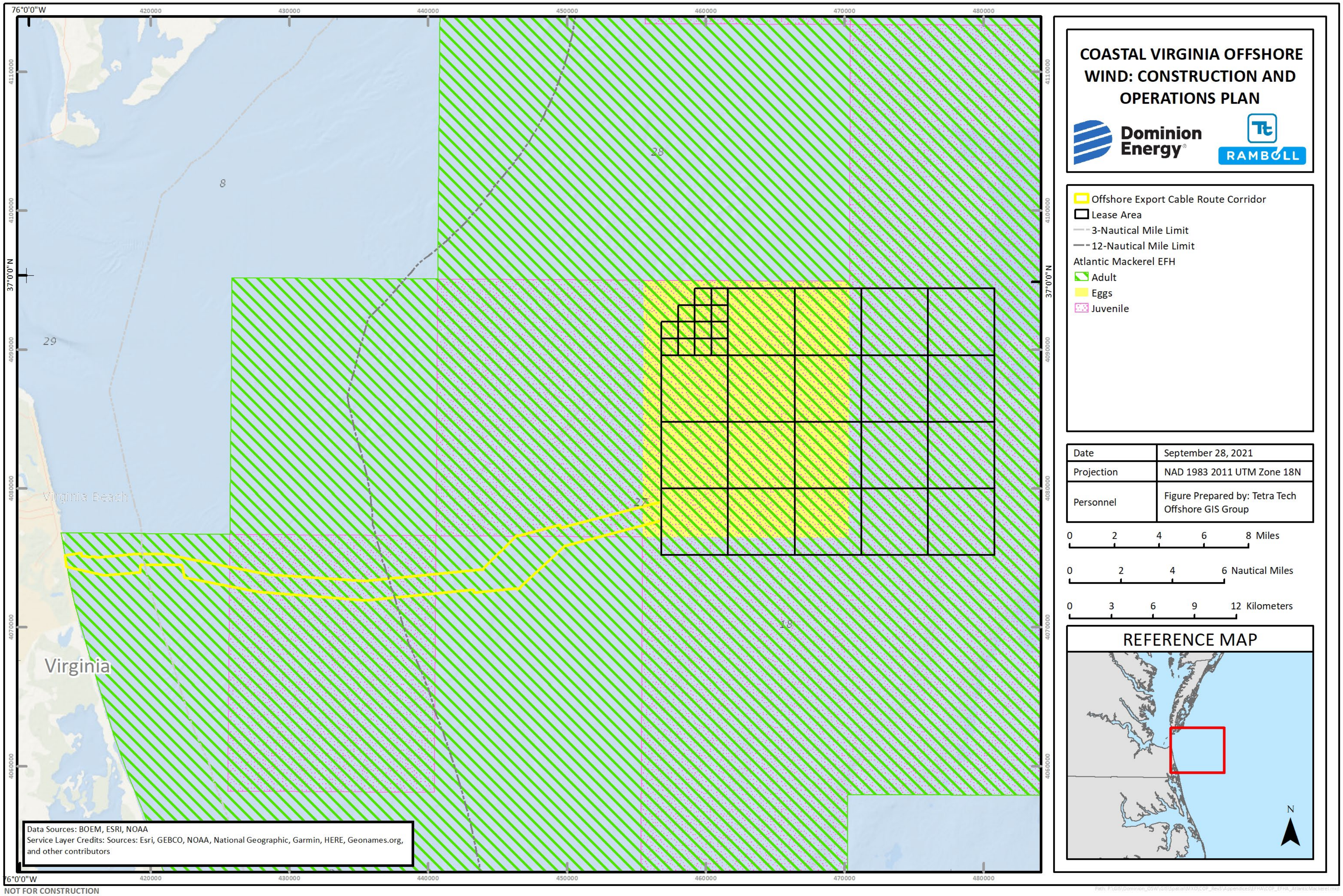

Figure E-1-14. **Atlantic Mackerel (*Scomber scombrus*) Designated EFH in the Offshore Project Area**

Atlantic mackerel juvenile EFH is designated in the Lease Area and federal of the Offshore Export Cable Route Corridor (Table E-1-14; Figure E-1-14). Atlantic mackerel juveniles are found in pelagic marine habitats on the continental shelf and in the high salinity zones of inshore estuaries and embayments (MAFMC 2011). Juveniles exhibit seasonal variations in depth and generally occur in depths of 66 to 131 ft (20 to 40 m) in fall, 164 to 230 ft (50 to 70 m) in winter, 98 to 295 ft (30 to 90 m) in spring, and 66 to 164 ft (20 to 50 m) in summer (Studholme et al. 1999). They are opportunistic feeders that primarily consume small crustaceans including copepods, amphipods, mysid shrimp, and decapod larvae (Studholme et al. 1999). Designated EFH for Atlantic mackerel juveniles is from surface waters to depths of 1,050 ft (320 m), where temperatures span 39 to 72°F (4 to 22°C) and salinities exceed 25 ppt (Studholme et al. 1999).

