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VINEYARD WIND

Vineyard Wind Connector 2: Analysis to Support Petition Before the Energy Facilities Siting Board

Docket #EFSB 20-01

Volume I: Text
May 28, 2020

Submitted to
Energy Facilities Siting Board
One South Station
Boston, Massachusetts 02114

Submitted by
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In Association with
Foley Hoag LLP
Stantec, Inc.
Gradient
Geo SubSea LLC

Epsilon
ASSOCIATES INC.

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VOLUME II – FIGURES AND ATTACHMENTS

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ATTACHMENTS

List of Acronyms

AC	Alternating Current
ACEC	Areas of Critical Environmental Concern
ADT	Average Daily Trips
AIS	Air Insulated Substation
AUL	Activity Use Limitation
BACT	Best Available Control Technology
BMP	Best Management Practices
BOEM	Bureau of Ocean Energy Management
BVW	Bordering Vegetated Wetlands
BWSC	Bureau of Waste Site Cleanup
CAA	Clean Air Act
CBA	Community Benefits Agreement
CCC	Cape Cod Commission
CES	Clean Energy Standards
CIP	Copenhagen Infrastructure Partners
CMP	Construction Management Plan
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide Equivalent
COA	Corresponding Onshore Area
COMM	Centerville-Osterville-Marstons Mills
COP	Copenhagen Offshore Partners
COP	Construction and Operations Plan
CPT	Cone Penetration Test
CRMC	Coastal Resource Management Council
CSA	Cone Penetration Tests
CTV	Crew Transfer Vessel
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dBA	A-weighted Broadband
DEEP	Department of Energy and Environmental Protection
DEIR	Draft Environmental Impact Report
DEP	Department of Environmental Protection
DMF	Division of Marine Fisheries
DOER	Department of Energy Resources
DP	Dynamic Positioning
DPA	Designated Port Areas
DPU	Department of Public Utilities
DPW	Department of Public Works
DRI	Development Regional Impact

List of Acronyms (Continued)

EA	Environmental Assessment
EDC	Electric Distribution Companies
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EFSB	Energy Facilities Siting Board
eGRID	Emissions & Generation Resource Integrated Database
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMF	Electric and Magnetic Fields
ENF	Environmental Notification Form
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESP	Electrical Service Platform
FAA	Federal Aviation Administration
FAB	Fishermen's Advisory Board
FCP	Fisheries Communications Plan
FDR	Facilities Design Report
FEMA	Federal Emergency Management Agency
FIR	Fabrication and Installation Report
FIRM	Flood Insurance Rate Maps
FONSI	Finding of No Significant Impact
FPVC	Flexible Polyvinyl Chloride
FTB	Flowable Thermal Backfill
FTE	Full-Time-Equivalent
GHG	Greenhouse Gas
GIB	Gas Insulated Bus
GIS	Gas Insulated Substation
GWSA	Global Warming Solutions Act
HC	Hydrocarbons
HCA	Host Community Agreement
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HPFF	High-Pressure Fluid Filled
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
Hz	Hertz
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IHA	Incidental Harassment Authorization
ILSF	Isolated Lands Subject to Flooding
IMO	International Maritime Organization
ISO-NE	ISO New England

List of Acronyms (Continued)

IVW	Isolated Vegetated Wetlands
kV/m	Kilovolt per meter
LAER	Lowest Achievable Emission rate
LID	Low Impact Development
LIPA	Long Island Power Authority
LOA	Letter of Authorization
LSCSF	Land Subject to Coastal Storm Flowage
LSP	Licensed Site Professional
LT	Long Term
MACRIS	Massachusetts Cultural Resource Information System
MassCEC	Massachusetts Clean Energy Center
MassDOT	Massachusetts Department of Transportation
MBTA	Migratory Bird Treaty Act
MBUAR	Massachusetts Board of Underwater Archaeological Resources
MCP	Massachusetts Contingency Plan
MCZM	Massachusetts Coastal Zone Management
MEPA	Massachusetts Environmental Policy Act
MESA	Massachusetts Endangered Species Act
mG	milligauss
MHC	Massachusetts Historical Commission
MHHW	Mean Higher High Water
MHW	Mean High Water
MLW	Mean Low Water
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
MTBM	Microtunnel Boring Machine
MVA	Mega Volt Amps
MVAR	Mega Volt Amps (Reactive)
MVC	Martha’s Vineyard Commission
mv/m	Milli Volts per Meter
MW	Megawatt
NA	Noticed Alternative
NARW	North Atlantic Right Whale
NCEI	National Centers for Environmental Information
NEPA	National Environmental Policy Act
NHESP	Natural Heritage and Endangered Species Program
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOx	Nitrogen Oxides
NOAA	National Oceanic and Atmospheric Administration
NODP	Northeast Ocean Data Portal
NPCC	Northeast Power Coordinating Council

List of Acronyms (Continued)

NPDES	National Pollution Discharge Elimination System
NR	National Register of Historic Places
NREL	National Renewable Energy Laboratory
NRI	Natural Resources Inventory
NWS	National Weather Service
NY-ISO	New York-ISO
NYS	New York State
NYSERDA	New York State Energy Research and Development Authority
OCS	Outer Continental Shelf
OECC	Offshore Export Cable Corridor
OMP	Ocean Management Plan
ORW	Outstanding Resource Waters
OSHA	Occupational Safety and Health Administration
OSRP	Oil Spill Response Plan
O&M	Operations and Management
PAL	Public Archaeology Laboratory Inc.
PAM	Passive acoustic Monitoring
PATON	Private Aids to Navigation
PBD	Public Benefits Determination
PCBs	Polychlorinated Biphenyls
PJM	Pennsylvania, Jersey, Maryland Power Pool
PM	Particulate Matter
PMP	Probable Maximum Precipitation
PNF	Project Notification Form
POI	Point of Interconnection
PPA	Power Purchase Agreements
PPPP	Piping Plover Protection Plan
PR	Preferred Route
PSO	Protected Species Observer
PTF	Pool Transmission Facility
PURA	Public Utilities Regulatory Authority
PVC	Polyvinyl Chloride
QP	Queue Positions
RAO	Response Action Outcome
REC	Renewable Energy Credit
RFA	Riverfront Area
RFI	Request for Interest
RFP	Request for Proposals
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance
ROSA	Responsible Offshore Science Alliance

List of Acronyms (Continued)

ROV	Remotely Operated Vehicle
ROW	Right-of-Way
RPS	Renewable Energy Portfolio Standard
RTN	Release Tracking Number
SAP	Site Assessment Plan
SAV	Submerged Aquatic Vegetation
SEMA	Southeast Massachusetts
SF_6	Sulphur Hexafluoride
SLOSH	Sea, Lake, and Overland Surges from Hurricanes
SO_2	Sulphur Dioxide
SOVs	Service Operations Vessels
SPCC	Spill Prevention, Control and Countermeasures
SR	State Register of Historic Places
SSU	Special, Sensitive, and Unique
ST	Short Term
STATCOMs	Static Synchronous Compensators
SWDA	Southern Wind Development Area
TBF	To Be Filed
THPO	Tribal Historic Preservation Officers
TMPs	Traffic Management Plans
tpy	Tons per year
TOY	Time of Year
TR	Technical Report
TSHD	Trailing Suction Hopper Dredge
TSS	Total Suspended Solids
ULSD	Ultra-Low Sulfur Diesel
URAM	Utility-Related Abatement Measure
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	United States Geological Survey
VOC	Volatile Organic Compounds
WEA	Wind Energy Area
WPA	Wetland Protection Act
WQC	Water Quality Certification
WTG	Wind Turbine Generators
XLPE	Cross-linked Polyethylene

Section 1.0

Project Overview and Description

1.0 PROJECT OVERVIEW AND DESCRIPTION

Vineyard Wind LLC (Vineyard Wind, the Company, or Proponent) is permitting Park City Wind, an approximately 800-megawatt (MW) wind energy generation facility in the central portion of Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0501 (Lease Area) in federal waters. The Vineyard Wind Connector 2 (i.e., the "Project" for purposes of state review) is the Massachusetts-jurisdictional offshore and onshore transmission and the step-up substation necessary to deliver the offshore wind power generated by Park City Wind to the ISO-New England (ISO-NE) regional power grid. The offshore wind energy generation facility itself will be centrally located in the Lease Area in an area referred to as the Southern Wind Development Area (SWDA);[1] the northern portion of the Lease Area is being developed as the Vineyard Wind 1 project[2] in conjunction with the Vineyard Wind Connector 1 (EFSB 17-05) (see Figure 1-1).

Major elements of Park City Wind will include wind turbine generators (WTGs) and foundations, offshore electrical service platforms (ESPs) and foundations, inter-array cables[3], offshore transmission to shore, onshore transmission, and an onshore substation that will step up transmission voltage to 345 kV for interconnection with the electrical grid at the 345-kV West Barnstable Substation.[4]

At its nearest point, the SWDA is just over 19 miles (31 kilometers [km]) from the southwest corner of Martha's Vineyard and approximately 23 miles (37 km) from Nantucket; the SWDA is approximately 41 miles (66 km) south of the Cape Cod mainland.[5]

All proposed elements of the Park City Wind project will be subject to review under federal processes coordinated by BOEM. Massachusetts reviews, including those by the Energy Facilities Siting Board (EFSB) and other state, regional, and local entities, will focus on the elements of the project proposed within state boundaries (i.e., the Vineyard Wind Connector 2). These include portions of the offshore export cables, all of the onshore transmission, the proposed onshore substation, and the 345-kV interconnection

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1 Vineyard Wind also has future plans to develop the remaining southernmost portion of the Lease Area into an independent and separate wind energy generation facility.

