VINEYARD MID-ATLANTIC

CONSTRUCTION AND OPERATIONS PLAN

VOLUME II

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Appendix II-R Benthic Habitat Monitoring Plan Framework

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Revision	Date	Description
0	January 2024	Initial submission.
1	September 2024	Updated to incorporate revisions to the Project Design Envelope.
1	January 2025	Resubmitted without revisions.

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1 Benthic Habitat Monitoring Plan Framework

1.1 Vineyard Mid-Atlantic 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. At its closest point, the 174 square kilometer (km^2) (43,056 acre) Lease Area is approximately 38 kilometers (km) (24 miles [mi]) south of Fire Island, New York (Figure 1.1-1).

1.2 Description of Benthic Habitat Monitoring Framework

The Proponent is committed to developing a Benthic Habitat Monitoring Plan (BHMP) for Vineyard Mid-Atlantic in consultation with federal and state agencies. This document serves as a BHMP framework and provides an overview of the plan that will be developed, as more data become available. The BHMP will provide an analysis of potential impacts and recovery to seafloor habitat and associated benthic communities. Various impact variables/measurements and metrics will be compared to control sites located outside of the areas impacted by proposed construction activities. As described in Section 1.2.2, the survey design will include a collection of bathymetry, underwater video, and benthic grab sample data.

Benthic habitat monitoring is essential for analyzing the environmental impact of construction activities on the benthic habitat and organisms located within the Lease Area and the OECC. The BHMP will provide baseline data and a basis for assessing potential impacts on the infaunal biodiversity, abundance, and community structure of habitat, micro and macro-invertebrates, and fish assemblages within the control and the impact source areas. Surveys will also provide information for making assessments of seafloor sediment morphology and substrate within these areas of concern.