Atlantic mackerel adult EFH is designated in the Lease Area and both federal and state waters of the Offshore Export Cable Route Corridor (Table E-1-14; Figure E-1-14). Atlantic mackerel adults are found in pelagic marine habitats on the continental shelf and in the high salinity zones of inshore estuaries and embayments (MAFMC 2011). Adults exhibit seasonal variations in depth and generally occur in depths of 197 to 262 ft (60 to 80 m) in fall, 66 to 98 ft (20 to 30 m) in winter, 197 to 558 ft (60 to 170 m) in spring, and 164 to 230 ft (50 to 70 m) in winter (Studholme et al. 1999). Larger fish are often found at greater depths than smaller adults; distributions may be correlated with prey availability, downwelling events, and onshore advection of warm surface water (Studholme et al. 1999). Adults consume the same general prey as juveniles but consume a wider assortment of organisms and larger prey items (Studholme et al. 1999). Designated EFH for Atlantic mackerel adults in from surface waters to depths of 1,247 ft (380 m), where temperatures span 41 to 61°F (5 to 16°C) and salinities exceed 25 ppt (Studholme et al. 1999).

The Atlantic mackerel is managed under the MAFMC Atlantic Mackerel, Squid, and Butterfish FMP as a single stock: the Gulf of Maine/Cape Hatteras stock. The fishery stock is currently overfished and subject to overfishing (NOAA Fisheries 2019).

E-1.2.14 Atlantic Surfclam (*Spisula solidissima*)

No Atlantic surfclam egg or larva EFH is designated in the Offshore Project Area.

Atlantic surfclam juvenile EFH stages is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-15; Figure E-1-15). In the Mid-Atlantic Bight, Atlantic surfclam juveniles are found in benthic marine habitats throughout the substrate to a depth of 3 ft (1 m) below the water/sediment interface (MAFMC 2017). Planktonic larvae metamorphose to juveniles within 18 to 35 days. Juveniles are planktivorous siphon feeders that consume a variety of diatoms and ciliates (Cargnelli et al. 1999c). Designated EFH for Atlantic surfclam juveniles is benthic habitat in depths of 26 to 217 ft (8 to 66 m), where temperatures span 36 to 86°F (2 to 30°C) and salinities exceed 14 ppt (Cargnelli et al. 1999c).

Table E-1-15. Atlantic Surfclam (*Spisula solidissima*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Juvenile	112,799	12,575	0

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
Adult	112,799	5,477	0
Percent of Project Area Covered by EFH by Life Stage			
Juvenile	100.0%	88.3%	0.0%
Adult	100.0%	38.5%	0.0%
Percent of Total Species EFH Area Covered by Project Area			
Juvenile	0.684%	0.076%	0.000%
Adult	0.838%	0.041%	0.000%