2 "Vineyard Wind 1" refers to the project referred to as the "Vineyard Wind Energy Facility" in the Energy Facilities Siting Board's Final Decision in EFSB 17-05/D.P.U. 18-18/19 (May 10 2019). The "Project" in that proceeding, referred to therein as the "Vineyard Wind Connector" is referred to herein as the "Vineyard Wind Connector 1" to avoid confusion.

3 Inter-array cables connect several WTGs to a single ESP.

4 The Project's grid interconnection is proposed at the 345-kV West Barnstable Substation constructed as part of the NSTAR Lower SEMA Project, as distinguished from the 115-kV Oak Street Substation located on the northern side of the same parcel.

5 The SWDA is approximately 17 miles (28 km) from the nearest landmass (Nomans Land). Nomans Land is an uninhabited island located in the town of Chilmark, Dukes County, Massachusetts. It is situated about 3 miles (4.8 km) off the southwest corner of the island of Martha's Vineyard, and is used solely as the Nomans Land Island National Wildlife Refuge by the U.S. Fish and Wildlife Service and is closed to all public uses, in part due to the potential presence of unexploded ordnance from U.S. Navy training operations in the mid-20th century.

to the electrical grid, including expansion of the existing 345-kV West Barnstable Substation. Offshore elements of the Vineyard Wind Connector 2 will largely utilize the Offshore Export Cable Corridor (OECC) developed for Vineyard Wind 1 (and the Vineyard Wind Connector 1), which will transit through waters in the towns of Edgartown, Nantucket, Barnstable, and possibly a corner of Mashpee (see Section 1.5.3). The total length of the OECC is 63 miles (101 km) (approximately 7 miles [11.6 km] of which occur within the SWDA), with approximately 23 miles (37 km) of the OECC located within state waters. Onshore Project elements will be located entirely within the Town of Barnstable. A Project locus is provided as Figure 1- 1.

1.1 Introduction/Siting Board Jurisdiction

This document supports Vineyard Wind's petition to construct a transmission line and related equipment that connects a proposed offshore wind energy generation facility located in federal waters to the electric grid in Barnstable, Massachusetts. The Vineyard Wind Connector 2 will enable the delivery of approximately 800 MW of cost-effective, zero-carbon renewable energy to the New England electric grid.

Pursuant to G.L. c. 164, §§ 69G and 69J, the EFSB has jurisdiction over the construction of *"a new electric transmission line having a design rating of 69 kilovolts or more and which is one mile or more in length on a new transmission corridor"* and "*an ancillary structure which is an integral part of the operation of any transmission line that is a facility"* (980 CMR 1.01). As such, Vineyard Wind submits the analysis in this Petition (the "Analysis") to the EFSB in support of its petition for authority to construct, operate, and maintain 220-kV or 275-kV transmission cables from a wind energy generation facility proposed in federal waters to a new onshore substation proposed off Shootflying Hill Road as well as 345-kV transmission cables from that new substation to an interconnection point located at the West Barnstable Substation in the Town of Barnstable, Massachusetts. The EFSB has jurisdiction over the proposed onshore transmission, the proposed onshore substation, and the proposed offshore transmission within state waters. As indicated in *Alliance to Protect Nantucket Sound v. Energy Facilities Siting Board*, 457 Mass. 663, 686 (2010), the EFSB may also consider in-state impacts, if any, of the proposed offshore transmission in federal waters.[6]

The purpose of the Vineyard Wind Connector 2 is to connect a large-scale renewable wind energy generation facility within the federally designated Wind Energy Area (WEA) on the Outer Continental Shelf of the Massachusetts coast to the New England bulk power grid. The Project

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[6] After crossing into state waters between Martha's Vineyard and Nantucket and continuing north, the proposed OECC will pass through the pocket of federal waters located within Nantucket Sound before re-entering state waters and making landfall. To avoid any confusing fragmentation of the discussion of offshore export cables, but without intending to expand the jurisdiction of the Siting Board, the pocket of federal waters within Nantucket Sound is included in the Petition's description of offshore export cable routing. As discussed in Section 5.4.1, prior experience with offshore cable installation, together with specific plans for installation of offshore export cables for this Project, indicates that impacts will be limited to installation and contained within the immediate area of a given portion of cable, meaning that work in adjoining federal waters is not likely to have any in-state impacts.

will be another major step forward in meeting the region's growing demand for clean energy. More specifically, the Project will serve the public interest by delivering approximately 800 MW of power to the New England energy grid, thus making a substantial contribution to meeting individual New England state renewable energy requirements.

Routing for the proposed offshore and onshore export cables between the Company's wind energy generation facility in federal waters and the West Barnstable Substation is shown on a United States Geological Survey (USGS) quadrangle base map on Figure 1-1. Figures 1-2 and 1-3 show the proposed onshore routing from each of two possible landfall sites in Barnstable to the proposed Project substation (i.e., transmission routes) and from the proposed substation to the West Barnstable Substation interconnection point (i.e., grid interconnection routes), respectively. The onshore Preferred Route and Noticed Alternative Route are both entirely within the Town of Barnstable. The Project's proposed substation is located on a Vineyard Wind-controlled parcel on Shootflying Hill Road near the intersection of Route 6 and Route 132, approximately 0.7 miles [1.1 km] east of the interconnection location at the West Barnstable Substation.

The OECC passes through approximately 23 miles (37 km) of state waters (see Section 4.6.3).[7] Figure 1-4 shows the proposed OECC, which is largely the same corridor utilized for Vineyard Wind 1 (the Company's first project from the northern part of Lease Area OCS-A 0501); one difference is the OECC has been widened by approximately 985 feet (300 m) to the west, and along the stretch through the Muskeget Channel area it has also been widened by approximately 985 feet (300 m) to the east, bringing its typical width to approximately 3,800 feet (1,150 m) and its range from approximately 3,100 to 5,100 feet (950 to 1,550 m). This will enhance the ability to micro-site the offshore export cables within the OECC and avoid and minimize impacts to sensitive habitats.

As more fully described in Section 4.6, this corridor was identified through a process that included consultations with the Massachusetts Ocean Team and consideration of a number of factors, such as the resources and guidance provided by the 2015 Massachusetts Ocean Management Plan (OMP), bathymetric data, navigation corridors, and geophysical surveys that Vineyard Wind conducted in 2017, 2018, and 2019. This OECC was also carefully reviewed during state, regional, and local permitting of the Vineyard Wind Connector 1 in 2018 and early 2019, including as part of the Siting Board's review of that project as well as reviews by the MEPA Office, the Massachusetts Department of Environmental Protection (MassDEP), Cape Cod Commission, and Martha's Vineyard Commission. The OECC reaches the proposed landfall site at Craigville Public Beach while avoiding and minimizing impacts to sensitive resources. Consistent with the approach taken in the federal permitting process, in which Vineyard Wind has requested BOEM

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7 The total length of the OECC to the preferred landfall site from the SWDA in federal waters is approximately 63 miles (101 km).

approval of the OECC shown in Figure 1-4 as part of a "project envelope" allowing for optimization of cost, environmental protection, and reliability within a preapproved "envelope," Vineyard Wind requests that the EFSB approve the full corridor for installation of the two proposed offshore export cables.[8]

The balance of Section 1 presents an overview of the Vineyard Wind Connector 2. For general background, Section 1 also includes a description of the offshore development activities for Park City Wind in federal waters. The remaining sections of this Analysis provide detailed information to support the Project, specifically: Project Need (Section 2); Project Alternatives (Section 3); Route Selection (Section 4); a comparison of the Preferred and Noticed Alternative onshore routes (Section 5); and an analysis of Consistency with the Policies of the Commonwealth (Section 6).

1.2 Offshore Wind, Background

Over the course of the last two years, states up and down the East Coast from Massachusetts to Virginia have announced plans to procure over 22,000 MW of offshore wind energy over the next decade, representing an $85 billion+ investment and economic development opportunity. The New England states' leadership in passing offshore wind procurement legislation followed swiftly by decisions to proceed with large-scale procurements will enable the region to leverage its first-mover advantage at scale to capture as much of this quickly emerging industry as possible. The Vineyard Wind Connector 2, along with the generation at Park City Wind, is a commitment to work with state and local officials, businesses, communities, and impacted stakeholders to deliver a well-designed, constructed, and operated project.

During 2019, Vineyard Wind advanced development of Park City Wind, responding to solicitations for commercial-scale offshore wind projects from, among other entities, the Connecticut Department of Energy and Environmental Protection (DEEP). On December 5, 2019, DEEP announced that Vineyard Wind had been selected to develop the approximately 800-MW project.[9] The WTGs for Park City Wind will be located in the central portion of Lease Area OCS-A 0501, south/southwest of Vineyard Wind 1 (see Figure 1-1). Transmission from Park City Wind, known in state waters and onshore as the Vineyard Wind Connector 2, will interconnect to the ISO-NE grid at the existing 345-kV West Barnstable Substation in Barnstable, Massachusetts.

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8 This will provide flexibility in the engineering and installation stages to ensure the final cable alignments utilize the most recent data available from the dynamic marine environment and thereby avoid and minimize impacts.

9 Vineyard Wind's proposal included funding for port infrastructure development in Bridgeport, CT, a seaport on Long Island Sound. Bridgeport is known as "The Park City".

Park City Wind will be Vineyard Wind's second offshore wind energy generation facility, following the 800-MW Vineyard Wind 1 project located in the northern part of the same Lease Area and the associated transmission within Massachusetts known as the Vineyard Wind Connector 1, which was approved by the Siting Board in EFSB 17-05.[10]

The decade-long process used to delineate, approve, and auction lease areas for offshore wind energy generation in the Northeast and Mid-Atlantic states was led by the federal government with strong participation by states, including Massachusetts (see Section 1.2.1).