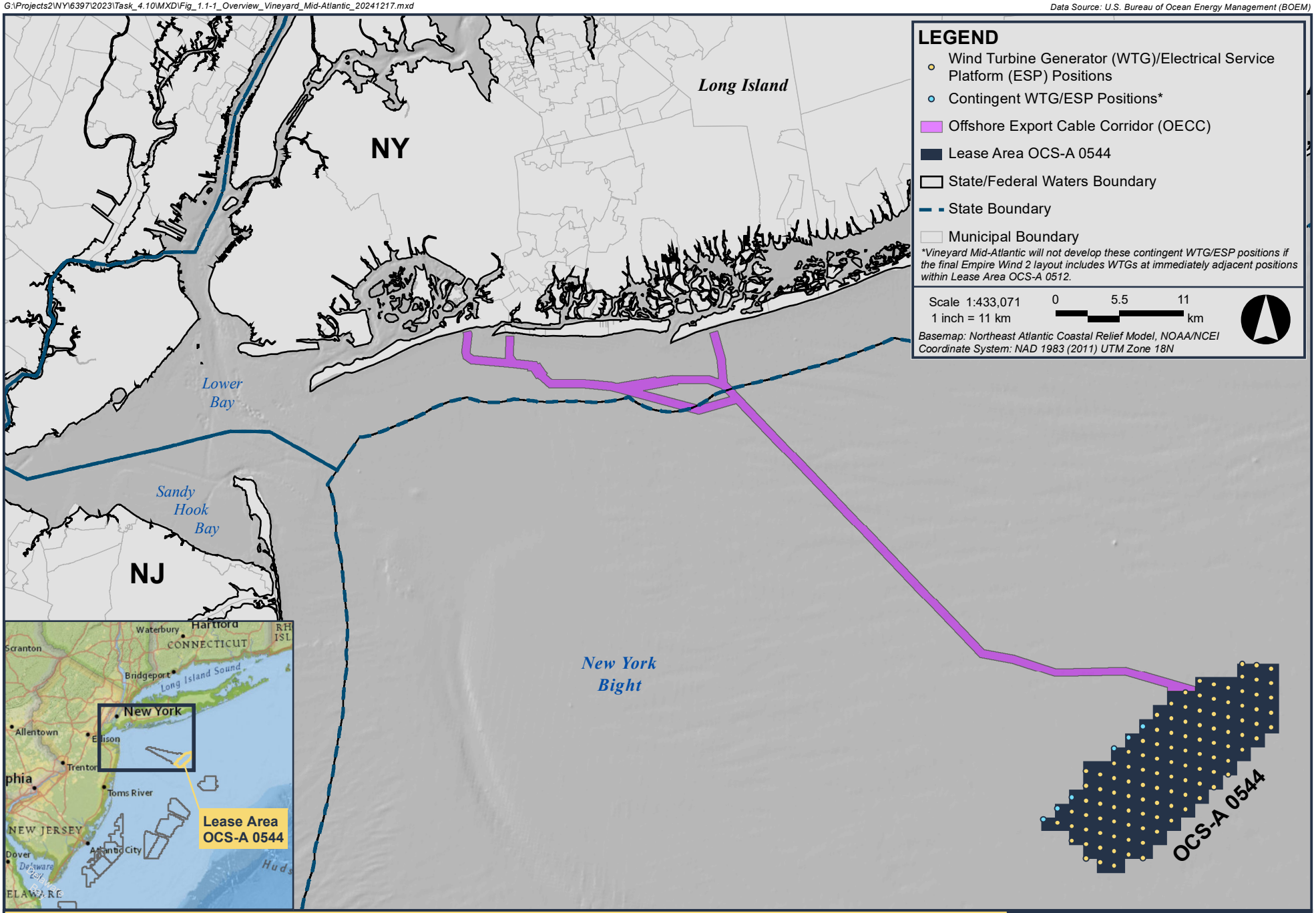

Figure 1.1-1
Overview of Vineyard Mid-Atlantic

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The draft BHMP framework is being developed using the best available information and best practices with an analysis of existing benthic survey information to determine the sample size needed for sufficient statistical power (Borja et al. 2000; Van Hoey et al. 2007; Borja and Dauer 2008; Daan et al. 2009; Degraer et al. 2013; Franco et al. 2015; Degraer et al. 2017; HDR 2017; Hutchison et al. 2020). The following guidelines and reviews are being used to inform the design of the BHMP:

- Developing Environmental Protocols and Modeling Tools to Support Ocean Renewable Energy and Stewardship—a BOEM-funded review of existing monitoring protocols for effects of offshore renewable energy (McCann 2012);

- Offshore Wind Energy Development Site Assessment and Characterization: Evaluation of the Current Status and European Experience—a BOEM-funded review of site assessment and characterization methods for offshore wind in both the United States (US) and Europe (Rein et al. 2013);

- Monitoring Guidance for Marine Benthic Habitats—a marine benthic habitat monitoring guidance report developed by the Joint Nature Conservation Committee of the United Kingdom (UK) (Noble-James et al. 2017);

- Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland (Saunders et al. 2011);

- Responsible Offshore Science Alliance (ROSA) Offshore Wind Project Monitoring Framework and Guidelines (ROSA 2021);

- BOEM's Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf (BOEM 2019); and

- National Marine Fisheries Service (NMFS) Recommendations for Mapping Fish Habitat (NMFS 2021).

A lack of a "one-size-fits-all" approach is theme highlighted in the literature, so appropriate monitoring protocols must be developed on a case-by-case basis (McCann 2012). Despite the multitude of options for conducting benthic habitat assessments and monitoring (Warwick et al. 2010), some basic standards and guidelines are available (e.g., ROSA 2021). First, using standardized protocols is important for comparison over time and between projects within an area. They are also essential for examining cumulative impacts on the environment.

A structured, repeatable classification system must be applied to quantitatively compare habitat. BOEM and NMFS have provided guidelines suggesting benthic habitat should be classified according to the Coastal and Marine Ecological Classification Standard (CMECS) to the lowest taxonomic unit possible (BOEM 2019; NMFS 2021). The CMECS standard is a

hierarchical system of classifying ecological units in the marine environment (FGDC 2012). For the quantitative assessment outlined in this BHMP framework, the benthic habitats and communities surveyed will be classified under the CMECS standard.

The Proponent will continue developing this BHMP as more data become available and the project progresses toward construction of the facilities, such as the foundation structures and OECC. The BHMP focuses on seafloor habitat and benthic communities to measure potential impacts and the recovery of these resources compared to control sites (referred to as "control stations") located outside of the areas potentially impacted by construction activities (referred to as "impact stations"). As described further in Section 1.2.2, the survey design includes collection of bathymetric data, video data, and benthic grab sample data.

1.2.1 Habitat Zones

The Proponent will be developing habitat zones based on data obtained from geophysical and geotechnical site assessment surveys conducted within the Lease Area and the OECC, including multibeam, side scan sonar, magnetometer, grab samples, vibracores, and underwater imagery. The habitat zones will be defined by primary seabed characteristics including surficial sediment types/geology, seafloor features, and general benthic conditions. Transects for benthic habitat monitoring will be conducted within each habitat zone using a representative sample size for each location within the habitat zone. A power analysis will be completed to determine the number of benthic grab sample stations and location of underwater video transects within each habitat zone. The transects and sampling stations will be conducted following the experimental survey design.

