VINEYARD MID-ATLANTIC

CONSTRUCTION AND OPERATIONS PLAN

VOLUME II APPENDIX

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VINEYARD MID-ATLANTIC

VINEYARD OFFSHORE

PUBLIC VERSION

Vineyard Mid-Atlantic COP
Appendix II-B Marine Site Investigation Report

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Prepared for:
Vineyard Mid-Atlantic LLC

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0	March 2024	Initial submission.
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Marine Site Investigation Report

Vineyard Mid-Atlantic

Lease Area OCS-A 0544

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EXECUTIVE SUMMARY

The Executive Summary is redacted in its entirety.

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List of Acronyms & Abbreviations

ALARP	As Low As Reasonably Practical
ALS	Accidental Limit State
AMP	Alternative Monitoring Plan
ANOSIM	Analysis of Similarities
ANOVA	Analysis of Variance
ASLF	Ancient submerged landform features
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BMP	Best Management Practices
BOEM	Bureau of Ocean Energy Management
BSB	Below seabed
CFR	Code of Federal Regulations
CMECS	Coastal Marine Ecological Classification Standard
COP	Construction and Operations Plan
CPT	Cone penetration test
CTD	Conductivity, temperature, density
DGNSS	Differential global navigation system
EFH	Essential fish habitat
ENC	Electronic Navigational Charts
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESP	Electrical service platform
FDR	Facility Design Report
FIR	Fabrication and Installation Report
FLAG	Fiber-Optic Link Around the Globe
FLS	Fatigue Limit State
g	Acceleration
GB	Grab sample
G&G	Geophysical and Geotechnical
GIR	Geotechnical Interpretative Report
GNSS	Global navigation satellite system
GRAD	Gradiometer
H’	Shannon Diversity Index
HAPC	Habitat Areas of Particular Concern
HDD	Horizontal directional drilling
HRG	High resolution geophysical
HSSE	Health, safety, security, and environment
HTC	Holocene Transgressive Channels
HVAC	High voltage alternating current
HVDC	High voltage direct current
IHA	Incidental Harassment Authorization
IHO	International Hydrographic Organization

List of Acronyms & Abbreviations (Continued)

IS	Irregular seabed
J’	Pielou’s Evenness
JNCC	Joint Nature Conservation Committee
KP	Kilometer post
LGM	Last glacial maximum
LIS	Laurentide ice sheet
LPTL	Lowest practical taxonomic level
M	Magnitude
MARA	Marine Archaeological Resource Assessment
MBES	Multibeam echosounder
MCS	Multi-channel seismic
MEC	Munitions and explosives of concern
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MMIS	Marine Minerals Information System
MMP	Marine Minerals Program
MPRSA	Marine Protection, Research and Sanctuaries Act
MSIR	Marine Site Investigation Report
M/V	Motor Vessel
NAD	North American Datum
NARW	North Atlantic right whale
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NJDEP	New Jersey Department of Environmental Protection
NMDS	Non-metric MultiDimensional Scaling
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOS	National Ocean Service
NYBF	New York Bight Fault
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSERDA	New York State Energy Research and Development Authority
OCS	Outer Continental Shelf
OECC	Offshore Export Cable Corridor
OOS	Out of service
PATON	Private aid to navigation
PAPE	Preliminary area of potential effect
PC	Pleistocene Channels
PDC	Project Design Criteria
POS	Position and orientation system

List of Acronyms & Abbreviations (Continued)

PSD	Particle size distribution
PSO	Protected species observer
PV	Plan view
QMA	Qualified Marine Archaeologist
ROV	Remotely operated vehicle
RSD	Ripple scour depressions
RTK	Real time kinematic
R/V	Research vessel
SAP	Site Assessment Plan
SAV	Submerged aquatic vegetation
SBP	Sub-bottom profiler
SCOOP	Self-contained ocean observing payload
SCS	Single-channel seismic
SEGY	Society of Exploration Geologists
SIMPER	Similarity percentages analysis
SLS	Serviceability Limit State
SPI	Sediment profile imagery
SSS	Side scan sonar
STRATAFORM	STRATA FORmation on Margins
SVP	Sound velocity profile(s)
TVG	Time variable gain
ULS	Ultimate limit state
USACE	United States Army Corps of Engineers
US	United States
USBL	Ultra-short baseline
USCG	United States Coast Guard
USCS	Unified Soils Classification System
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
VC	Vibracore
VO	Visual observer
VT	Video transect
WTG	Wind turbine generator
XRD	X-Ray diffraction analysis

List of Units and Conversions

Units

mm	millimeter(s)
cm	centimeter(s)
m	meter(s)
km	kilometer(s)
in	inch
ft	feet
mi	statute mile(s)
NM	nautical mile(s)
J	joule(s)
Hz	hertz
kHz	kilohertz
kn	knot(s)
$cm\ s^{-1}$	centimeters per second
m/s	meters per second
ft/s	feet per second
$yd^3\ yr^{-1}$	cubic yards per year
s	second
ya	years ago
Ma	millions of years ago
nT	Nanoteslas
C	Celsius
F	Fahrenheit
lb	pound
kg	kilogram

Unit Conversions

1 km = 1,000 m = 3,280.8 ft

1 NM = 6,076 ft = 1,851.9 m = 1.852 km

1 mi = 5,280 ft = 1,609.3 m = 1.609 km

1 m = 3.28 ft = 100 cm

1 cm = 10 mm

1 in = 2.54 cm

1 km^2 = 247.1 acres

0° C = 32°F

1 lb = 0.45 kg

Geology Classifications

Bedforms (BOEM general classification)

Name	Wavelength	Height
Sandwave	>60 m (>196.8 ft)	>1.5 m (>4.9 ft)
Megaripple	5-60 m (16.4-196.8 ft)	0.5-1.5 m (1.6-4.9 ft)
Ripple	<5 m (<16.4 ft)	<0.5 m (<1.6 ft)

Grain Size (Unified Soils Classification System)

Soil Component	Fraction	Particle Size (mm)	Particle Size (inches)
Boulder	--	>300	>11.8
Cobble	--	76-300	2.9-11.8
Gravel	Coarse	19-76	0.75-2.9
	Fine	4.75-19	0.19-0.75
Sand	Coarse	2-4.75	0.08-0.19
	Medium	0.43-2	0.02-0.08
	Fine	0.08-0.43	0.003-0.02
Fines	Silt	0.004-0.074	0.0002-0.003
	Clay	<0.004	<0.003

Slope Gradients (BOEM general classification)

Class	Gradient
Very gentle	<1°
Gentle	1 to 4.9°
Moderate	5 to 9.9°
Steep	10 to 14.9°
Very steep	>15°

NMFS (2021) Benthic Habitat Classifications

Class	Subclass	Group	Subgroup	Grain Size (mm)	Component%	NMFS Habitat
Rock Substrate	Bedrock/ Megaclast	--	--	≥ 4,096	>50% Rock	Complex
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravels	Boulder	256–<4,096	≥80% Gravel	
			Cobble	64–<256		
			Pebble/ Granule	2–<64		
			Gravel Pavement	2–<4,096		
		Gravel Mixes	Sandy Gravel	Mix of Gravels, Sand, and Mud	30 – 80% Gravel; Sand is ≥90% of remaining Sand-Mud mix	
			Muddy Sandy Gravel		30–80% Gravel; Sand is 50–≥90% of remaining Sand-Mud mix	
			Muddy Gravel		30–80% Gravel; Mud is ≥50% of remaining Sand-Mud mix	
		Gravelly	Gravelly Sand	Mix of Gravels, Sand, and Mud	5–<30% Gravel; Sand is ≥90% of remaining Sand-Mud mix	
			Gravelly Muddy Sand		5–<30% Gravel; Sand is <50–≥90% of remaining Sand-Mud mix	

NMFS (2021) Benthic Habitat Classifications (Continued)

Class	Subclass	Group	Subgroup	Grain Size (mm)	Component %	NMFS Habitat
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravelly	Gravelly Mud	Mix of Gravels, Sand, and Mud	5–<30% Gravel; Mud is ≥50% of remaining Sand-Mud mix	Complex
	Fine Unconsolidated Substrate	Sand	Very Coarse/ Coarse Sand	0.5–<2	<5% Gravel; ≥90% Sand	Soft Bottom
			Medium Sand	0.25–<0.5		
			Fine/Very Fine Sand	0.0625–<0.25		
		Muddy Sand	--	<0.0625	<5% Gravel; 50–<50% Sand; remainder is silt-clay mix	
		Sandy Mud	--		<5% Gravel; 10-<50% Sand; remainder is silt-clay mix	
		Mud	--		<5% Gravel; ≥90% Mud; remainder is Sand	

NMFS (2021) Benthic Habitat Classifications (Continued)

Class	Subclass	Group	Subgroup	Grain Size (mm)	Component %	NMFS Habitat
Shell Substrate	Shell Reef Substrate	Clam Reef Substrate	--	>4,096	>50% shell cover	Complex
		Crepidula Reef Substrate	--			
		Mussel Reef Substrate	--			
		Oyster Reef Substrate	--			
	Shell Rubble	--	--	64–<4,096		
	Shell Hash	--	--	2–<64		

1 INTRODUCTION

1.1 Overview

Vineyard Mid-Atlantic LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0544 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Mid-Atlantic." Vineyard Mid-Atlantic includes 118 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. One or two of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. Offshore export cables installed within an Offshore Export Cable Corridor (OECC) will transmit power from the renewable wind energy facilities to onshore transmission systems on Long Island, New York.