The primary driver for offshore wind projects in the region is their ability to deliver zero-carbon renewable energy that will provide economical bulk power while reducing carbon dioxide (CO_2) emissions, in the context of ambitious state programs to decarbonize electric power production and legislation such as the Commonwealth's 2008 Global Warming Solutions Act (GWSA)[11] and Connecticut's Act Concerning Global Warming Solutions, Public Act 08-98.[12] Global warming's impacts are regional, national, and global in scope; the solutions to mitigate the scale of global warming's impacts must be sought at these scales as well. Massachusetts, Connecticut, Rhode Island, New York, and more recently New Jersey have led in seeking renewable energy and fostering development of an offshore wind industry. In New England, where there is a shared regional electric grid and offshore wind is the only large-scale renewable energy source available, the states have an even greater opportunity to collaborate productively in support of offshore wind projects. Vineyard Wind's Park City Wind project and its associated transmission in state waters (Vineyard Wind Connector 2) will be another significant step forward in meeting the region's growing demand for clean energy.

An additional driver for offshore wind projects is the promise of significant economic benefits to local communities, states, and the region as a whole. These benefits can come in the form of new jobs created for the development, construction, and operations/maintenance for these projects, port infrastructure development, advancement of domestic manufacturing and assembly capacity, investment in industry research and development, environmental monitoring, and

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[10] Vineyard Wind filed a petition to construct the Vineyard Wind Connector with the EFSB under G.L. c. 164, § 69J on December 18, 2017 and filed related petitions under G.L. c. 164, § 72 and G.L. c. 40A, § 3 with the EFSB on February 15, 2018. The EFSB issued its Final Decision approving the project, with certain conditions, on May 10, 2019 (EFSB 17-05, DPU 18-18, DPU 18-19).

[11] Enacted in 2008, the GWSA established aggressive GHG emissions reduction targets mandating that the Commonwealth reduce its GHG emissions by 10 to 25% from 1990 levels by 2020 and by at least 80% from 1990 levels by 2050 (St. 2008, c. 298). Among other provisions, the GWSA obligates administrative agencies such as the Siting Board to consider reasonably foreseeable climate change impacts (e.g., additional GHG emissions) and related effects (e.g., sea level rise) in evaluating and issuing permits.

[12] Among other things, the Connecticut Global Warming Solutions Act, like the similarly named act in Massachusetts, sets GHG emission reduction requirements.

research. A successful New England drive to promote the offshore wind industry can support a steady flow of projects that will leverage economies of scale in the supply chain while fostering development of a robust industry. New York/New Jersey collaborations on offshore wind could realize similar benefits and reinforce synergies with efforts in New England.

While the Project is being developed in response to a Connecticut procurement, it promises numerous benefits for Massachusetts, Connecticut, and the broader New England/Northeast region. These benefits are described in greater detail Section 1.6. The remainder of this Section 1.2 highlights some of the benefits the Project provides to demonstrate how the bundle of benefits associated with offshore wind development will reach local, state, regional, national, and global communities.

The Vineyard Wind Connector 2 will enable Park City Wind to provide greenhouse gas reductions with global effect and particular benefits to states across the region that have adopted greenhouse gas emission reduction goals. It will also provide significant economic development at the regional level, with unique benefits in local communities. And, by reducing reliance on the regionally constrained natural gas supply on cold peak gas demand days, the Project will foster winter grid reliability at multiple scales: on Cape Cod, in Massachusetts, and in the greater ISO-NE electric grid.

In addition to promoting the growth of a regional industry, the Vineyard Wind Connector 2 and Park City Wind will also generate significant and specific local benefits (see Section 1.6). For instance, the Town of Barnstable will receive substantial payments in accordance with the existing Host Community Agreement (HCA, second project provision). These will include the agreed-upon HCA payment and local real estate and personal property taxes on the Vineyard Wind Connector 2. The Company is also collaborating with the Town to possibly coordinate construction of the Vineyard Wind Connector 2 with the Town's sewer project, thus minimizing public disruptions and yielding economic savings for the Town of Barnstable.

Local benefits are not limited to Barnstable, but rather will spread to communities across southeastern Massachusetts and southern New England (see Section 1.6). Vineyard Wind expects to continue its efforts to train and develop a southern New England-based labor force to support aspects of Project construction, operation, and maintenance. These efforts will continue in collaboration with area universities, community colleges, and vocational programs. Beyond its commitment to work with Connecticut in developing construction staging support and an operation and maintenance facility in Bridgeport Harbor, Vineyard Wind may also continue to utilize the New Bedford Marine Commerce Center to support aspects of the Vineyard Wind Connector 2 construction.

1.2.1 Background on Offshore Wind Lease Areas

Via a public stakeholder and desktop screening[13] process which began in 2009, BOEM (within the United States Department of the Interior) has evaluated areas along the Atlantic Coast with respect to potential suitability for offshore wind development. Working in conjunction with the Department of Energy's National Renewable Energy Laboratory (NREL), BOEM has identified a series of suitable tracts on the Outer Continental Shelf from South Carolina north to Massachusetts.

The location of the Massachusetts offshore wind lease areas, including Vineyard Wind's Lease Area OCS-A 0501, was determined through a process that involved significant public input over a period of more than six years. The process began with the formation of a Massachusetts-BOEM task force, composed of representatives from many federal, state, tribal, and local government agencies, as well as public stakeholder meetings with the community, labor groups and the fishing industry, starting in 2009. As a result of this initial planning, BOEM identified a preliminary Massachusetts WEA of approximately 2,224 square nautical miles.[14]

BOEM then published a Request for Interest (RFI) on December 29, 2010. This RFI requested expressions of commercial interest from potential developers, as well as any information from the public relevant to determining the suitability of BOEM's WEA for wind energy project development. BOEM then provided for a second period of public comment which ended on April 18, 2011. Responses from 10 companies (including Vineyard Wind) were received, along with 260 public comments.

After careful consideration of public comments as well as input from BOEM's intergovernmental Massachusetts Renewable Energy Task Force, BOEM extensively modified the WEA in response to stakeholder concerns. For example, BOEM excluded certain areas identified as important habitats that could be adversely affected if ultimately developed for offshore wind. BOEM also excluded an area of high sea duck concentration as well as an area of high fisheries value to reduce potential conflict with commercial and recreational fishing activities. The distance from the BOEM WEA to the nearest shore was also extended to further reduce any possible viewshed impacts. These extensive revisions in response to public comments resulted in the WEA being reduced to approximately 40% percent of its original size.

On February 6, 2012, BOEM published a "Call for Information and Nominations" (the Call) for areas within the revised BOEM WEA, and that same month BOEM also published a Notice of Intent to prepare an Environmental Assessment (EA) for the "Call Area." The EA was made available for public review on November 12, 2012, a revised EA was issued on June 4, 2014, and BOEM issued a "Finding of No Significant Impact" (FONSI) which concluded that reasonably foreseeable environmental effects associated with the commercial wind lease issuance would not significantly

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13 Conducted by the Department of Energy's National Renewable Energy Laboratory.

14 2,941.2 square miles, or 1,882,393 acres.

impact the environment. The EA and FONSI were limited to the potential issuance of leases; a project subsequently proposed for a specific lease area would be the subject of a more detailed environmental review.

On January 29, 2015, BOEM held a competitive lease sale, conducted as an auction, for the four lease areas within the Massachusetts WEA. While the lease areas were to be awarded to the highest cash bid, prior to the auction BOEM awarded Vineyard Wind[15] a discount to the bid amounts it would have to pay in recognition of the Community Benefits Agreement the Company had entered into with the local, community-based non-profit cooperative Vineyard Power. Vineyard Wind won Lease Area OCS-A 0501 in the auction, and another bidder won a lease area immediately adjacent to the west. The other two available lease areas within the Massachusetts WEA, south of Nantucket, were not awarded in the 2015 lease sale, although they were awarded in a 2018 lease sale. In a parallel process working with the state of Rhode Island, BOEM awarded a lease area to a third bidder, located due south of Rhode Island. Figure 1-5 illustrates the various lease areas and identifies the leaseholders.

Vineyard Wind's more than 166,886-acre (approximately 261-square-mile, or 675-square-kilometer) Lease Area OCS-A 0501 is approximately 10 miles (16 km) wide and 30 miles (48 km) long.[16] As shown on Figure 1-5, the long axis of the Lease Area is oriented northeast to southwest. For the Park City Wind project, the Company is proposing to develop the central portion of this Lease Area. At its nearest point, the SWDA is just over 19 miles (31 km) from the southwest corner of Martha's Vineyard and approximately 23 miles (37 km) from Nantucket; the SWDA is approximately 41 miles (66 km) south of the Cape Cod mainland (see Figure 1-1).

In the opinion of Vineyard Wind, its SWDA is as good as any offshore wind site in the world. It has high wind speeds,[17] excellent seafloor conditions, moderate depths, and reasonable proximity to multiple grid interconnection points in an area of high electrical load with a strong need for new generation capacity.

1.2.2 Connecticut Energy Legislation (An Act Concerning the Procurement of Energy Derived from Offshore Wind)

Public Act 19-71, *An Act Concerning the Procurement of Energy Derived from Offshore Wind* (the Act), was passed by the Connecticut General Assembly with overwhelming bipartisan support and signed into law by Connecticut Governor Lamont on June 7, 2019. The Act is intended to ensure a diversified electrical energy portfolio for the State while strengthening region's clean energy

15 At the time of the auction, Vineyard Wind LLC was called Offshore MW LLC

16 As shown on Figure 1-5, the perimeter of the Lease area is irregular or "sawtoothed" in configuration hence the overall area is less than that of a true 10- by 30-mile rectangle.