1.2.2 Survey Design

The Proponent will utilize a combination Before-After Gradient (BAG)/ Before-After Control-Impact (BACI) sampling design to assess potential impacts. These approaches will consist of collecting samples at specific distances from the impact source (either scour protection or offshore export cable) along impact monitoring transects. These surveys will also include control stations located outside of impact monitoring areas for comparison purposes. It is generally recommended that control sites be placed where similar environmental conditions (substrate type, hydrodynamics, other anthropogenic impacts) to those at the impact sites also occur (McMann 2012). The proposed BAG/BACI design integrates portions of each sampling design, which will be used to provide an in-depth analysis of impacts and recovery of benthic habitat and organisms.

BAG/BACI design sampling will consist of randomly selected benthic monitoring transects within the habitat zones identified within the Lease Area and the OECC (see Section 1.2.1). The number of transects and sampling stations will be based on the power analysis, which will be determined as development progresses. The analyses would assess whether there is a significant (25%) difference in benthic community metrics (e.g., abundance, density, or other indicator) between pre-construction and post-construction (i.e., before and after-impact). A

25% change in community indices has been used before in benthic monitoring studies and has been found to be detected with power close to 80% for most benthic taxa (Lambert et al. 2017). The sampling data would be used to statistically compare potential differences between the control and monitoring areas, and between sampling locations at various distances from the impact source.

The statistical analysis will consist of an *a priori* power analysis using G*Power software to determine the locations and representative sample size of the benthic grab samples collected within the Lease Area and OECC. The benthic grab samples will then be analyzed to determine changes in the environmental indices mentioned above. An 80/20% power analysis will be used to accept or reject the null hypothesis and a 95% (0.05) confidence interval will be used to determine whether there is a significant difference of 25% or greater between the Lease Area and OECC samples and the control samples, sample stations and impact source, and before and after construction. The following null hypotheses will be tested based on a three-factor analysis of variance:

- H_{01}: There will be no difference in benthic community metrics (e.g., abundance, diversity, or other indicator) or grain size distribution (e.g., CMECS classification) between impact and control areas before and after construction.

- H_{02}: There will be no difference in benthic community metrics along a gradient of distance from potential impact sources (i.e., WTGs or OECC) before or after construction.

Effect size, or the expected change to be detected, will be estimated based on the variability in infaunal community diversity from the benthic grab samples. Diversity will be used as the environmental index due to the relative sensitivity based on abundance and evenness of the community metrics which creates a representative sample of the benthic community in the sample areas. The grab samples will then be analyzed using G*Power 3.1 (Faul et al. 2009) and statistically calculated to detect a 25% change in benthic community diversity to illustrate the representative number of grab samples, sample stations, and transects and determine whether there is a change in the previously mentioned parameters.

Additional analyses would include data collecting from the following:

- Multi-beam echo sounder surveys

- Benthic grab samples

- Underwater video surveys

Video and multi-beam echo sounder (i.e., bathymetry) surveys will be performed in a "t" pattern, which consists of a long axis perpendicular to the OECC and the short-axis parallel to the cable alignment. Video monitoring surveys will also be captured both perpendicular and parallel to the cable or WTG foundation along each transect.

A representative number of benthic grab samples will be collected at locations (also referred to as sample stations) along a gradient extending from the impact source (either scour protection or offshore export cable). Stations will be positioned within the impact area adjacent to the impact source (approximately 0 meter (m) [0 foot (ft)]) and at specified distances from the impact source, to be determined by the power analysis; three replicate grab samples will be collected at each station. Collecting multiple samples at each station provides a better assessment of small-scale variability, improves the precision of the mean indices, and increases the capture of rare, uncommon, or unevenly distributed organisms, while also reducing the effects of small sample size bias (Gotelli and Ellison 2004; Noble-James et al. 2017). Replicated grab samples will be examined separately to analyze variation within the station and then averaged to provide a representation of each sampling station along the transects.

Control stations will consist of video footage and one grab sample station, which will be located at a specific distance away from the nearest impact grab station, which will be determined by the power analysis specified above. OECC transects will have a specified distance between control and impact grab stations within each habitat zone, which will be highly dependent on the gradient sampling design and will be determined by the power analysis specified above. In addition, control station locations may be further refined during the planning stages of survey execution phase with consideration for site accessibility (e.g., water depth, health and safety concerns, proximity to other marine users, etc.). Lease Area control stations will be located outside the Lease Area boundary in areas designated by the Fisheries Monitoring Plan.

The grab sample and video data will be used to monitor potential change (as recommended by McCann 2012) in the following:

- Infaunal density, diversity, and community structure (benthic grabs);
- Seafloor morphology and structure (multi-beam echo sounder);
- Medium grain-size (benthic grab and underwater video); and
- Abundance, diversity, and percentage of epibenthic species, with specific focus on biologically important species and those colonizing hard structures (i.e., reef effects; underwater video).

The sampling design will be based on statistical power analyses, which will determine the number of samples taken within each habitat zone and the distances between the control and impact stations for a representative assessment of sedimentation and benthic organisms.

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