The Offshore Development Area includes the Lease Area, OECC, and the broader region surrounding offshore facilities that could be affected by Vineyard Mid-Atlantic related activities. Figure 1.1-1 provides an overview of the Offshore Development Area covered in this Marine Site Investigation Report (MSIR). The Lease Area is approximately 174 square kilometers (km^2) (43,045 acres) in size and is located in the federally designated New York Bight Lease Areas. The closest point from the Lease Area to land is approximately 39 kilometers (km) (24 miles [mi]) southeast of Fire Island, New York. The OECC travels from the northwestern edge of the Lease Area towards Long Island, New York. As the OECC approaches shore, it splits into three approaches to connect to three potential landfall sites (up to two landfall sites and approaches will be utilized for construction or installation): the Rockaway Beach Approach, the Atlantic Beach Approach, and the Jones Beach Approach (Figure 1.1.-2). The Proponent has also identified a "Western Landfall Sites OECC Variant" that may be used for routing offshore export cables to the Rockaway Beach and Atlantic Beach Landfall Sites.

This MSIR addresses offshore areas being considered for the development of Vineyard Mid-Atlantic at the time of this report submission. This combines the results of the field programs completed to-date. A site investigation ground model that integrates the shallow and deep subsurface conditions was developed from the data and interpretations, with the site characterizations summarized in detail within this MSIR.

1.2 Objectives

The Offshore Development Area was fully investigated to assess the site conditions and feasibility during the geophysical, geotechnical, and environmental surveys from 2022 to 2023. This MSIR integrates the results and interpretations from the conducted field programs and the appropriate supporting information from public data to satisfy the BOEM requirements. These requirements (BOEM 2020a) are laid out in the *Information Guidelines for a Renewable Energy Construction and Operations Plan (COP)* dated May 27, 2020, the federal regulations in 30 CFR 585.626(a), and the

FINAL Information Needed for Issuance of a Notice of Intent (NOI) Under the National Environmental Policy Act (NEPA) for a COP document (BOEM 2023a).

To support the Vineyard Mid-Atlantic COP, integrated site characterization studies required by the stipulations in Lease OCS-A 0544, geophysical and geotechnical (G&G) surveys were conducted, including high-resolution geophysical (HRG) investigations, and data were acquired to map the surface and subsurface site conditions. The surveys were also performed to satisfy the requirements and stipulations outlined within Addendum C of the BOEM commercial lease to Vineyard Mid-Atlantic LLC of submerged lands for renewable energy development on the Outer Continental Shelf (OCS) as well as the relevant BOEM guidelines that are listed below:

- Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR § 585 (BOEM 2020b);
- Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR § 585 (BOEM 2023b);
- Guidelines for Submission of Spatial Data for Atlantic Offshore Renewable Energy Development Site Characterization Surveys (BOEM 2023c).

Survey activities also met the requirements of other federal agencies responsible for oversight of specific tasks associated with the offshore program, such as protected species mitigation (e.g., National Marine Fisheries Service [NMFS]).

Extensive research prior to the initiation of the field programs was also performed, and publicly available datasets were integrated into Vineyard Mid-Atlantic databases for supplementing site condition maps. The purpose of these studies was to:

1. Acquire information to allow geohazards interpretations and analysis to aid in ground model creation.
2. Support the initial design phases of the WTG/ESP foundations and other deep engineering evaluations in the Lease Area.
3. Provide data for mapping site conditions in the OECC and to support cable route feasibility and selection, burial assessment, engineering/design, and construction planning.
4. Inform the Proponent and stakeholders of environmental issues and sensitive habitats for avoidance.
5. Provide data for assessments of cultural/archaeological resources in the area of potential bottom disturbance for all Vineyard Mid-Atlantic components.
6. Provide the supporting information needed for permitting and approval of the proposed Vineyard Mid-Atlantic development activities.

1.3 Vineyard Mid-Atlantic Offshore Surveys

Section 1.3 is redacted in its entirety.

1.4 Supporting Datasets

In addition to the collected 2022 and 2023 field program data and survey campaign results, there are several existing public datasets from prior research completed near the Offshore Development Area. The regional datasets provided the necessary framework that offered beneficial information and aided the understanding of site conditions. These datasets, which are listed below, were reviewed and appropriate information extracted for use in this MSIR. See Section 10 for a comprehensive list of scientific and technical papers that were used in this report.

- NOAA National Ocean Service (NOS) Hydrographic Surveys and seabed samples in US coastal waters
- NOAA National Data Buoy Center
- NOAA CO-OPS Tidal Current Predictions
- NOAA Historical Hurricane Tracks
- NOAA Office for Coastal Management/BOEM OceanReports
- New York State Energy Research and Development Authority (NYSERDA) Multibeam echosounder and benthic survey data (NYSERDA 2017)
- NYSERDA Hudson North (Subarea A) HRG and Geotechnical data (NYSERDA 2021a)
- United States Geological Survey (USGS) East-Coast Sediment Texture Database (USGS 2014)
- USGS and University of Colorado: usSEABED Offshore Surficial-Sediment Database
- USGS Earthquake Hazards Program

1.5 Key Personnel

Section 1.5 is redacted in its entirety.

2 REGIONAL SETTING

Section 2 is redacted in its entirety.

3 LEASE AREA SITE CHARACTERIZATION

Section 3 is redacted in its entirety.

4 LEASE AREA HAZARDS ASSESSMENT

Section 4 is redacted in its entirety.

5 OFFSHORE EXPORT CABLE CORRIDOR SITE CHARACTERIZATION

Section 5 is redacted in its entirety.

6 OFFSHORE EXPORT CABLE CORRIDOR HAZARDS ASSESSMENT

Section 6 is redacted in its entirety.

7 GEOLOGICAL RESULTS RELEVANT TO SITING AND DESIGN

Section 7 is redacted in its entirety.

8 RESULTS OF BIOLOGICAL SURVEYS

This section of the Marine Site Investigation Report (MSIR) documents the benthic biological studies completed for Vineyard Mid-Atlantic during the 2022 and 2023 field programs, as well as background research and historical data. Surveys were conducted in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0544 (Lease Area) in 2022, and the Offshore Export Cable Corridor (OECC) was investigated in 2023. These survey data, as well as publicly available data, are described in Section 8.1 and were used for the benthic habitat mapping described in Section 8.2.

Nektonic (free swimming fish, marine mammals, and turtles), avian (birds), and bat fauna information is based on existing research and historical data. These topics are addressed in Section 4 of COP Volume II.

8.1 Benthic Habitat Survey Results

Benthic habitats located within the Offshore Development Area consist of a diverse assemblage of bottom substrate types, though Sand and Gravelly sediments were the most frequently observed. Habitats occupying the seafloor and very shallow subsurface of the seabed are included in the classification of benthic habitats. Sonar data (multibeam echosounder and side scan sonar) and ground truthing information (grab samples, video transects, and vibracore [VC] samples) collected during the 2022 field program were used to classify benthic habitats within the Lease Area. Similarly, data collected during the 2023 field program were used to characterize benthic habitats within the OECC.