17 Initial metocean data collected by AWS Truepower, working in connection with the MassCEC and Woods Hole Oceanographic Institute (WHOI) has a mean wind speed at 100m of 10.3 meters per second (23 miles per hour) (Oct 2016-June 2017).

economy. The offshore wind energy legislation is also expected to support the development of a major U.S. offshore wind industry, an industry in which southern New England is actively working to become a leader and major player. A domestic offshore wind industry would bring significant job creation and economic activity to the region.

The Act authorizes the Connecticut DEEP, in consultation with the procurement manager of the Connecticut Public Utilities Regulatory Authority (PURA), the Office of the Attorney General, and the Office of Consumer Counsel, to work with Connecticut's electric distribution companies to solicit proposals, in one solicitation or multiple solicitations, for up to 2,000 MW of offshore wind. In considering offshore wind proposals received in response to the solicitation, DEEP must consider, among other factors, whether a proposal (1) is in the best interest of ratepayers, (2) promotes electric distribution system reliability, (3) has positive impacts on Connecticut's economic development, (4) is consistent with requirements and reduce greenhouse gas emissions, (5) is consistent with policy goals outlined in the state's Comprehensive Energy Strategy, and (6) uses practices to avoid, minimize, and mitigate impacts to wildlife, natural resources, ecosystems, and traditional or existing water-dependent uses. Successful proposals selected by DEEP are awarded long-term power purchase agreements (PPAs) with Connecticut's electric distribution companies. These PPAs are intended to enable project developers to finance and construct offshore wind projects.

In accordance with the Act, DEEP provided notice of its intent to solicit proposals through a Request for Proposals (RFP) on June 7, 2019, and the final RFP was issued on August 16, 2019. After receiving more than 30 bid variants from three different developers on the October 30, 2019 submission deadline, Vineyard Wind's bid to provide approximately 804 MW of offshore wind energy was selected for the award on December 5, 2019. Vineyard Wind and the state's two electric distribution companies, Eversource Energy and the United Illuminating Company, have negotiated and finalized PPAs with a 20-year term.

While the power generated by the Park City Wind project is being purchased by electric distribution companies in Connecticut, ISO-NE operates as a coordinated grid across all six New England states. The injection of renewable energy into the ISO-NE grid will therefore displace power generated by fossil fuel sources located in Massachusetts and elsewhere in New England that would otherwise operate to meet the region's power demands. Thus, the power generated by Park City Wind and delivered by the Vineyard Wind Connector 2 will directly support Massachusetts' efforts to reduce carbon emissions pursuant to the Commonwealth's 2008 GWSA.

1.2.3 Massachusetts Ocean Management Plan

Initially released in 2009 and subsequently revised in 2015, the Massachusetts OMP creates a framework for managing uses and activities within the state's ocean waters, including offshore wind projects and associated transmission. As described in greater detail in Section 6.4.5, jurisdiction of the OMP covers the area from the seaward limit of state waters (generally three miles offshore) to a nearshore boundary that lies approximately 0.3 miles (0.48 km) seaward from Mean High Water (MHW).

A large part of the planning process for the OMP was devoted to mapping and evaluating natural resources and existing water-dependent uses (e.g., navigation and fishing), and identifying which of these resources and uses may be sensitive to different types of projects, such as transmission cables. The OMP identifies the following special, sensitive, and unique (SSU) resources that must be addressed for cable projects: (1) core habitat of the North Atlantic right whale, fin, and humpback whales; (2) hard/complex seafloor; (3) eelgrass; and (4) intertidal flats. As described in Section 4.6, in 2017, 2018, and 2019, Vineyard Wind performed marine surveys to identify and refine feasible routes for the proposed offshore export cables that would avoid and minimize impacts to these resources.

The OMP identifies some preliminary corridors for offshore wind transmission cables that are in presumptive compliance with siting standards of the OMP. Vineyard Wind considered these corridors while assessing offshore routing alternatives, but they were unsuitable for the Project given that water depths within the mapped preliminary corridors are frequently too shallow, a landing in Barnstable is needed to minimize routing distance (mapped preliminary corridors do not include a landfall site in that portion of the south shore of Cape Cod), and the Project is proposed to cut through federal waters in Nantucket Sound to minimize the distance of the OECC. Section 6.4.5 provides additional detail about Project consistency with the OMP.

1.3 Project Overview

The following sections describe the proposed Vineyard Wind Connector 2, including, for background, a brief description of Park City Wind development activities in federal waters and more detailed discussions of the offshore and onshore transmission cables as well as proposed substation infrastructure. Portions of Park City Wind within state geographic jurisdiction and hence the focus of this Petition, known as the Vineyard Wind Connector 2, include the entire onshore route, the proposed onshore substation and grid interconnection, and the portion of the OECC in state waters (see Figure 1-1).

After crossing into state waters between Martha's Vineyard and Nantucket and continuing north, the two proposed offshore export cables will pass through the area of federal waters located within Nantucket Sound before re-entering state waters and making landfall. To avoid any confusing fragmentation of the discussion of offshore transmission, the pocket of federal waters within Nantucket Sound is included in the description of offshore export cable routing.

1.3.1 Offshore Wind Array (Federal Waters, for background)

Vineyard Wind is developing an approximately 800-MW offshore wind project (known as Park City Wind) in the central portion of Lease Area OCS-A 0501 in federal waters. The federal development activities have been in an active phase of data collection, environmental analysis, engineering, and economic optimization for over a year. The offshore wind energy generation facility for Park City Wind is being developed and permitted at the federal level using a "project envelope" concept. The envelope concept allows an applicant to describe a range of reasonably foreseeable project parameters that allows for a robust environmental review and permitting process while maintaining a reasonable degree of flexibility with respect to selection and purchase of key components (e.g., WTGs, foundations, offshore cables, offshore substations). Further, the envelope approach will allow the Project to optimize cost, environmental protection, and reliability.

Key elements of the federal development activities for Park City Wind, as bounded by the project envelope, are as follows:

- Project Size: approximately 800 MW.
- WTGs, entirely within federal waters: WTGs being considered for Park City Wind range from approximately 10 to 16 MW, with approximately 50 to 81 WTGs being permitted federally. In consultation with adjacent lease area developers and the U.S. Coast Guard (USCG), the WTGs and ESPs in the SWDA will be oriented in an east-west, north-south grid pattern with one nautical mile (approximately 1.15-mile) spacing between positions.
- Regional Emissions Reductions: The WTGs for this Project will be among the most efficient currently demonstrated for offshore use. It is expected that the WTGs will be capable of operating with an annual capacity factor of approximately 50%.[18] Assuming that an approximately 800-MW project is built, machines of this efficiency and capability would offset carbon dioxide-equivalent (CO_{2e}) emissions from the ISO-NE system by approximately 1.59 million tons per year (tpy).[19] In addition, nitrogen oxides (NOx) emissions across the New England grid would be expected to decrease by approximately 850 tpy, with sulfur dioxide (SO_2) emissions decreasing by approximately 450 tpy. See Section 2.3 for additional details.
- WTG and ESP foundations, entirely within federal waters, may be monopiles, jackets (piled), or bottom-frame foundations (piled, or gravity pad).
- Offshore export cables: Two 220-kV or 275-kV offshore export cables will deliver approximately 800 MW from the Park City Wind offshore wind energy generation facility to a landfall site in Barnstable, MA.

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18 Capacity factor is standard industry measure. A power plant operating at 100% load for 8,760 hours per year would have a capacity factor of 100%. The same plant operating at 100% load for 4,380 hours per year would have a capacity factor of 50%.

19 The avoided emissions analysis assumes a total Park City Wind capacity of approximately 804 MW with a 50% average capacity factor transmitted using 220-kV HVAC cables. The analysis is based on NPCC New England subregion annual non-baseload output emission rates from EPA's Emissions & Generation Resource Integrated Database eGRID2018(v2) released 3/9/2020. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

- Inter-array Cables, entirely within federal waters: 66-kV to 132-kV inter-array cables will connect radial "strings" of WTGs to a shared ESP.

- ESPs, entirely within federal waters: One or two offshore substations, or ESPs, will include step-up transformers and other electrical gear. The ESPs are expected to be located along the northwest edge of the SWDA in federal waters.

The construction-related or operations-related impacts of the non-jurisdictional portions of Park City Wind on resources within Massachusetts are predominantly those associated with vessel activity as those vessels transit through state waters to the Company's SWDA in federal waters. Given the limited spatial extent of impacts from the offshore cable installation, no impacts in state waters are expected from cable installation activities in federal waters. The only other impact of the non-jurisdictional portions of the federal development activities are related to the potential visibility of the WTGs from the south shores of Martha's Vineyard and Nantucket.

Navigation and vessel traffic impacts are discussed in Section 4.6.3, with that discussion describing that construction and installation activities may temporarily affect navigation and/or fishing activities in the vicinity of construction and installation vessels. These impacts will be temporary and largely limited to the project's construction and installation period. The Company is developing a detailed Navigational Risk Assessment that will conform to the USCG guidance for Offshore Renewable Energy Installations contained in Navigation Vessel Inspection Circular 02-07 and incorporate information obtained through consultation with the USCG and numerous marine trades and maritime transportation stakeholders.

Aside from temporary safety zones around Project vessels and the potential for increased vessel traffic during the construction and installation phase, no significant disruption of established navigation patterns or aids to navigation is anticipated.