Sources: Cargnelli et al. 1999c; MAFMC 2017

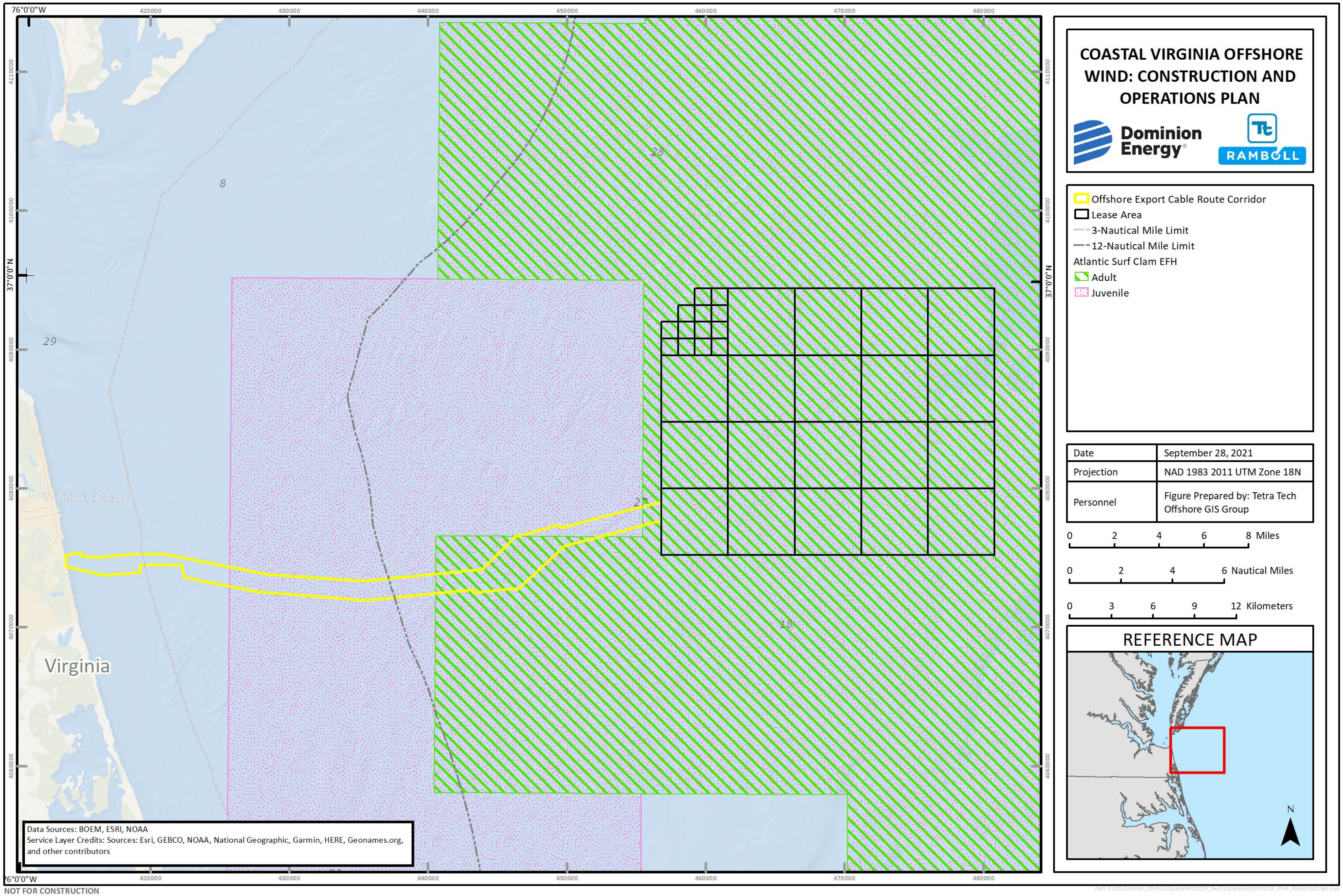

Figure E-1-15. **Atlantic Surfclam (*Spisula solidissima*) Designated EFH in the Offshore Project Area**

Atlantic surfclam adults are found in benthic marine habitats throughout the substrate to a depth of 3 ft (1 m) below the water/sediment interface (MAFMC 2017). They consume the same planktivorous prey as juveniles. Designated EFH for Atlantic surfclam juveniles is benthic habitat in depths of 26 to 217 ft (8 to 66 m), where temperatures span 36 to 86°F (2 to 30°C) and salinities exceed 14 ppt (Cargnelli et al. 1999c).

The Atlantic surfclam is managed under the MAFMC Atlantic Surfclam and Ocean Quahog FMP as a single stock: the Mid-Atlantic Coast stock. The fishery stock is not currently overfished or subject to overfishing (NOAA Fisheries 2019).

E-1.2.15 Black Sea Bass (*Centropristis striata*)

No black sea bass egg EFH is designated in the Offshore Project Area.

Black sea bass larva EFH is designated in the Lease Area and federal waters of the Offshore Export Cable Route Corridor (Table E-1-16; Figure E-1-16). In the Mid-Atlantic Bight, black sea bass larvae are found in pelagic marine habitat over the continental shelf and in the mixed to high salinity zones of regional estuaries (MAFMC 1998a). They primarily feed on decapods (Drohan et al. 2007). Larvae typically transform into juveniles in nearshore habitats. Designated EFH for black sea bass larvae is in the upper 328 ft (100 m) of the water column over depths of 6,562 ft (2,000 m), where temperatures span 52 to 79°F (11 to 26°C) and salinities are within 30 to 35 ppt (Steimle et al. 1999c; Drohan et al. 2007; MAFMC 2017).