Grab samples collected during the 2022 and 2023 field programs were also used to identify infauna present within the Lease Area and the OECC. Video transect footage collected as part of these field programs was used to identify epifauna in addition to characterizing benthic habitats. Locations of the grab samples and video transects within the Lease Area are presented in Figure 1.3-4 and Figure 1.3-5. Locations of grab samples and video transects within the OECC are shown in Figure 1.3-12 through Figure 1.3-15. For a full description of geologic conditions within the Lease Area, see Section 3. Section 5 contains a full description of geologic conditions within the OECC.

8.1.1 Benthic Sediment and Habitat Classification Overview

All benthic habitat ground truthing samples and habitat delineations for Vineyard Mid-Atlantic were classified following the National Marine Fisheries Service (NMFS) Recommendations for Mapping Fish Habitat (NMFS 2021). This classification scheme uses the Coastal and Marine Ecological Classification Standard (CMECS) (FGDC 2012) as the basis for sample classification. The NMFS Recommendations utilize the Substrate Component and Biotic Component of CMECS. NMFS modified the original CMECS Substrate Component classifications by removing the Slightly Gravelly Substrate Group, combining several Subgroups, and creating a new Supergroup of Gravel Pavement (NMFS 2021) (Table 8.1-1). Per the guidance of NMFS (2021), the NMFS-modified

CMECS classifications were used to determine whether a sample or group of samples was either a Soft Bottom, Complex Mix, or Complex station. These station designations were then used to determine whether a sonar-delineated habitat area was either a Soft Bottom habitat, Heterogeneous Complex habitat, Complex habitat, or Large Grained Complex habitat.

Table 8.1-1 NMFS Modified CMECS Classification

Class	Subclass	Group	Subgroup	NMFS Habitat
Rock Substrate	Bedrock/Megaclast	--	--	Complex
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravels	Boulder	
			Cobble	
			Pebble/Granule	
			Gravel Pavement	
		Gravel Mixes	Sandy Gravel	
			Muddy Sandy Gravel	
			Muddy Gravel	
		Gravelly	Gravelly Sand	
			Gravelly Muddy Sand	
			Gravelly Mud	
	Fine Unconsolidated Substrate	Sand	Very Coarse/Coarse Sand	Soft Bottom
			Medium Sand	
			Fine/Very Fine Sand	
		Muddy Sand	--	
		Sandy Mud	--	
		Mud	--	
Shell Substrate	Shell Reef Substrate	Clam Reef Substrate	--	Complex
		Crepidula Reef Substrate	--	
		Mussel Reef Substrate	--	
		Oyster Reef Substrate	--	
	Shell Rubble/Hash	--	--	

Additional details about the benthic habitat mapping process and results can be found in Section 8.2.1, which contains the mapping associated with the Essential Fish Habitat (EFH) Assessment. The full EFH Assessment can be found in the COP Appendix II-D. Within state waters, additional data from historical state mapping efforts were used to assess sensitive habitats (Section 8.2.2).

8.1.2 Benthic Grab Sample Review

8.1.2.1 Lease Area

The Lease Area is comprised primarily of fine unconsolidated sediments including Muddy Sand, Medium Sand, and Very Coarse/Coarse Sand. Patches of Gravelly Sand are also present in the northern and southern portions of the Lease Area (Figure 8.1-1 and Figure 1.3-4). Ripples are present throughout the Lease Area, except for in some small patches of flat, Silty Sand in the northwest corner of the Lease Area (Figure 8.2-2).

A total of 65 benthic grab samples were collected from 35 stations within the Lease Area in 2022 (Figure 1.3-4). Sediment recovery was successful for all grabs, and grain size was analyzed to assign a NMFS-modified CMECS classification to each sample. Most samples were classified as Medium Sand, and two samples (one in the northeast corner and one in the southwest edge of the Lease Area) were classified as Very Coarse/Coarse Sand. A single sample (GB010) was classified as Gravelly Sand and contained approximately 9% gravel.

Publicly available data were also used to provide additional information about the conditions in and around the Lease Area. Grab samples collected as part of the usSEABED program (Buczkowski et al. 2020) indicate that the Lease Area is comprised of soft sediment (Sand and Mud) (Figure 8.1-2). One usSEABED sample located within the Lease Area was classified as Slightly Gravelly Sand but contained only 1% gravel and was therefore not considered to be indicative of Heterogeneous Complex or Complex habitat. These findings of soft sediments and occasional possible gravel pockets align closely with the data collected during the 2022 field program.

New York State Energy Research and Development Authority (NYSERDA) conducted an environmental and geophysical survey in 2017 and collected sediment profile imagery (SPI) and plan view (PV) imagery offshore Long Island and New Jersey (NYSERDA 2017). CMECS sediment classifications assigned from these photographs were also similar to results from the 2022 field program. NYSERDA samples within and around the Lease Area were classified as Sand and Slightly Gravelly Silty Sand (Figure 8.1-3).

For more information on grab sampling methodology and results, see the 2022 Lease Area Benthic Factual Report in Appendix II-B13.

8.1.2.2 Offshore Export Cable Corridor

The OECC contains primarily fine unconsolidated substrate (Sand), as well as patches of Gravelly (e.g., Gravelly Sand) and Gravel Mix (e.g., Sandy Gravel) substrate containing Pebble/Granule. The offshore portion of the OECC near the Lease Area (KP 0 to KP 21.8) contains Sand with no instances of Gravel observed, other than some small patches of Pebble/Granule between KP 0 and KP 0.8. Heading north of KP 21.8, the sediment type is still dominated by Sand but also contains patches of Gravelly Sand and Sandy Gravel (Figure 8.1-4 and Figure 1.3-12). Gravel was most frequently observed in ripple troughs within ripple scour depressions (RSDs). Ripples and RSDs are common morphological features throughout the OECC. Nearshore, sediments continue to alternate between areas of Sand, Gravelly Sand, and Gravel Mix (Figure 8.1-5 and Figure 1.3-13). Amphipod tube mats are present in patches between KP 21.8 and KP 49.5 (Figure 8.2-5 and Figure 8.2-6), though some studies in the region suggest that these patches may vary seasonally and annually (Maciolek et al. 2010). Further details regarding the habitats observed in the OECC are summarized in Section 8.2.1.2.

A total of 107 grab samples were collected from 59 stations in the OECC during the 2023 field program. Of these 59 stations, 35 were sampled once, and 24 were sampled in triplicate (Figure 1.3-12 and Figure 1.3-13). Sediment recovery was successful for all samples. As with the Lease Area samples, grain size was analyzed to assign a NMFS-modified CMECS classification to each OECC sample. The majority (80%) of samples were classified as Sand, with some samples also belonging to the Gravelly (14%) and Gravel Mix (6%) substrate groups. No samples were classified as Muddy Sand or Shell Hash. Additional details about grab sample results and methodology can be found in the 2023 OECC Benthic Factual Report (see Appendix II-B13).

Publicly available datasets were also consulted during the habitat mapping process. Grab samples collected as part of the usSEABED program (Buczkowski et al. 2020) were consistent with 2023 survey results, and show Sandy and Muddy substrates farther offshore, then transitioning to patches of Sandy and Gravelly substrates closer to shore (Figure 8.1-6 and Figure 8.1-7).

8.1.3 Underwater Video Review

Underwater video transects were conducted in the Lease Area in 2022 and the OECC in 2023. Transects were collected every 1-2 kilometers (km) (0.5-1 NM) along the OECC and spaced approximately 2 km (1 NM) apart or less throughout the Lease Area. Video imagery was used to identify the benthic habitat types present and provide ground-truthing for NMFS-classified habitat maps. Fauna and flora were identified and enumerated along each video transect to provide information about the organisms that utilize the habitats within the Lease Area and the OECC. Any anthropogenic debris observed in video footage was also recorded. A subset of video transects were co-located with grab samples in order to ground-truth visual observations with grain size data.

Findings from the underwater video review are summarized below. Additional details regarding video results can be found in the Benthic Factual Reports located in Appendix II-B13. For more information about mapping methodology and detailed descriptions of the habitats present in the Lease Area and the OECC, see Section 8.2.1.

8.1.3.1 Lease Area

A total of 35 underwater video transects were conducted throughout the Lease Area in 2022. These video transects were used to help determine the sediment and NMFS (2021) benthic habitat type, as well as quantify the flora and fauna present. Of the 35 transects analyzed, 27 showed exclusively Soft Bottom habitat, and 8 were classified as a Complex Mix of both Soft Bottom and Complex habitats (Figure 8.1-8 and Figure 1.3-5). None of the Lease Area video transects were classified as fully Complex. The most common sediment types observed throughout the Lease Area were Very Coarse/Coarse Sand and Medium Sand. Occasional instances of Muddy Sand were also recorded. Patches of Gravelly Sand and Sandy Gravel were present in seven of the video transects assigned a NMFS (2021) classification of Complex Mix, and areas of Shell Hash were observed on one of the Complex Mix video transects (VT026). Small shell fragments and occasional Surf Clam and Razor Clam shells were also observed on many of the Soft Bottom video transects, though the shell abundances did not meet the 50% threshold required to be considered Shell Hash or Shell Rubble under the NMFS-modified CMECS classification system in these instances.