1.3.2 Offshore Transmission Cables

The offshore wind energy generation facility in federal waters will connect to the onshore electrical grid via two new 220-kV or 275-kV three-core high-voltage alternating current (AC) offshore export cables that will travel north from the SWDA in federal waters, crossing into state waters and then passing through a pocket of federal waters again in Nantucket Sound before re-entering state waters and making landfall on the Cape Cod mainland. The offshore export cables will be installed along a single OECC, but with sufficient separation to allow for safe installation and any future repair work, if required. A typical separation distance of approximately 165 feet (50 m) will be maintained between cables, although this distance could be modified pending ongoing routing evaluations. As described below and in Section 4.6, the Vineyard Wind Connector 2 will utilize largely the same OECC as Vineyard Wind Connector 1, which will also install two offshore export cables. Vineyard Wind will maintain a minimum distance of approximately 330 feet (100 m) between each cable pair, and the minimum spacing between cable pairs could be even greater in deeper waters. For sections where the cables cross sensitive habitat or where a narrower corridor is needed for other reasons (e.g., where water depth does not allow access), the typical cable spacing may be decreased.

From the landfall site to the Lease Area in federal waters, the OECC is approximately 39 miles (62 km) long. Depending on the final location of the ESP(s), the OECC within the Lease Area may be up to approximately 19 miles (31 km) in length, resulting in a total OECC length of up to approximately 58 miles (93 km). Due to micro-siting of cables within the OECC to minimize impacts to sensitive habitats, the maximum length per cable between the landfall site and ESP(s) is approximately 63 miles (101 km).[20] The length of the OECC within state waters is approximately 22 miles (35 km); assuming a 5% allowance for micro-siting, the maximum length per cable within state waters is approximately 23 miles (37 km).

Each offshore export cable is expected to be comprised of a 220-kV or 275-kV three-core AC cable for power transmission and one or more fiber optic cables[21] for communication, temperature measurement, and protection of the high-voltage system (see Figure 1-6). The Vineyard Wind Connector 2 will require two offshore export cables to provide sufficient redundancy to ensure reliable operations and sufficient transmission capacity under conditions whereby favorable wind speeds are sustained over a long duration at the Park City Wind SWDA.

Each offshore export cable will be approximately 11 inches (27 centimeters [cm]) in diameter with a weight of approximately 82 pounds per linear foot (122 kilograms per meter) in air. As shown on Figure 1-6, each cable will typically include three copper or aluminum conductors, with each conductor encapsulated by solid cross-linked polyethylene (XLPE) insulation. Water-blocking sheathing will be used to prevent water infiltration. Specific cable designs vary between cable suppliers, and cable technology continues to evolve. The three insulated conductors will be twisted with a synthetic filler between the conductors, and the twisted or bundled conductors will then be wrapped in stainless steel wire and polyethylene rod armoring and finally encased in a tough outer sheath. This AC offshore cable system will not contain any fluids, and this type of transmission has been used extensively on European offshore wind projects.

The proposed OECC is shown on Figure 1-4 and described in more detail in Section 4.6. Early in Project development, chart reviews and initial field data were used to identify potential routes from Lease Area OCS-A 0501 to possible landfall sites on Cape Cod, and these early investigations were supplemented by detailed marine surveys the Company performed in 2017, 2018, and 2019. The OECC extends north between Martha's Vineyard and Nantucket via Muskeget Channel, then continues northward through Nantucket Sound, terminating at the preferred Craigville Public

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[20] This length of offshore export cable includes a 5% allowance for micro-siting within the OECC outside the Lease Area, and a 15% allowance for micro-siting within the Lease Area.

[21] Fiber optic cables are typically integrated into the offshore export cable, but may be bundled externally to the export cable. In either scenario, the fiber optic and export cables would be installed simultaneously.

Beach Landfall Site or the alternative Covell's Beach Landfall Site. Routing for the portion of the offshore cable proposed in state waters is the product of the Company's technical analysis of conditions for cable installation, cost, as well as consultations with the Massachusetts Ocean Team and consideration of the Massachusetts OMP.

Within state waters, the length of the OECC to the preferred Craigville Public Beach Landfall Site or to the variant Covell's Beach Landfall Site is approximately 23 miles (37 km), while the total length in federal and state waters is approximately 63 miles (101 km), including contingencies for micro-siting. Section 4.6 contains additional information about the OECC and how it was delineated.

Installation of the offshore and onshore export cables, including the transition from offshore to onshore, is described in more detail in Section 5.4. At the landfall site, horizontal directional drilling (HDD) will be used to complete the offshore-to-onshore transition while avoiding any impacts to the nearshore or coastal resources. Section 5.4.2 discusses the transition from offshore to onshore in greater detail.

The physical connection between the offshore and onshore export cables will be made in underground concrete transition vaults/joint bays that will be installed within a paved parking lot at either the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site and accessed via two or three manholes covered by secure metal covers. From the surface, the only visible components of the cable system will be the manhole covers. The necessary work at the landfall site would be performed in the off-season, or as otherwise permitted by the relevant agencies, to minimize any disturbance to area residents or visitors.

1.3.3 Onshore Export Cables

For the onshore stretch of transmission from the landfall site to proposed substation, each three-core (three-conductor) offshore export cable will transition to three separate single-core onshore cables (either 220 kV or 275 kV) consisting of a copper or aluminum conductor covered by solid XLPE insulation and fiber optic cables that will be installed from the landfall site to the onshore substation; this transition will occur at the transition vaults/joint bays proposed at the landfall site. At the proposed onshore substation, voltage will step up to 345 kV. Six 345-kV onshore export cables will connect the Project's proposed substation to the grid interconnection location at the 345-kV West Barnstable Substation. Therefore, the Project will consist of two offshore export cables, six onshore export cables (220-kV or 275-kV cables connecting the landfall site to the proposed substation and 345-kV cables connecting the proposed substation to the interconnection location), and two fiber optic cables; all onshore cables will be contained within a buried concrete duct bank.

Each onshore cable will contain a metallic sheath and a non-metallic outer jacket that will wrap around the XLPE solid insulation. The primary functions of these last layers are to prevent direct contact between the conductor and the ground and to control and minimize thermal and electrical losses. Each onshore cable could be up to approximately 6 inches (15 cm) in diameter and will weigh approximately 16.4 pounds per foot (24.4 kg/m); the cables will not contain any fluids. A manufacturer's cutaway of a model onshore cable is provided as Figure 1-7; three of these cables will make up a single AC circuit.

Each onshore export cable will have its own conduit within a concrete duct bank that will be installed along the entire length of the onshore cable route. This duct bank, shown in a typical cross-section on Figure 1-8, will be an array of polyvinyl chloride (PVC) or high-density polyethylene (HDPE) pipes or sleeves encased in concrete. Up to eight approximately 10-inch-diameter conduits spaced approximately 12 inches apart will be installed within the duct bank to accommodate onshore conductors and spare conduits, with additional smaller conduits for fiber optic communications cables; grounding will be accommodated within the duct bank trench.

For the majority of the onshore route, these conduits will be arrayed four conduits wide by two conduits deep, with the total duct bank measuring approximately 5 feet (1.5 m) wide and 2.5 feet (0.8 m) deep. A more upright design arrayed two conduits wide and four conduits deep is also possible, which would measure approximately 2.5 feet (0.8 m) wide and 5 feet (1.5 m) deep (see Section 5.4.3 and Table 5-5 for additional duct bank details). Depending on the configuration of existing subsurface utilities, this duct bank arrangement could be modified along short stretches to enable deeper burial depth to respect utility separation requirements.

The duct bank will have a typical depth of cover of three feet (0.9 m); however, if required due to existing conditions (e.g., at certain utility crossings), the minimum cover will be 2.5 feet (0.8 m) (see Section 5.4.3 for additional construction details related to the duct bank). The typical duct bank layout as shown in Figure 1-8 may be modified in areas where dictated by existing conditions, such as the presence of culverts. If an existing culvert is not deep enough to allow a duct bank section to be installed above, then the duct bank will be installed beneath the culvert while providing sufficient support. Installation of the proposed duct bank is described in greater detail in Section 5.4.3.

Once the duct bank is in place, the cables (one cable per conduit) will be pulled into place between underground vaults, which will be spaced at intervals of approximately 1,500 to 3,000 feet (457 to 915 m), depending on route characteristics. The splice vaults along the onshore route will be precast concrete structures with top and bottom halves joined in the field. Splice vaults and transition vaults are shown in the engineering plans provided in Attachment F. The vaults and duct bank will also house the fiber optic cables, splice box grounding wires, and link boxes.

Similar XLPE cable systems have been installed by Massachusetts utilities in several urban and suburban locations in recent years. Installation of the in-road underground duct bank and export cables within public roadways will be performed during the off-season, or as otherwise permitted by the relevant agency, to minimize traffic disruption. This type of construction typically advances at the rate of 80 to 200 feet (24 to 60 m) per day.

Once the proposed duct bank and associated onshore export cables arrive at the proposed substation site (described in Sections 1.3.4 and 4.3.4), the voltage will step up to 345 kV. From the proposed substation, six 345-kV onshore export cables will continue for approximately 0.7 miles to the West Barnstable Substation, where they will interconnect with the electrical grid. The cable technology proposed for the Project is described in greater detail in Section 3.1.3.

A thorough routing analysis was performed to identify a Preferred Route and a Noticed Alternative Route for the Project, and this routing analysis is provided in its entirety in Section 4.0. Preferred and Noticed Alternative routes are identified for the transmission routes, which connect the landfall site to the proposed substation, as well as for the grid interconnection routes, which connect the proposed substation to the interconnection location. A map showing the onshore transmission routes and associated variants is provided as Figure 1-2; grid interconnection routes and associated variants are shown on Figure 1-3. The Preferred and Noticed Alternative routes are described geographically in Section 1.5, and the routes are compared in detail in terms of environmental considerations, human/community considerations, and construction in Section 5.0.