Table E-1-16. Black Sea Bass (*Centropristis striata*) Designated EFH in the Offshore Project Area

Action Area	Lease Area	Offshore Export Cable Route Corridor	
		Federal Waters	State Waters
Total Project Acreage	**112,799**	**14,234**	**1,652**
EFH Acreage in Project Area by Life Stage			
Larva	54,001	7,098	0
Juvenile	112,799	14,234	1,652
Adult	112,799	14,234	1,652
Percent of Project Area Covered by EFH by Life Stage			
Larva	47.9%	49.9%	0.0%
Juvenile	100.0%	100.0%	100.0%
Adult	100.0%	100.0%	100.0%
Percent of Total Species EFH Area Covered by Project Area			
Larva	0.679%	0.089%	0.000%
Juvenile	0.405%	0.051%	0.006%
Adult	0.428%	0.054%	0.006%

Sources: MAFMC 1998a; Steimle et al. 1999c; Drohan et al. 2007; MAFMC 2017

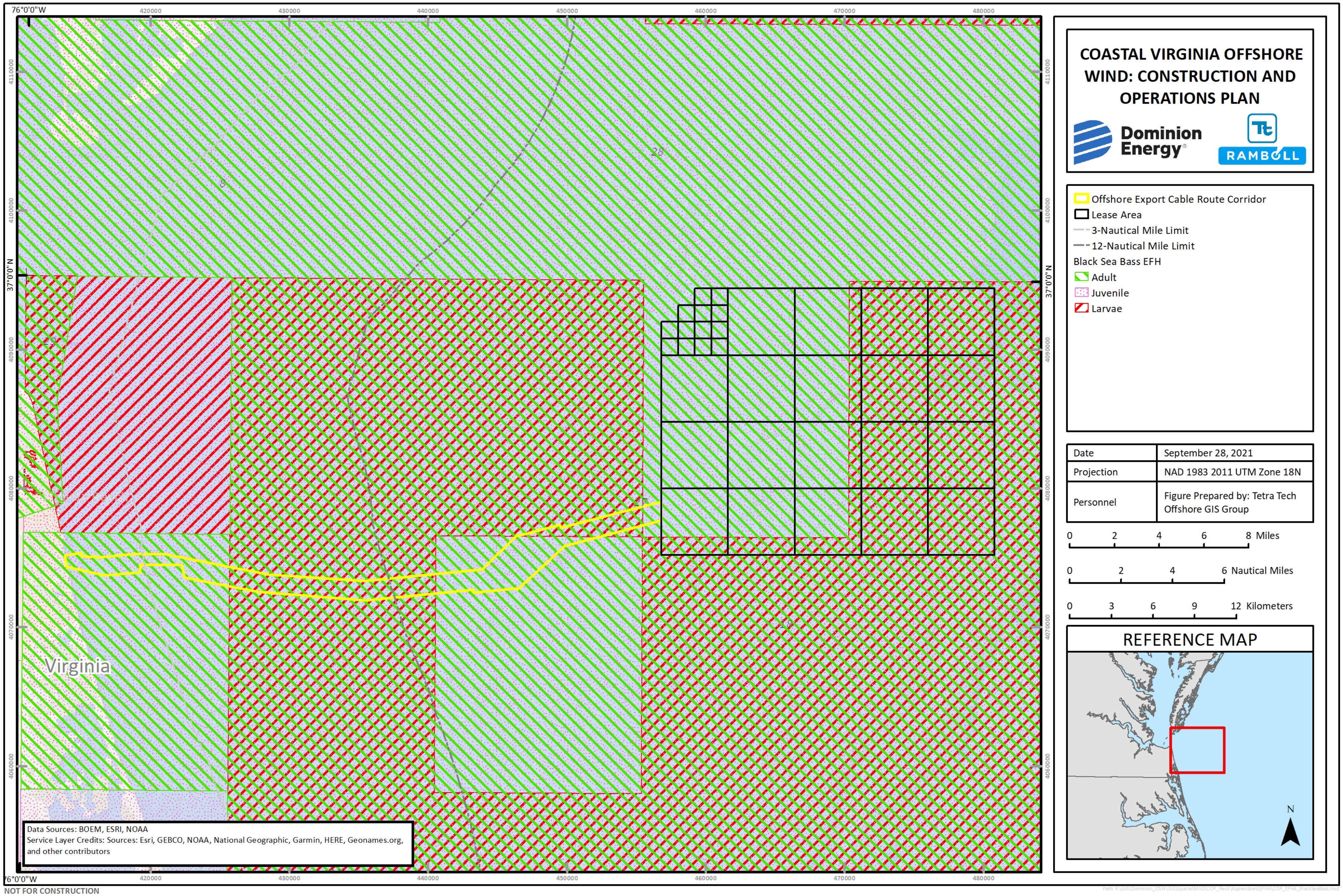

Figure E-1-16. **Black Sea Bass (*Centropristis striata*) Designated EFH in the Offshore Project Area**