Sand dollars (*Echinarachnius parma*) were abundant across the Lease Area and were observed in all video transects. Sea cucumbers (Dendrochirodtida), northern sea stars (*Asterias rubens*), and blood stars (*Henricia* spp.) were also occasionally observed. Other common invertebrates included hermit crabs (*Pagurus* spp.), walking crabs (*Cancer* spp.), sea scallops (*Placopecten magellanicus*), and sea sponges (Porifera spp.). Longfin squid (*Doryteuthis pealeii*) were also observed in eleven transects within the Lease Area.

Butterfish (*Peprilus triacanthus*) were the most abundant vertebrate species, accounting for 76% of observations in the Lease Area. Lizardfish (*Synodus* spp.), witch flounder (*Glyptocephalus cynoglossus*), little skates (*Leucoraja erinaceus*), smooth skates (*Malacoraja senta*), and skate egg cases were also occasionally observed. The number of faunal observations varied significantly between video transects, and there was no apparent association between the number of fauna observed and the NMFS classification of the transect.

In total, 14 vertebrate taxa, 27 invertebrate taxa, and 2 egg cases (skate and moon snail) were identified in the Lease Area. Additional evidence of faunal activity, including empty shells, burrows, and tubes believed to be built by polychaetes or amphipods, were also recorded. No flora was observed in the Lease Area. A section of exposed cable was observed on imagery from VT027, which was aligned with linear magnetic anomalies observed in the geophysical data (Figure 4.2-2). Potential cable crossings within the Lease Area are further discussed in Section 4.2.2.1.

Trawl surveys conducted by the NOAA Northeast Fisheries Science Center (NEFSC) and the New Jersey Department of Environmental Protection (NJDEP) within the New York Bight identified longfin squid, little skates, and butterfish as abundant species within the study area (Grothues et al. 2021), which aligns with the video transect survey results presented above. Additionally, trawl surveys also identified large numbers of scup (*Stenotomus chrysops*), northern sea robins

(*Prionotus carolinus*), silver hake (*Merluccius bilinearis*), and Atlantic herring (*Clupea harengus*) within the New York Bight (Grothues et al. 2021), though none were recorded during the 2022 Lease Area video survey.

Additional details regarding the Lease Area video transect results can be found in the Benthic Factual Report in Appendix II-B13.

8.1.3.2 Offshore Export Cable Corridor

A total of 61 video transects were conducted in the OECC in 2023 (Figure 1.3-14 and Figure 1.3-15). These transects were used to classify the type of benthic habitats present, as well as any fauna, flora, or anthropogenic debris. Thirty-two of the transects from the OECC showed exclusively Soft Bottom habitat, whereas 29 were classified as Complex Mix, with both Soft Bottom and Complex habitats present within the same transect (Figure 8.1-9 and Figure 8.1-10). No video transects were classified as fully Complex. Sand was the sediment type most frequently observed in the OECC transects. Gravelly Sand and Sandy Gravel were observed in patchy distributions in the video transects classified as Complex Mix. Gravel consisted of Pebble/Granule and was often located within ripple troughs. Patches of Shell Hash were observed on transects VT040 and VT064, and shell fragments were common throughout the OECC in concentrations of less than 50%.

Sand dollars were highly abundant in video transects, particularly in the offshore portions of the OECC. Decorator worms (*Diopatra* sp.), hermit crabs (*Pagurus* sp.), burrowing anemones (Edwardsiidae), moon snails (*Euspira heros*), and portly spider crabs (*Libina emarginata*) were other common invertebrates observed. Smaller numbers of squid (Coleoidia), mud tunicates (*Molgula* sp.), walking crabs (*Cancer* sp.), sea stars (*Asterias rubens*), and boring sponges (*Cliona cellata*) were also recorded. One potential sea pen was identified on VT058.

Fish species frequently observed on OECC video transects included northern sea robins (*Prionotus carolinus*), scup (*Stenotomus chrysops*), little skates (*Leucoraja erinacea*), and butterfish (*Peprilus triacanthus*). Smaller numbers of flounder (Pleuronectiformes), clearnose skate (*Raja eglanteria*), striped sea robin (*Prionotus evolans*), spiny dogfish (*Squalus acanthias*), and hake (Phycidae) were also observed.

A total of 16 vertebrate and 28 invertebrate taxa, and 3 types of egg cases were identified in the OECC video transects. Egg cases included moon snail egg collars, skate egg cases, and squid mops. Tube mats created by amphipods were also observed in 8 video transects (Figure 8.2-5). Grab stations GB017 and GB021 also indicated the presence of these tube mats on the grab camera video footage, and both contained large numbers of *Ampelisca vadorum*, a documented tube-building amphipod (Steimle 1982).

Additional information about the video transects collected in the OECC can be found in the Benthic Factual Report located in Appendix II-B13.

8.1.4 Benthic Infauna Analysis

In addition to identifying macrofauna and flora recorded on video transect footage, organisms present in grab sample sediment (infauna) were also quantified and identified to the lowest practical taxonomic level (LPTL). In the following sections, benthic communities are described within the context of the Lease Area and the OECC in addition to comparisons across CMECS substrate groups and between nearshore versus offshore samples. Table 8.1-2 defines key terms that are used throughout the following sections.

Table 8.1-2 Statistical Measures and Community Composition Metrics Used to Describe Infauna

Term	Definition
Taxonomic Richness	Taxonomic richness refers to the number of taxa (species or LPTL) present in a sample. Organisms were identified to the species level whenever possible, though there were some occasions where this was not feasible and individuals were classified to the genus or family level instead.
Shannon Diversity Index (H')	The Shannon diversity index describes how diverse the species in a given community (or sample) are. Values for Shannon diversity typically range from approximately 1.5 to 3.5, with larger numbers representing more diverse communities. Shannon diversity is calculated using the following equation: $$H' = -\sum_{j=1}^{S} p_i \ln p_i$$ Where S is the number of species present in the sample, and pi equals the proportion of individuals found in the *i*th species.
Pielou's Evenness (J')	Pielou's evenness is a metric that considers both diversity as well as species richness to provide a measure of how evenly distributed species abundances are in a community or sample. This can indicate whether a sample is dominated by one or two species, or if all species have an equal number of individuals. Values for Pielou's evenness range from 0 (no evenness) to 1 (complete evenness). Pielou's evenness can be calculated using the following equation: $$J' = \frac{H'}{\ln S}$$ Where H' is equal to the Shannon diversity index and *S* is equal to the number of species in the sample.
Analysis of Variance (ANOVA)	ANOVA is a statistical test which determines whether two or more categorical groups are statistically different. This is done by testing for a difference of means using a variance. The resulting p value from an ANOVA test can indicate whether the tested groups are significantly different. P values of 0.05 or less are considered to be significantly different.
Analysis of Similarities (ANOSIM), Global R	ANOSIM is used to analyze the similarity between community samples. This is a multivariate statistic, which can determine if biological communities differ significantly between samples. This is done by comparing the mean of ranked dissimilarities between groups to the mean of ranked dissimilarities within groups. One of the results of an ANOSIM test is a Global R value. An R value

Term	Definition
	close to 1 suggests that the groups being tested are dissimilar, while an R value close to 0 suggests that the groups are similar.
Bray-Curtis Similarity	Bray-Curtis Similarity is a way to measure the amount of dissimilarity between biological communities at two different sites or samples. Values for Bray-Curtis Similarity typically range from 0 to 1, where 0 indicates that the two samples are identical (exact same number of each type of species), and 1 indicates that the sites are completely dissimilar (they do not share any of the same species). Bray-Curtis Similarities were used to create Non-Metric Multi-Dimensional Scaling (NMDS) plots for infauna data, which are described below.
NMDS	NMDS plots shows an ordination based on dissimilarity between samples (in this case, Bray-Curtis Similarity, described above). The closer two points are to each other on an NMDS plot, the more similar the communities in those samples are. Conversely, if two points are on opposite sides of an NMDS plot, it can be inferred that those samples are not very similar to one another.
Similarity Percentages Analysis (SIMPER)	SIMPER analysis can be particularly useful in cases where ANOSIM tests indicate a statistically significant difference in community structure between compared groups. SIMPER analysis is used to determine which taxa contribute most to the differences in community composition observed.
Unique Taxa	Taxa which were identified in (unique to) only one grab sample within the project area.