1.3.4 Substation

As described above, the Project will require an onshore substation where the 220 kV or 275 kV voltage in the onshore export cables will step up to 345 kV in preparation for interconnection at the existing West Barnstable Substation. The Project's onshore substation site is an approximately 6.7-acre privately-owned parcel off Shootflying Hill Road. The site is southwest of the intersection of Route 6 and Route 132[22] and is less than a mile east of the existing West Barnstable Substation, where it has frontage on Shootflying Hill Road and direct access to utility right-of-way (ROW) #343 (see Figure 1-9). The site, which currently houses a motel, is in a residentially zoned area as well as the Ground Water Protection Overlay District.

The northern part of the site currently contains a motel building, while the southern part consists of wooded land. To the west, the site is bordered by residential parcels, to the north it is bordered by Shootflying Hill Road and further north the Route 6 layout, to the east it is bordered by land owned by the Chamber of Commerce and the Massachusetts Department of Transportation (MassDOT), and to the south it is bordered by ROW #343.

The buried duct bank will enter the Project substation site from either ROW #343 or Shootflying Hill Road, depending on the variant ultimately implemented.

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22 Route 6, the Mid Cape Highway, is a four-lane divided limited access highway. Route 132, south of Route 6, is a four-lane commercial arterial providing access to commercial areas in Hyannis/Barnstable as well as the Barnstable County Airport.

The Project's onshore substation will be enclosed with wire mesh fence and/or concrete masonry unit (CMU) wall and will house two 220/345-kV or 275/345-kV "step-up" transformers, gas-insulated switchgear and a control room inside two metal enclosures, and other necessary equipment likely including shunt reactors, STATCOMs, and harmonic filters along with associated bus work and support structures, overhead and underground wiring and conduits, protective systems, electrical service equipment, grounding protection, and lightning protection masts. The Company has considered both air-insulated substation (AIS) and more compact gas-insulated substation (GIS) designs. An AIS design uses equipment spacing to allow ambient air to provide the required insulation; a GIS is enclosed within a structure that uses pressurized sulphur hexafluoride (SF_6) gas to insulate the substation equipment. Both types of designs are used extensively at substations around the northeast.

An AIS facility inherently requires more space between equipment and, given the site selected for the proposed substation, Project engineers determined that an AIS-only design would not fit on the property. Accordingly, Vineyard Wind proposes a GIS design. A conceptual schematic drawing of the approximately 800-MW GIS design is provided as Figure 1-10, which illustrates a maximum build-out of the site. As shown on Figure 1-10, Vineyard Wind plans to plant vegetated screening on the western and northern boundaries; the eastern boundary may be utilized for part of the perimeter access drive, and the abutting land is undeveloped wooded land. The vegetated screening along the western edge will provide visual screening for existing residences. Since the southern property line extends into ROW #343, no vegetated screening will be possible in that location. Substation construction may require initial clearing of the entire site, but revegetation along the site boundaries would occur outside of the substation boundary/screening wall.

The entire site will have a perimeter access fence, and the westerly side may have a sound attenuation wall if determined necessary. A compact GIS arrangement contained within a structure possessing a sound-attenuating exterior will significantly reduce noise impacts relative to a standard open-air AIS arrangement. A sound attenuation study for the site will be conducted to evaluate changes in sound levels associated with substation operation; an ambient sound monitoring study has already been completed at the proposed substation site and is provided in Section 5.3.6.

In conjunction with the onshore routing analysis, the Company assessed a number of potential locations for the proposed substation infrastructure; these are described in additional detail in Section 4.3.4.

As mentioned above, some of the electrical equipment at the proposed GIS substation will contain SF_6. The SF_6 gas will be used in new circuit breakers, which are designed to be gas-tight and sealed for the life of the equipment. SF_6 quantities can vary between manufacturers, but it is estimated that the 220-kV or 345-kV circuit breakers will contain between 125 and 165 pounds of SF_6 gas per breaker. The current configuration has between 14 and 16 GIS circuit breakers. Gas-insulated bus (GIB), located outdoors, will contain a similar amount of gas about every five linear feet; the proposed layout utilizes approximately 1,500 linear feet of GIB. Substation equipment will meet the applicable requirements of 310 CMR 7.72. Emissions will be represented by the manufacturer to have less than a 0.1% maximum annual leak rate, and Vineyard Wind will follow manufacturer-recommended maintenance procedures and best industry practices to avoid leakage. Upon equipment removal, Vineyard Wind will be responsible for the secure storage, reuse, recycling, or destruction of the SF_6. Vineyard Wind expects little to no leakage of SF_6, based on the purchase and maintenance of equipment with leakage guarantees and pressure monitoring; breakers will be continuously monitored.

Vineyard Wind is in the process of purchasing assessor map parcel #214-001, an approximately 2.8-acre parcel of land located immediately southeast of the West Barnstable Substation (see Figure 1-11). The purchase of this parcel is expected to be finalized at the end of May 2020. While this parcel will likely be utilized as the northern terminus of a trenchless crossing across Route 6 (see Section 1.5.2.1.4), it also provides some flexibility regarding the proposed substation design. Vineyard Wind and Project engineers are considering an alternative that would involve relocating some of the equipment (e.g., static synchronous compensators [STATCOMS], shunt reactors) associated with the proposed substation from the Shootflying Hill Road site to assessor map parcel #214-001, located immediately southeast of the West Barnstable Substation. This would provide greater flexibility for the GIS design on the motel site and would also provide greater flexibility for enhancing buffers on the motel site to minimize visual and noise-related impacts to adjacent residences.

Assessor map parcel #214-001 is entirely forested and is surrounded by Route 6 to the south, Eversource's West Barnstable Substation property to the west and north, and undeveloped land to the east; there are no residences or other sensitive receptors in proximity to the parcel. A possible maximum build-out of assessor map parcel #214-001 is shown on Figure 1-12; under this scenario, all of the 2.8-acre site would be cleared, but it would reduce the substation footprint on the Shootflying Hill Road parcel. Vineyard Wind is planning to perform a Natural Resources Inventory (NRI) on assessor map parcel #214-001 in spring 2020.

1.3.4.1 Containment System

The Company will provide full-volume (110%) containment systems for substation components using dielectric fluid (i.e., the main transformers, iron core reactors, and equipment containing dielectric fluid associated with the STATCOMS). While sumps for transformers are standard practice, they are not normally used for other lower-volume fluid-filled equipment given the low probability of any leakage. However, the Company has opted to commit to such containment given the sensitive nature of the Cape Cod watershed and based on consultations with local officials. The containment sumps will be designed to fully contain the dielectric fluid in the very unlikely event of a complete, catastrophic failure of the transformer or other equipment.

In addition, at the Town of Barnstable's request, Vineyard Wind has committed to adding additional containment volume in consideration of an extreme rain event. Thus, the Company is willing to increase the 110% containment volume to account for the simultaneous Probable Maximum Precipitation (PMP) event in a 24-hour period, which will be determined for the substation site in consultation with the Town of Barnstable. Also included in the design as additional mitigation is a common drain system that routes each individual containment area, after passing through an oil-absorbing inhibition device, to an oil water separator before draining to the infiltration basin.

More specifically, the substation will include two 450 MVA step-up transformers (220 or 275 kV to 345 kV). The heavy steel transformer casings will be filled with dielectric fluid, which has both insulating and heat transfer functions. Dielectric fluid is essentially a high-grade mineral oil, and transformers are rugged pieces of equipment designed for a long service life, and are carefully monitored and regularly inspected. The dielectric fluid itself is not corrosive, and accordingly leaks of dielectric fluid are rare. Nonetheless, Vineyard Wind has committed to placing more than full-capacity containment under each transformer as described above.

The proposed substation will also include some reactive power compensation and power quality equipment. This equipment will likely include shunt reactors, STATCOMs, and harmonic filters. To the extent to which any of this equipment uses dielectric fluid, the equipment will be underlain by a full-capacity (110%) containment structure. This precaution is over and above normal industry practice, but is a commitment made by Vineyard Wind based on concerns expressed by the Town of Barnstable.

In addition, a Spill Prevention, Control and Countermeasures (SPCC) Plan will be included in the Proponent's Construction Management Plan. The Company will also include spill response in its emergency response plan as part of the Project's overall safety management system. Appropriate spill containment kits and spill control accessories will be strategically situated at the substation and may include absorbent pads, temporary berms, absorbent socks, drip pans, drain covers/plugs, appropriate neutralizers, over pack containers all for immediate use in the event of any inadvertent spills or leaks. All operators will be trained in the use and deployment of such spill prevention equipment. The Company will also have a third-party licensed spill response contractor on call as part of the Project's overall Oil Spill Response Plan.

1.3.4.2 Stormwater Management

A stormwater management system at the substation site will include the low-impact development (LID) strategies, which are designed to capture, treat, and recharge stormwater runoff. These may include:

- Roof runoff disconnection and infiltration (via dry wells) to minimize ground surface contact;
- Grass water quality swales to capture and convey site runoff;
- Sediment forebays to prevent surface runoff;

- Deep sump catch basin(s) to pretreat surface runoff; and

- Infiltration basin(s) to recharge clean stormwater back to the ground.

It is expected that post-development stormwater will substantially infiltrate on-site because the substation yard surface will be predominantly permeable (e.g., crushed stone). However, during substantial stormwater events, runoff will flow from parking and driveway pavement, roof tops, gravel yard areas, and any landscaped or grassed areas to likely pretreatment best management practices (BMPs) and an infiltration basin. Grass swales, sediment forebays, deep sump catch basins, and infiltration basins provide a treatment train that improves the quality of stormwater runoff, reduces the quantity of stormwater runoff, and provides infiltration and recharge to groundwater. These are considered BMPs by the MassDEP.

