VINEYARD NORTHEAST

CONSTRUCTION AND OPERATIONS PLAN
VOLUME II APPENDIX

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VINEYARD OFFSHORE

PUBLIC VERSION

Vineyard Northeast COP

Appendix II-R Benthic Habitat Monitoring Plan Framework

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Revision	Date	Description
0	April 2023	Initial submission.
1	November 2023	Made minor revisions.
1	March 2024	Resubmitted without revisions.

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1.1 Vineyard Northeast Overview

Vineyard Northeast 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 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast." Vineyard Northeast includes 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. Up to three of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut. If high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[1] of Lease Area OCS-A 0534. Figure 1.1-1 provides an overview of Vineyard Northeast.

1.2 Description of Benthic Habitat Monitoring Framework

The Proponent is committed to developing a Benthic Habitat Monitoring Plan (BHMP) for Vineyard Northeast 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 objective of the BHMP will be to monitor recovery after construction in areas with sensitive habitats where similar post-construction monitoring has not already been conducted for other projects (such as along the OECCs). 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 OECCs. 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.

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1 An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

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 of existing methods and protocols 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 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 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).

There is a lack of a "one-size-fits-all" approach in the literature; thus, 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 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.

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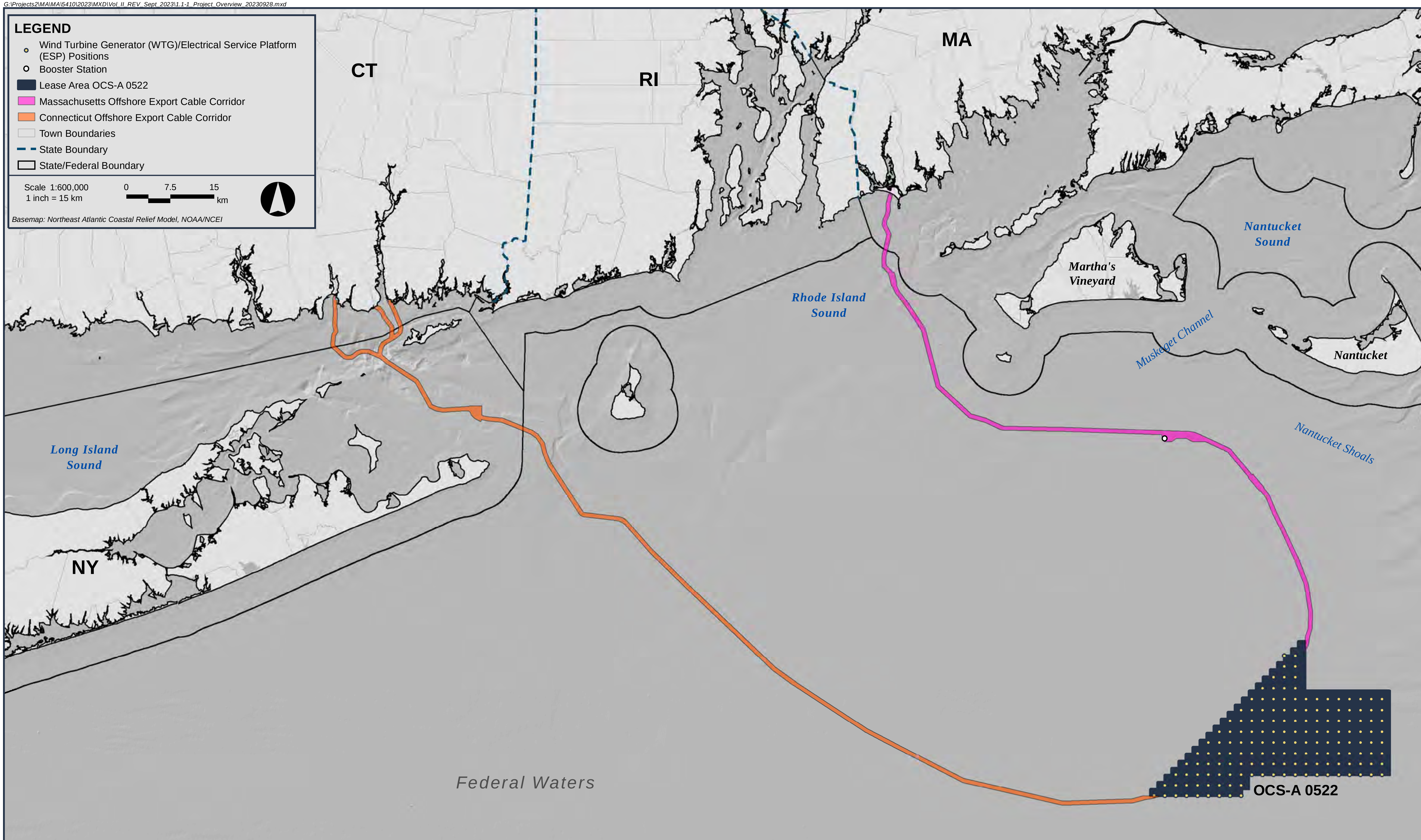

Figure 1.1-1
Overview of Vineyard Northeast

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As stated, the Proponent will continue to develop the BHMP as more data become available and Vineyard Northeast progresses toward construction of the offshore facilities, such as the foundations and offshore export cables. The BHMP will focus 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").

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 OECCs, 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.

The BAG/BACI design will consist of randomly-selected benthic monitoring transects and benthic grab samples within the habitat zones identified within the Lease Area and the OECCs (see Section 1.2.1). As development of Vineyard Northeast progresses, a statistical analysis will be conducted consisting of an *a priori* power analysis using a G*Power software to determine the number of transects and locations and representative sample size of the benthic grab samples to be collected within the Lease Area and OECCs. A power analysis estimates the necessary sample size to detect changes in environmental indices at a particular power level. It is based on the size of the effect, tests to be run, and the specified level of power and significance (Antcliffe 1992). The level of power is commonly defined as 0.80, which represents an 80% chance of detecting an effect where one exists, or a 20% chance of failing to reject the null hypothesis when it is false (Type II error). The significance is usually set to 0.05, which represents a 5% chance of detecting an effect where one does not exist, or incorrectly rejecting the null hypothesis when it is true (Type I error) (Cohen 1988; Antcliffe 1992; Noble-James et al. 2017). The analysis would assess whether there is a significant (25% or greater) 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% or greater change in community indices has been used previously in benthic monitoring studies and has been found to be detected with a level of power close to 80% for most benthic taxa (Lambert et al. 2017). 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) 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., foundation location or offshore export cable) 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% or greater 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 collection 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 foundation location that occurs along each impact monitoring 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 m) 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 based on 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 also be determined by the power analysis specified above. In addition, control station locations may be further refined during the planning stages of the 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.

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).

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