8.1.4.1 Lease Area

Sixty-five grab samples were collected from 35 stations in the Lease Area in 2022. Infauna were collected from one of the samples at each station for analysis. Benthic organisms were found in 34 of the 35 grabs analyzed, with one sample (GB016) not containing any specimens. A total of 439 individuals from 5 phyla and 47 taxa were identified in the Lease Area samples. Annelida (primarily polychaete worms) and Echinodermata (*Echinarachnius parma*) were the most common phyla observed, and were responsible for 59% and 22% of individuals, respectively. Smaller numbers of Mollusca (primarily bivalves), Arthropoda (crustaceans), and Nemertea (ribbon worms) were also present. Though only contributing to 8% and 6% of total abundance, mollusks and arthropods were responsible for 37% and 21% of unique taxa observed (Figure 8.1-11). No unique taxa were present for echinoderms or nemertean worms, which were common across many samples.

The average total density of infauna in Lease Area samples was 1,695 individuals m^{-2}. The density of organisms was variable, with 0 individuals m^{-2} present in GB016 and 4,567 individuals m^{-2} in GB019 (Figure 8.1-12). Grab sample GB019 had a high density of organisms compared to other Lease Area grab samples due to a large number of polychaetes (*Polygordius* sp.). Taxonomic richness ranged from 0 to 10, with an average of 6 taxa present in each sample (Figure 8.1-13). Taxonomic richness was highest in samples GB005 and GB010, and lowest in GB016. There were no consistent spatial patterns in total organism density or richness. Only one sample (GB010) within the Lease Area was classified as Gravelly Sand and therefore assigned a NMFS classification of Complex. The infauna community composition within this grab was not significantly different from the other samples, which were classified as either Medium Sand or Very Coarse/Coarse Sand (Figure 8.1-14).

Shannon diversity ranged from 0 to 2.16, with an average of 1.46. Infauna diversity was highest in samples GB014A and GB005, and lowest in GB016 (where there were no individuals observed) and GB001A (Figure 8.1-15). Pielou's evenness averaged 0.86, with a range of 0.55 to 1.0. Evenness was lowest in GB001A, which contained few species and was dominated by the sand dollar *Echinarachnius parma*. GB018 and GB019, which were both dominated by *Polygordius* sp. Polychaetes, also had low levels of evenness (Figure 8.1-16). No spatial patterns in total organism diversity evenness were present.

Since all samples were located offshore in federal waters, and there was only one sample which had a CMECS substrate group other than Sand (GB010, which was classified as Gravelly), no multivariate community comparisons were conducted for Lease Area samples. For additional information on the infauna collected during the 2022 Lease Area field program, please see the Lease Area Benthic Factual Report in Appendix II-B13.

8.1.4.2 Offshore Export Cable Corridor

One hundred and seven grab samples were collected from 59 stations in the OECC in 2023. One sample at each of these 59 stations was analyzed for the presence and abundance of infauna. Benthic organisms were found in all 59 samples analyzed. A total of 26,825 individuals from 11 phyla and 208 taxa were identified in the OECC samples. Arthropoda (malacostracans), Annelida (primarily polychaetes), and Mollusca (bivalves and gastropods) were the most abundant phyla, responsible for approximately 56%, 37%, and 4% of observations, respectively. Smaller numbers of individuals belonging to Nemertea, Cnidaria, Chordata, Echinodermata, Hemichordata, Phoronida, Platyhelminthes, and Xenacoelomorpha were also observed, with each phylum contributing to less than 2% of total abundance (Figure 8.1-17 and Figure 8.1-18). Mollusks were responsible for 33% of all unique taxa despite accounting for only 4% of total observations. Annelids also had a high proportion of unique taxa observed in the OECC samples (45%).

Average infauna density in the OECC samples was 18,281 individuals m^{-2}, with a range from 1,120 individuals m^{-2} in GB014A to 121,840 individuals m^{-2} in GB053A (Figure 8.1-19). Taxonomic richness had an average of 29 taxa per sample, with a range from 5 taxa in GB049 to 62 taxa in GB017A (Figure 8.1-20). It should be noted that the low richness in GB049 could be skewed by a smaller sample size, as it was the only OECC sample collected using a 0.1 m^2 VanVeen grab rather than the 0.25 m^2 box core due to shallow conditions that could only be accessed using a smaller vessel. The next lowest level of taxonomic richness was 14 taxa in GB048A and GB034A.

Shannon diversity averaged 2.15 in the OECC samples, with a range of 0.11 at GB034A, which was dominated by the amphipod *Pseudunciola obliquua*, to 3.28 at GB023, which contained relatively low numbers of many different taxa (Figure 8.1-21). Evenness ranged from 0.04 at GB034A to 0.98 at GB014A with an average of 0.65, indicating that there was a mixture of evenly distributed samples as well as those which were dominated by a singular taxon (Figure 8.1-22).

Community metrics including Shannon diversity, Pielou's evenness, taxonomic richness, and organism abundance were compared across CMECS substrate groups as well as between nearshore and offshore samples using analysis of variance (ANOVA) tests. Additionally, the macrofauna community structures were also compared between CMECS groups and nearshore versus offshore samples. Raw abundances were fourth root transformed prior to multivariate analysis to reduce the weight of highly abundant taxa. Bray-Curtis similarities were used to compare the communities, which are visualized in NMDS plots (Figure 8.1-23 and Figure 8.1-24). Sample GB049 was found to be an outlier and was therefore excluded from analysis. This nearshore sample was collected by a separate contractor using a Van Veen grab, and it is likely that the smaller sample size caused the difference in results.

Comparison Between Nearshore and Offshore Samples

Infauna data were compared between nearshore and offshore samples to determine if the composition of benthic communities varies based on distance from shore. Nearshore samples (n = 26) were defined as those within state waters, and those within federal waters were considered offshore samples (n = 32).

Average diversity and taxonomic richness were significantly higher in offshore samples compared to nearshore samples (ANOVAs, $p < 0.05$). There was no statistically significant difference in the evenness of organisms between nearshore and offshore samples (ANOVA, $p = 0.10$), or in the density of organisms, which varied substantially between individual samples (ANOVA, p = 0. 34). Density values were log-transformed to better meet assumptions of normality associated with ANOVA. Figure 8.1-25 compares the mean and standard deviation values for community metrics such as density, taxonomic richness, diversity, and evenness.

Multivariate statistics were also used to compare the compositions of macrofauna communities between nearshore and offshore grab samples. An ANOSIM test conducted on fourth-root abundances using Bray-Curtis similarities detected a statistically significant difference between nearshore and offshore macrofauna communities (ANOSIM, $p = 0.001$, Global $R = 0.401$). SIMPER analysis revealed an average dissimilarity of 73.61% between nearshore and offshore samples, with amphipod *Pseudunciola obliqqua,* which was more abundant in nearshore samples, and polychaete *Polygordius jouinae*, which was more common offshore, as the two species most responsible for the dissimilarity. Benthic community composition comparisons are shown graphically in Figure 8.1-23 in the form of a NMDS plot; the physical distance between points represents the similarity of infauna communities between those samples.

Comparison Across CMECS Substrate Groups

Community metrics such as diversity, evenness, taxonomic richness, and total organism density were compared between samples classified in the CMECS substrate groups of Sand, Gravelly, and Gravel Mixes (Figure 8.1-26). ANOVA tests conducted on these data indicate that there were no statistically significant differences between sediment groups for any of these indices (ANOVA, all p > 0.05). Density data were log-transformed prior to testing to better meet assumptions of normality.

The structure of macrofauna communities were also compared between CMECS substrate groups using multivariate statistics. Macrofauna found in samples classified as Sand (n = 46), Gravelly (n = 9), and Gravel Mixes (n = 4) were compared, with statistically significant differences found across groups (ANOSIM, p = 0.001, Global R = 0.316). A graphical comparison of community structure is shown in Figure 8.1-24 as a NMDS plot.