The stormwater management design will meet or exceed the Massachusetts Stormwater Policy recommendations, and the Project will comply with MassDEP Stormwater Standards. The Project will also seek a National Pollutant Discharge Elimination System (NPDES) General Permit for construction activities from the U.S. Environmental Protection Agency (EPA).

1.3.4.3 Lighting

Outdoor lighting is planned at the proposed substation. Light fixtures are typically holophane type fixtures equipped with light shields to prevent light from encroaching into adjacent areas. Light shields may be rotated within fixtures to the most effective position to keep light overflow from leaving the substation. The design will work to comply with night sky lighting standards to the maximum extent practicable. There are typically a few lights illuminated for security reasons on dusk–to-dawn sensors as well as a few on motion-sensing switches, depending on the application needed for the site. The majority of lights will be switched on for emergency situations only and would not be used on a regular basis. The Company will work with the Town of Barnstable to ensure the lighting scheme complies with Town requirements.

1.3.5 Expansion of West Barnstable Substation

Some modifications to the interconnection point at the 345-kV West Barnstable Substation will be necessary to accommodate the Vineyard Wind Connector 2. Vineyard Wind is consulting with Eversource on the specific design and location of these modifications, as well as working with ISO-NE on the System Impact Study for interconnecting the Project. Per the Feasibility Study results, the new equipment required at the Eversource substation includes the following:

- A new 345-kV breaker and half bus arrangement including eight breakers that will terminate the 345-kV 399 Line at the new bus;

- Two 345-kV feeders connecting the Project to the existing 345-kV West Barnstable Substation;

- A second 345/115-kV Autotransformer with similar impedances and ratings as the existing 345/115-kV Autotransformer; and

- A 115-kV breaker bay to accommodate the low side autotransformer connection.

The final design of the West Barnstable Substation expansion will need to be formulated in collaboration with Eversource and in consultation with the Town of Barnstable. However, Vineyard Wind's engineers have created a conceptual schematic design of what this expansion could look like based on the Feasibility Study results. This design, shown on Figure 1-12, is contained on the Eversource property just northeast of the existing West Barnstable Substation equipment and south of the Oak Street Substation.

1.4 Existing Infrastructure in Routing Area

1.4.1 Transmission Infrastructure

Existing transmission infrastructure was assessed and considered for the routing analysis presented in Section 4.0, and is shown in the context of the routing study area on Figure 4-1.

On the onshore side, 345-kV transmission extends onto Cape Cod before terminating at the West Barnstable Substation, while 115-kV transmission extends past the West Barnstable Substation to Barnstable Switching Station before continuing further onto the Cape. Eversource Energy is the electric provider on Cape Cod, and both of the substations in Barnstable are Eversource-owned.

On the offshore side, existing offshore cables in the overall routing study area include transmission cables associated with the Block Island Wind Farm, trans-Atlantic communication cables, three transmission and communications cables that connect Martha's Vineyard to the mainland in Falmouth, and two transmission cables extending to Nantucket. In addition, the two offshore export cables for Vineyard Wind 1 are proposed within the same OECC as this Project but east of the two proposed cables, such that no crossing will be necessary. A segment of submarine cable also provides power and data connection to an academic offshore research platform south of Martha's Vineyard.

Other offshore cables may be under consideration in the relatively near future to bring electricity to the mainland from the other federal offshore lease areas located in the WEA, but to Vineyard Wind's knowledge no applications for those cables have been submitted, and none have been permitted.

The OECC does not cross any existing offshore cables, although well-established engineering techniques could be used to achieve such a crossing should it become necessary (see Section 5.4.1.3). Construction methodology is discussed in Section 5.4.

1.4.2 Marine Infrastructure

Nantucket Sound and the waters off the south shore of Cape Cod contain existing marine infrastructure that was considered during the offshore routing analysis described in Section 4.6. These features are reported on nautical charts jointly issued by the U.S. Department of Commerce, the National Oceanic and Atmospheric Administration (NOAA), and the National Ocean Service, and include features such as navigation channels, anchorage areas, and ordinance disposal sites. Existing marine infrastructure is shown on a NOAA chart on Figure 1-13.

1.5 Summary of Routing

The routing analysis provided in Section 4.0 identifies Preferred and Noticed Alternative routes for connecting the landfall site to the proposed substation site and subsequently to the interconnection location. The routes are described geographically below and are compared in terms of environmental, human/community, and construction considerations in Section 5.0.

1.5.1 Onshore Transmission Routes (Landfall Site to Proposed Substation)

The Preferred and Noticed Alternative routes for transmission from the landfall site to the proposed substation site are described below.

1.5.1.1 Preferred Route (Shootflying Hill Road)

The Preferred Route begins in a paved parking lot at the Craigville Public Beach Landfall Site (see Figure 1-2). As shown in Table 1-1, the route proceeds generally north on Craigville Beach Road for approximately 0.5 miles through moderate-density residential areas, then continues north on Main Street for approximately 0.5 miles through more developed mixed residential and commercial areas. Continuing north on Old Stage Road in Centerville Village for approximately 0.7 miles through mixed residential and commercial areas, the route passes through the Centerville Historic District. The route then crosses Route 28 and follows Shootflying Hill Road for approximately 2.1 miles through moderate-density residential areas before turning southeast onto ROW #343 for the final approximately 0.2 miles to the site for the proposed Project substation, where voltage will step up to 345 kV in preparation for interconnection with the existing electrical grid. Vineyard Wind is proposing to locate the section of duct bank within ROW #343 within the existing utility ROW access road, which will avoid the need for tree clearing.

Table 1-1 Transmission Route – Preferred Route (Shootflying Hill Road)

Road Segment	***Approximate Length (miles)***
Craigville Beach Road	0.5
Main Street	0.5
Old Stage Road	0.7
Shootflying Hill Road	2.1
ROW #343	0.2
total	*4.0*

Approximately 0.24 miles north of the landfall site, the Craigville Beach Road segment includes a crossing of the Centerville River where there is an existing two-lane bridge. The Centerville River crossing is described in greater detail in Section 1.5.1.4.

The total length of this Preferred Route is 4.0 miles, and the route is located almost entirely within public roadway layouts except for possibly the Centerville River Crossing as well as the final approximately 1,000 feet (0.2 miles) along ROW #343. The proposed duct bank will be installed either beneath pavement or within ten feet of pavement.

The Proponent is also considering three variants of this Preferred Route; each variant is described below and is shown on Figure 1-2. Photographs of the Preferred Route are provided in Attachment A.

1.5.1.1.1 Variant 1 – Covell's Beach Landfall Site

This variant of the Preferred Route provides an alternative landfall option at the Covell's Beach parking lot approximately 0.4 miles east of Craigville Public Beach. The Town-owned paved parking lot at Covell's Beach is being utilized as the landfall site for the Vineyard Wind Connector 1 and through the permitting of that project was proven as an acceptable landfall location. For this reason, it is presented as a variant to the preferred transmission route that could be utilized in case unforeseen challenges arise pertaining to the Craigville Public Beach Landfall Site. The Company would only expect to use this variant should it prove infeasible to make landfall at the Craigville Public Beach parking lot.

The Covell's Beach Landfall Site is a variant, and not preferred, for the Vineyard Wind Connector 2 for three main reasons. First, use of the Covell's Beach Landfall Site for the Vineyard Wind Connector 2 would add approximately 0.4 miles to the onshore route along Craigville Beach Road, for a total route length of 4.5 miles, which would increase the number of residences (375 vs. 316) affected by temporary construction impacts and would also increase Project costs. Second, utilizing a separate landfall site from Vineyard Wind Connector 1 would mean some geographic separation between the proposed infrastructure to accomplish the offshore-to-onshore transition, improving reliability and avoiding a second winter season of disrupting the parking lot at Covell's Beach. Third, the Covell's Beach Landfall Site is physically constrained by the current design for Vineyard Wind Connector 1, which leaves limited and potentially inadequate space for Vineyard Wind Connector 2 landfall and equipment. Finally, this variant also passes more historic resources than the Preferred Route (40 vs. 33), although the Project will avoid significant impacts to those resources.

1.5.1.1.2 Variant 2 – South Main Street

This variant diverges from the Preferred Route at the intersection of Craigville Beach Road with South Main Street, following South Main Street eastward to Main Street, Mothers Park Road, Phinneys Lane, and Great Marsh Road. The variant then rejoins the Preferred Route north of Route 28 at Shootflying Hill Road. This variant is proposed as a means of avoiding the Centerville Historic District; however, construction through the historic district is feasible and this variant would only be utilized if the more direct route through the Historic District proves problematic.

The South Main Street variant is approximately 1.2 miles longer than the Preferred Route, with a total length of 5.2 miles, and is located almost entirely within existing roadway layouts except for possibly the Centerville River Crossing as well as the final approximately 1,000 feet (0.2 miles) along ROW #343. However, the additional 1.2 miles in length does not offer any advantages except for avoiding the historic district, while in fact construction through the historic district is not only feasible but could even be beneficial if Project construction is coordinated with the Town of Barnstable's plans to install sewer infrastructure. Furthermore, this variant would pass two additional sensitive receptors relative to the Preferred Route (6 vs. 4) and would potentially add two sharp bends to the route (see Figure 1-2).