Samples classified as Sand contained significantly different macrofauna communities compared to Gravelly (ANOSIM, p = 0.001, Global R = 0.281) and Gravel Mix substrates (ANOSIM, p = 0.002, Global R = 0.476). Because samples classified as Gravel Mix contained more gravel (30-80%) than Gravelly samples (5-30%), it is unsurprising that there was a larger effect (larger Global R value) observed between Sand and Gravel Mix samples than between Sand and Gravelly samples. Differences in community structure between Sand and Gravelly samples was driven by the amphipod species *Pseudunciola obliquua*, as well as the polychaetes *Spio setosa* and *Polygordius jouinae*. *Pseudunciola obliqqua*, as well as the polychaete *Brania wellfleetensis* and Oligochaeta spp., were most responsible for differences between samples classified as Sand and Gravel Mixes. No significant differences were detected between Gravelly and Gravel Mix substrate groups (ANOSIM, p = 0.715, Global R = -0.097).

It should be noted that grain size and infauna were collected from different attempts for four samples: GB028A, GB030A, GB036, and GB046. This means that the sediment used for grain size analysis was collected near the infauna sample (typically less than 5 m [16.4 ft] away) but was not extracted from the exact same sample. Statistically significant differences across CMECS groups, specifically between Sand and Gravelly and Sand and Gravel Mix substrates, were still present when these samples were excluded from analysis.

For additional information on infauna collected in the OECC during the 2023 field program, see the benthic factual report included in Appendix II-B13.

8.2 Mapping of Potential Sensitive Habitats

Benthic habitats are classified and mapped using NMFS's Recommendations for Mapping Fish Habitat (NMFS 2021) for the entire Offshore Development Area (see Section 8.2.1). In addition, information regarding specific sensitive habitats in New York state waters are described using information from state environmental agencies (see Section 8.2.2).

8.2.1 Essential Fish Habitat

NMFS's Recommendations for Mapping Fish Habitat (NMFS 2021) requires the following habitat areas to be mapped:

- Soft Bottom habitats (i.e., mud and/or sand)

- Complex habitats (i.e., SAV [submerged aquatic vegetation], shell/shellfish, and/or hard bottom substrate)
- Heterogeneous Complex habitats (i.e., mix of soft and complex stations within a delineated area)
- Large Grained Complex habitats (i.e., large boulders)
- Benthic features (i.e., ripples, megaripples, and sandwaves)

The sections below outline the data and methods used to create the essential fish habitat maps within the Lease Area and OECC while meeting NMFS (2021) guidelines. The full Essential Fish Habitat assessment is available in COP Appendix II-D.

Data Sources Used for Essential Fish Habitat Mapping

Within the Lease Area, sonar data acquired in 2022 as part of the geophysical field program provided the first layer of information regarding seafloor composition based on the acoustic reflectivity, which is a function of the bottom texture, roughness, slope, relief, and sediment grain size. For the OECC, geophysical coverage was acquired during the 2023 field program. These data allow for characterization of the seafloor substrate and are directly related to the types of habitats occupying the benthos and were therefore used to delineate habitat boundaries within the Lease Area.

Ground truthing surveys (grabs, video transects, and VCs) were also conducted in the Lease Area in 2022 and OECC in 2023. These data were also used to classify the types of habitats that are present. All geophysical data and ground truthing samples from the Lease Area and OECC have been used to create the habitat maps displayed in the MSIR and Essential Fish Habitat Assessment (COP Appendix II-D).

Mapping Procedure

Habitat boundaries were made using sonar data to delineate zones with different sediment types. Then, ground truthing samples were classified using the NMFS-modified CMECS classification system, which was then translated into a final classification of Soft, Complex, or Complex Mix (both soft and complex samples) for each station. Based on sonar reflectivity and classifications of video transects and grab samples, each delineated area was assigned to one of the four NMFS (2021) habitat categories: Complex, Heterogeneous Complex, Large Grained Complex, or Soft Bottom. Each of these categories is further described in the sections below. Sonar-delineated boundaries that bordered other boundaries of the same habitat category were kept as separate boundaries (i.e., not merged), to illustrate differences in seabed morphology that indicated potentially different benthic conditions. Benthic features (i.e., bedforms) in the Lease Area and OECC were also mapped using sonar data to align with the NMFS (2021) Recommendations.

The NMFS Recommendations for Mapping Fish Habitat (NMFS 2021) habitat classification system is particularly focused on hard bottom habitat and how it relates to essential fish habitat. Complex habitat is defined as hard bottom substrates, hard bottom with epifauna or macroalgae cover, and vegetated habitats (NMFS 2021). These are delineated areas where all ground truthing included Complex stations that showed hard bottom (defined in CMECS as the substrate groups: Gravels, Gravel Mixes, Gravelly, and Shell), or where sonar data appeared similar to areas with Complex stations. Heterogeneous Complex habitat is defined as delineated areas where ground truthing and/or sonar data showed both Complex habitat and Soft Bottom habitat. Large Grained Complex habitat is defined as delineated areas where ground truthing or sonar data showed rock outcrops or abundant large boulders (greater than 4 m [13.1 ft] in size). Soft Bottom habitat is defined as areas where all ground truthing samples showed sand or mud. Varying amounts of Soft Bottom and Heterogeneous Complex habitats were found within the Lease Area and OECC and are discussed in the following sections. No Complex or Large Grained Complex habitats were identified in the Offshore Development Area. It should be noted that habitat boundaries can be gradational in nature, particularly between Soft Bottom and Heterogeneous Complex habitats. Occasional, isolated boulders may be found in all habitat types.

The definition of Complex in the NMFS (2021) mapping recommendations has a small grain size threshold (greater than 2 mm [0.08 in]) and low composition threshold (greater than 5% gravel), making it a very conservative classification system. Therefore, many ground truthing samples may be classified as Complex, potentially more so than if other classification systems had been used (e.g., Auster [1998] or USCS). Many of the samples that are considered Complex, such as those in the Gravelly Group, have low percentages of gravel (5 to 30%) and a small grain size of Pebble/Granule (2 - 64 mm [0.08 - 2.5 in]).

See Appendix II-B2 for the complete methodology of the Benthic and Essential Fish Habitat mapping. Additionally, see Appendix II-B4 for a complete set of plan view charts of the Lease Area and the OECC showing full sonar data coverage from 2022 and 2023 with the habitat mapping data along with associated screen captures and pictures from ground truthing samples.

8.2.1.1 Lease Area

The Lease Area is comprised of primarily Soft Bottom habitat, with some patches of Heterogeneous Complex habitat also present (Figure 8.2-1). Video transects and grab samples collected in 2022 indicate that sediment within Soft Bottom habitats consists of primarily Medium Sand and Very Coarse/Coarse Sand. Patches of Silty Sand were also identified on sonar and video transect imagery within the northern parts of the Lease Area (Figure 8.2-2).

Heterogeneous Complex habitat present within the Lease Area contains Gravelly Sand to Sandy Gravel with a gravel component of Pebble/Granule. Video transects conducted within the Lease Area in 2022 indicate that these patches of gravel are discontinuous, with areas of soft sediment surrounding patches of gravel, which are typically found in ripple troughs. Heterogeneous

Complex habitat is most abundant in the northern part of the Lease Area, except for some smaller patches present towards the center and southern portions of the Lease Area (Figure 8.2-1).

It should be noted that one video transect (VT026) on the eastern side of the Lease Area also showed two small patches of Shell Hash where shell fragments were found in ripple troughs (Figure 8.2-3). The concentration of shell fragments only exceeded 50% for short portions of the video transect, and each of these areas measures less than 4 m (13 ft) in length. There are no distinct differences in the sonar reflectivity, making it difficult to accurately delineate Heterogeneous Complex habitat around this feature. This, combined with the size of the feature, which is less than the NMFS (2021) minimum mapping unit of 100 m^2, led to the decision to not add any habitat boundaries around the shell patches observed on this video transect. However, it should be noted that there could potentially be small areas containing Shell Hash interspersed with Soft Bottom habitat in this region of the Lease Area.

Ripples are present throughout nearly the entire Lease Area, except within the patches of Silty Sand in the northern section of the Lease Area (Figure 8.2-2). These ripples are typically small, with wavelengths measuring less than 1.5 m (4.92 ft) and wave heights less than 20 cm (0.66 ft). The ripples are typically oriented in a NNE to SSW direction. No megaripples or sandwaves were identified in the Lease Area.

Detailed charts of the benthic habitats present in the Lease Area can be found in Appendix II-B4.

8.2.1.2 Offshore Export Cable Corridor

The 2023 field program data (sonar and results from benthic grab samples, video transects, and VCs) as well as publicly available datasets of benthic grab samples (usSEABED database) were used to characterize the habitats present within the OECC. These habitats are described in the subsections below, which have been divided into offshore (federal) and nearshore (state) waters. Detailed benthic habitat charts showing the habitats identified within the OECC can be found in Appendix II-B4.

Offshore

Soft Bottom habitats are the dominant habitat type observed in the offshore portion of the OECC between KP 0 and KP 50.1. KP 0 to KP 21.8 is comprised of almost exclusively soft sediments, with the exception of some areas of Heterogeneous Complex habitat near the Lease Area between KP 0 and KP 0.8 (Figure 8.2-4). Occasional regions of Heterogeneous Complex habitat, containing patchy gravel in the form of Pebble/Granule, become more common between KP 21.8 and KP 50.1 and between KP W0 and W4 within the Western Landfall Sites OECC Variant in federal waters (Figure 8.2-7).

Ripples are common throughout the offshore portion of the OECC with wavelengths measuring less than 1.5 m (4.92 ft) and heights less than 20 cm (0.66 ft). No megaripples or sandwaves were observed, though there are irregular seafloor features located offshore between KP 0 and KP 37.4 which have wavelengths ranging between 15 and 175 m (49 and 574 ft). However, these features have heights measuring less than 0.5 m (1.64 ft) and therefore do not meet the BOEM bedform general classifications of megaripples or sandwaves as outlined in the Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585 (BOEM 2023b). Rippled areas can provide habitat value for some fish species (Normandeau 2014).

Tube mats believed to be constructed by the amphipod *Ampelisca vadorum*, were identified in the OECC scattered between KP 21.8 and KP 49.5 (Figure 8.2-5 and Figure 8.2-6). These features were observed on 8 video transects (VT015, VT016, VT020, VT021, VT023, VT024, VT028, and VT034). Tubes often had a patchy distribution throughout the video transect, with high densities (70-100% coverage) observed in some areas, and an overall absence of tubes in others. Two grab stations had these tubes visible on the grab sample video footage (GB017 and GB021) and contained large numbers of *Ampelisca vadorum*.

Like many other members of its genus, *Ampelisca vadorum* is a documented tube builder (Steimle 1982); combining muddy sediments with glandular secretions to construct these structures (Cadien 2015). Tube mats were observed in Soft Bottom areas, as well as within sediments classified as Gravelly Muddy Sand where gravel concentrations were low (5-20%), and the soft portion of the substrate was used to construct the structures. It should be noted that the extent of these features is not necessarily permanent and can vary over time (Maciolek et al. 2010), and figures display the interpreted distribution of these tube mats at the time of survey. Additionally, habitat boundaries delineating the tube mat feature are gradational in nature, and occasional observations of low densities of tubes were made just outside of the marked polygons. The limits represented on the maps are the best approximation of a boundary containing the majority of this feature. Further information regarding grab sample and video transect results, including observations of tube mats, can be found in the 2023 OECC Benthic Factual Report located in Appendix II-B13.

Nearshore

Soft Bottom and Heterogeneous Complex habitats are common within nearshore (state) waters from KP 50.1 to the landfall site(s). Ripples are also abundant and were frequently observed on sonar imagery and video transects close to shore. Ripple wavelengths measure less than 1.5 m (4.92 ft) and heights less than 20 cm (0.66 ft). Some ripples are located within ripple scour depressions (RSDs), which are abundant shoreward of KP 40.5 offshore and within state waters. These RSDs are classified as Heterogeneous Complex habitats and primarily consist of Gravelly and Gravel Mix sediments, which were often observed in ripple troughs (Figure 8.2-7). Ripples are also present within Soft Bottom habitats within state waters and can often be found continuing out from the western edge of RSDs, particularly between KP 52 and KP 73.

Nearly all gravel observed in the OECC had a component of Pebble/Granule, though some potential boulders were identified between KP 62.7 and KP 64.2 using sonar imagery. Two transects (VT040 and VT064) showed the presence of Shell Hash, with shell concentrations between 50% and 65%. Complex and Large Grained Complex habitats are absent from the OECC.

No amphipod tube mats were observed within state waters. Detailed descriptions of the habitats observed within nearshore waters are included in Table 8.2-1. Figure 1.1-2 shows the nearshore portion of the OECC with each landfall approach labelled.

Table 8.2-1 Description of Habitats Observed in Nearshore Waters within the OECC

OECC Segment	Description of Habitats Present
Main Segment in State Waters	KP 50 to KP 52 contains mostly flat, Soft Bottom habitat. KP 52 to KP 53.5 contains Heterogeneous Complex habitat within an RSD, with Soft Bottom habitat containing ripples continuing to KP 55. Habitats between KP 55 to KP 58.3 alternate between flat Soft Bottom habitat and ripples, which have been classified as Heterogeneous Complex in some areas due to the presence of Pebble/Granule. A small amount of Shell Hash was also observed within the Heterogeneous Complex habitat near KP 57.4. This pattern of alternating Soft Bottom and Heterogeneous Complex habitats continues between KP 58.3 and KP 70, though flat seafloor becomes less common as ripples begin to dominate the Soft Bottom areas. Some areas of potential boulders were identified between KP 62.7 and KP 64.2.
Western Landfall Sites OECC Variant	Ripples cover the majority of the Western Landfall Sites OECC Variant between KP W0 and KP W3.3. Some small patches potentially containing amphipod tube mats are present between KP W0 and KP W0.7. Flat, Soft Bottom habitat covers KP W3.3 to KP W5.2. KP W5.2 to KP W9 alternates between Heterogeneous Complex (containing patchy gravel) and Soft Bottom habitats, with ripples dispersed throughout. It should be noted that a portion of the Western Landfall Sites OECC Variant (KP W0 to KP W4) is located within federal (offshore) waters, despite being described in this table.
Rockaway Beach Approach	The Rockaway Beach Approach consists of Soft Bottom and Heterogeneous Complex habitats. RSDs cross the OECC along the Rockaway Beach Approach, which contain gravel in the form of Pebble/Granule in the ripple troughs and have been classified as Heterogeneous Complex habitat. Additional ripples without gravel are present in some Soft Bottom habitat areas. Patches of silty sand may also be present (for instance, between KP 74 and KP 75).
Atlantic Beach Approach	One larger RSD categorized as Heterogeneous Complex crosses the Atlantic Beach Approach between KP A70.5 and KP A72. Ripples are common, and smaller Heterogeneous Complex RSDs are also present. A region of silty sand was observed near KP A71.5.
Jones Beach Approach	The Jones Beach Approach is dominated by Soft Bottom habitat, with some small RSDs containing Heterogeneous Complex habitat present between KP J51 and KP J53. A small patch of Shell Hash was also observed within the Heterogeneous Complex habitat near KP J52. Ripples cover most of the Approach between KP J53 and KP J55, with zones Heterogeneous Complex habitat present between KP J53.6 and J55.

8.2.2 State-Mapped Sensitive Habitats

This section presents areas which have been mapped as sensitive habitats by the state of New York, including significant coastal fish and wildlife habitats, significant natural communities, and regulatory tidal wetlands.

The New York State Department of Environmental Conservation (NYSDEC) published a New York Action Plan in 2017, which aims to synthesize what is known about the status of ocean ecosystems, develop short-term and long-term goals to produce positive outcomes for natural systems and human activities, and improve understanding on how interrelated components of the ocean ecosystem function. The Action Plan is divided into four goals, each containing multiple objectives and action items which are designed to meet these goals. The most relevant of these goals is "Goal 1: Ensure the ecological integrity of the ocean ecosystem", which includes the objective to protect and restore sensitive inshore, offshore, and estuarine habitats (NYSDEC 2017).

Significant Coastal Fish and Wildlife Habitats

NYSDEC has designated certain areas as significant coastal fish and wildlife habitats, which are defined in the New York Codes, Rules, and Regulations (Title 19 § 602.5) as habitats which:

- "Exhibit to a substantial degree [of] one or more of the following characteristics:
    - The habitat is essential to the survival of a large portion of a particular fish or wildlife population (e.g., nursery grounds, feeding areas).
    - The habitat supports a species which is either endangered, threatened, or of special concern as those terms are defined at 6 NYCRR Part 182.
    - The habitat supports fish or wildlife populations having significant commercial, recreational, or educational value.
    - The habitat is of a type which is not commonly found in the State or a coastal region of the state; and
- Are varying degrees difficult or even impossible to replace in kind."

Figure 8.2-8 shows the location of areas near the OECC which have been formally classified as significant coastal fish and wildlife habitat by NYSDEC. These areas are separate from EFH, and only include habitats located within New York state waters. None of these boundaries overlap with the OECC, though the shores of Jones Beach West (located near the Jones Beach Approach) and Silver Point Beach (located near the Atlantic Beach Approach) have been designated as significant coastal fish and wildlife habitat. Many back bay habitats on Long Island have also been classified as significant.

Significant Natural Communities

The state of New York defines significant natural communities as "rare or high-quality wetlands, forests, grasslands, ponds, streams, and other types of habitats, ecosystems, and ecological areas" (NYSDEC 2023a). Though they do not overlap with the OECC, there are significant natural communities near each of the three landfall sites, as nearly all the beaches on the south shore of Long Island have been classified as significant along with many back bay habitats. Figure 8.2-9 shows the location of significant natural communities near the OECC.

Regulatory Tidal Wetlands

Tidal wetlands provide key ecosystem services, such as shoreline stabilization and storm protection, water filtration, and detoxification. They also act as nursery habitat for ecologically and economically significant species of fish and crustacean (Purcell et al. 2020). The state of New York has mapped the distribution of wetlands and associated regulatory areas on Long Island (Figure 8.2-10). No marshes or vegetation overlap with the OECC, and all three landfall sites are classified as 'littoral zone,' which includes "all lands under tidal waters which are not included in any other [wetland habitat] category, extending seaward from shore to a depth of six feet at mean low water" (NYSDEC 2023b). Intertidal marsh and coastal shoals, bars, and mudflats are present in the back bay environments inland of the OECC landfall site(s) (Figure 8.2-10).

8.2.3 Observed Fisheries Species Information

More than 300 fish species are believed to occur in marine ecosystems near New York and use the area for feeding, growth, and reproduction (NYSDEC 2017). Underwater video imagery provides insight into some of the animals inhabiting or using the benthic habitats in the Offshore Development Area. These data were compared to public information available on Essential Fish Habitat (EFH) as well as habitats on the continental shelf and nearshore embayments of Long Island, New York. For a detailed summary of historical and current research results on EFH, see COP Appendix II-D. While it is understood that EFH covers large offshore regions based on different datasets, results from the underwater video footage can reveal distinct locations where higher concentrations of fish were observed within the Offshore Development Area. Extrapolation of the video imagery to surrounding seabed areas based on the sonar data allows an estimation of sections in the Offshore Development Area where enhanced bottom structure supportive of more abundant fish communities may exist.

Video footage was collected from the Lease Area during the 2022 field program, and from the OECC during the 2023 field program. Fisheries managed species observed on video transects from these field programs are summarized below in Table 8.2-2. Each of the species listed below has EFH overlapping with a portion of the Offshore Development Area. Most frequently observed species included the Atlantic butterfish (*Peprilus triacanthus*), Atlantic sea scallops (*Placopecten magellanicus*), longfin squid (*Loligo pealeii*), scup (*Stenotomus chrysops*), little skate (*Leucoraja erinacea*), and witch flounder (*Glyptocephalus cynoglossus*). Butterfish were primarily found in the northeastern portion of the Lease Area, while Atlantic sea scallops, longfin squid, and witch flounder were found distributed throughout the Lease Area.

Some frequently observed species, such as Atlantic sea scallops, scup, and squid, were more abundant in some portions of the OECC than others. Atlantic sea scallops were only observed offshore and were most common in Soft Bottom habitats, though there were some occasional observations made within Heterogeneous Complex areas. Scup and squid were observed throughout the OECC but were both much more common shoreward of KP 44.7. Observations of squid, little skate, and butterfish were distributed throughout the OECC and did not display any clear spatial trends.

An abundance of drag scars have been identified throughout the Lease Area using sonar. A high density of drag scars exists particularly in the northeastern portion of the Lease Area, indicating that an abundance of fishing activity is likely (Figure 8.2-11). Drag scars were also observed in the OECC within both federal and state waters and were most abundant between KP 14.2 and KP 40.2, as well as between KP W5.7 and KP 63 (Figure 8.2-12).

Table 8.2-2 Fisheries Species Observed During 2022 and 2023 Field Programs

Fisheries Species		Area Observed		Total Number Observed
Common Name	Scientific Name	Lease Area	OECC	
Atlantic butterfish	*Peprilus triacanthus*	957	45	1,002
Atlantic sea scallop[1]	*Placopecten magellanicus*	622	14	636
Atlantic surf clam	*Spisula solidissima*	12	0	12
Black seabass	*Centropristis striata*	0	1	1
Bluefish	*Pomatomus saltatrix*	0	5	5
Little skate	*Leucoraja erinacea*	20	50	70
Longfin squid	*Loligo pealeii*	75	8	83
Northern shortfin squid	*Illex illecebrosus*	0	9	9
Quahog[2]	*Veneridae*	13	0	13
Red hake	*Urophycis chuss*	3	1	4
Scup	*Stenotomus chrysops*	0	71	71
Spiny dogfish	*Squalus acanthias*	0	12	12
Summer flounder	*Paralichthys dentatus*	3	12	15
White hake	*Urophycis tenuis*	0	2	2
Winter flounder	*Pseudopleuronectes americanus*	5	2	7
Winter skate	*Leucoraja oceallata*	1	0	1
Witch flounder	*Glyptocephalus cynoglossus*	61	0	61

Fisheries Species		Area Observed		Total Number Observed
Common Name	Scientific Name	Lease Area	OECC	
Unidentified flounder[3]	Pleuronectiformes	9	25	34
Unidentified hake[3]	Phycidae	0	3	3
Unidentified skate[3]	Rajidae	7	1	8
Unidentified squid[3]	Coeloidea	0	60	60

Notes:

1. The common name deep sea scallop may also be used for this species in some datasets, such as the Lease Area digital data.
2. EFH for ocean quahogs (*Arctica islandica*) overlaps with portions of the Offshore Development Area. Due to the speed of the remotely operated vehicle (ROV), distance above the seafloor, and burrowing nature of these bivalves, it was not always possible to identify quahogs to a species level from video footage. Instead, quahogs were identified to the family level (*Veneridae*).
3. Due to the fast-moving nature of some flounder, hake, skate, and squid, not all individuals were identifiable to the species level. However, these data are included in Table 8.2-2 because some counts may be attributable to species which possess EFH within the project area.

In addition to EFH zones, there are also Habitat Areas of Particular Concern (HAPC) that encompass subsets of EFH and include areas that are particularly vulnerable to degradation or have extreme ecological importance. There are no HAPCs which overlap with the Offshore Development Area, though there is HAPC for summer flounder (*Paralichthys dentatus*) relatively close to each landfall site. Three summer flounder were observed in the Lease Area during the 2022 field program, and all observations were recorded in Soft Bottom habitat. Twelve summer flounder were observed in the OECC during the 2023 field program where they were found inhabiting both Soft Bottom and Heterogeneous Complex habitats within federal and state waters.

Skates, including little skates, were observed during the 2022 and 2023 field programs. One winter skate (*Leucoraja oceallata*) was identified in the Lease Area. It is possible that some of the skates listed as unidentified in Table 8.2-2 are also winter skates, as they are difficult to distinguish from little skates at smaller sizes using video imagery alone (Frisk and Miller 2006). Clearnose skates (*Raja eglanteria*) were also frequently recorded in the Lease Area and the OECC, though they do not have EFH overlapping with the Offshore Development Area. Skate egg cases were common throughout the Lease Area and the OECC in both Soft Bottom and Heterogeneous Complex habitats, indicating that these areas may be used for reproduction. Squid mops were also observed five times along four video transects in the OECC (VT014, VT039, VT044, VT062), though none were identified in the Lease Area.

For more information regarding EFH and potential development impacts on fisheries species, please see the Essential Fish Habitat Assessment in COP Appendix II-D. For additional details regarding the fauna observed during the 2022 and 2023 field programs, please see the benthic factual reports located in Appendix II-B13.

8.3 Protected Species Observation Results

Section 8.3 is redacted in its entirety.

9 CONCLUSIONS AND SUMMARY

Section 9 is redacted in its entirety.

10 REFERENCES

Section 10 is redacted in its entirety.