1.5.1.1.3 Variant 3 – Northern Substation Access

This variant provides an alternative for accessing the proposed substation site from the north off of Shootflying Hill Road rather than from the south off of ROW #343. Variant 3 continues along Shootflying Hill Road for an additional approximately 0.3 miles before turning into the site of the proposed substation. At a total length of 4.1 miles, Variant 3 is approximately the same length as the Preferred Route, and is located entirely within existing roadway layouts except for possibly the Centerville River Crossing.

This variant is proposed as an alternative if it is not possible to use the existing utility ROW. It is not preferred because it would also narrow the options for 345-kV cables exiting the substation site, increase temporary construction impacts in roadway layouts, impact three residential homes along Shootflying Hill Road during construction, and could potentially create a situation where the Vineyard Wind Connector 2 duct bank would need to cross itself, adding an unnecessary complication to construction, increasing costs, and potentially impacting reliability.

1.5.1.2 Noticed Alternative (Oak Street Route)

As shown on Figure 1-2 and in Table 1-2, the Noticed Alternative begins at the Craigville Public Beach Landfall Site and proceeds northerly on Craigville Beach Road for approximately 0.5 miles. At the intersection between Craigville Beach Road and South Main Street, the route essentially follows Variant 2 of the Preferred Route, continuing northeasterly on South Main Street for approximately 0.7 miles, turning sharply west on Main Street for approximately 0.4 miles to Mothers Park Road where it turns briefly to the north for approximately 0.1 miles to join Phinneys Lane, and then continuing northeast on Phinneys Lane for approximately 0.4 miles, crossing Route 28 and turning west on Great Marsh Road. The Noticed Alternative follows Great Marsh Road for approximately 0.9 miles, crossing Shootflying Hill Road and ultimately turning northward onto Old Stage Road for 1.4 miles to Oak Street, where it turns northeast and continues approximately 0.9 miles to Service Road. The route then follows Service Road for approximately 0.8 miles to Shootflying Hill Road, which it follows for the remaining approximately 0.1 miles to the site of the proposed substation.

The total length of the route is 6.1 miles, and the route is located entirely within public roadway layouts except for possibly the Centerville River crossing.

Table 1-2 Transmission Route – Noticed Alternative (Oak Street Route)

Road Segment	***Approximate Length (miles)***
Craigville Beach Road	0.5
South Main Street	0.7
Main Street	0.4
Mothers Park Road	<0.1
Phinneys Lane	0.4
Great Marsh Road	0.9
Old Stage Road	1.4
Oak Street	0.9
Service Road	0.8
Shootflying Hill Road	0.1
total	*6.1*

The Company is also considering two variants of this Noticed Alternative; each variant is described below and is shown on Figure 1-2. Photographs of the Noticed Alternative are provided in Attachment B.

1.5.1.2.1 Variant 1 – Covell's Beach Landfall Site

This variant of the Noticed Alternative provides an alternative landfall option at the Covell's Beach parking lot approximately 0.4 miles east of Craigville Public Beach, and the Company would only expect to use this variant should it prove infeasible to make landfall at the Craigville Public Beach parking lot. The Town-owned paved parking lot at Covell's Beach is being utilized as the landfall site for the Vineyard Wind Connector 1 and through the permitting of that project was proven as an acceptable landfall location. For this reason, it is presented as a variant to the preferred transmission route that could be utilized in case unforeseen challenges arise pertaining to the Craigville Public Beach Landfall Site.

The Covell's Beach Landfall Site is a variant, rather than part of the Noticed Alternative, for three main reasons. First, use of the Covell's Beach Landfall Site for the Vineyard Wind Connector 2 would add approximately 0.4 miles to the onshore route along Craigville Beach Road, for a total route length of 6.5 miles, which would increase the number of residences (419 vs. 362) affected by temporary construction impacts and would also increase Project costs. Second, utilizing a separate landfall site from the Vineyard Wind Connector 1 would mean some geographic separation between the proposed infrastructure to accomplish the offshore-to-onshore transition, improving reliability and avoiding a second winter season of disrupting the parking lot at Covell's Beach. Third, the Covell's Beach Landfall Site is physically constrained by the current design for Vineyard Wind Connector 1, which leaves limited and potentially inadequate space for the Vineyard Wind Connector 2 landfall and equipment. Finally, this variant also passes more historic resources than the Noticed Alternative (45 vs. 38), although the Project will avoid significant impacts to those resources.

1.5.1.2.2 Variant 2 – ROW #345

Variant 2 shortens the Noticed Alternative by approximately 0.7 miles by utilizing approximately 1.6 miles of existing transmission ROW between Old Stage Road and the proposed substation site, ultimately accessing the proposed substation site from the south. With a total length of 5.4 miles, approximately 3.8 miles would be within existing roadway layouts while approximately 1.6 miles would follow the existing transmission ROW #345 and ROW #343.

While a shorter route with fewer construction-period traffic impacts and fewer potential conflicts with existing subsurface utilities, this variant would likely require tree clearing on private land within the transmission ROW where the ROW has not been maintained to its full width. In addition, this variant would likely require a trenchless crossing within the utility ROW to avoid impacts to a wetland, increasing costs and the complexity of construction. Finally, the variant would pass through more area mapped as public water supplies (1 mile vs. 0.5 miles) and would cross three Article 97-jurisdictional parcels instead of two.

1.5.1.3 Intersection of Preferred Route and Noticed Alternative

As shown on Figure 1-2, the Preferred Route and Noticed Alternative cross once at the intersection of Shootflying Hill Road and Great Marsh Road. This crossing point does theoretically provide an opportunity to switch between the two routes, utilizing the first portion of one route and the second portion of the other.

South of the crossing, Variant 2 of the Preferred Route is the same as the Noticed Alternative, so is fully analyzed in this Petition.

North of the crossing, deviating from the Preferred Route would have some clear disadvantages. Following the Noticed Alternative rather than continuing along the Preferred Route would add significant length (1.6 miles) as well as passage past more residential units (362 versus 316, see Section 4.5.1). Following Variant 2 of the Noticed Alternative rather than continuing along the Preferred Route would also add length (0.9 miles) but would also add construction along a long (1.6-mile) stretch of ROW #345 where tree clearing would be likely and a wetland crossing, likely via HDD, would be needed (see Section 5.2.1.2.2).

Therefore, while the intersection of the Preferred Route and Noticed Alternative creates the theoretical opportunity to follow the first part of the Preferred Route and the second part of the Noticed Alternative, as discussed above and demonstrated in Sections 4 and 5, utilizing the northern part of the Preferred Route is the clearly superior option.

1.5.1.4 Centerville River Crossing

As described above in the context of the onshore transmission routes, both the Preferred Route and Noticed Alternative cross the Centerville River while on Craigville Beach Road. The Centerville River is a tidal waterbody that ebbs to the west and drains into Nantucket Sound at East Bay. Near the Craigville Beach Road bridge, the river is approximately 260 feet wide (80 m), although it is significantly constricted by the approaches on either side of the bridge, which has a clear span of only 75 feet (23 m). The bridge, built in 2002, is fixed and its relatively low profile allows for the passage of only small boats. This low profile also means the existing bridge deck lies within the 100-year floodplain. The bridge deck is approximately 50 feet (15 m) wide and accommodates two lanes of traffic, with two sidewalks and a separate fishing platform on its south side.

Given that the existing bridge deck cannot support the additional weight of the cables and it is not feasible to maintain existing hydraulic clearance beneath the bridge with the addition of cables, the Project is not proposed within the existing bridge deck to maintain reliability and avoid potential risk during storm conditions. While determining the most appropriate method for crossing the Centerville River in this location, Project engineers assessed the viability of multiple design options, including replacement of the bridge superstructure, trenchless techniques (microtunnel, HDD, and direct pipe), and construction of a new utility bridge parallel to the existing bridge. These design alternatives are described below.

The Company has discussed options for the Centerville River crossing with the Town of Barnstable and the Massachusetts Department of Transportation (MassDOT). Based on those consultations and engineering considerations, the current preferred option is microtunnel, followed by the other two trenchless crossing options, and finally the bridge superstructure replacement. These options are discussed in Sections 1.5.1.4.1 through 1.4.1.5.4. As described in Section 1.5.1.4.5, the Company does not anticipate advancing the utility bridge option at this time.

1.5.1.4.1 Bridge Superstructure Replacement

The bridge superstructure replacement option involves replacing the deck of the existing bridge to accommodate the onshore export cables, which would be contained in two conduit bundles, each containing four 8-inch steel conduits (three active conduits and one spare). This option would not modify the existing bridge footprint. Each conduit bundle would be supported between the bridge beams below the roadway in two separate bays (see Figures 1-14a, 1-14b, and 1-14c). To accommodate the conduit configuration, the superstructure replacement would require, at a minimum, a 55-inch-deep precast concrete beam, an 8-inch-deep concrete deck, and a 3.5-inch bituminous wearing surface. The road surface would be approximately 2 feet 9 inches higher than the current installation, resulting in re-grading of approaches on both sides of the bridge for approximately 290 to 365 feet as well as re-grading the north branch of Short Beach Road, extending existing and new retaining walls, and re-grading five residential driveways. The roadway and driveway regrading are within typical tolerances.

This option would enable the proposed power conduits to be hidden beneath the bridge, and would avoid need to construct a separate and entirely new structure across the river or a route under the river. The metal conduit design would provide shielding of each individual cable, with the tightly-spaced symmetrical “diamond” configuration conducive to optimal cancellation of Electric and Magnetic Fields (EMF). However, routine bridge inspections would require temporary power shutdown or adequate EMF shielding to allow inspection personnel hands-on access to adjacent bridge components for a duration of 6 to 8 hours, on a schedule of approximately once every two years. This option was evaluated in the EMF analysis presented in Section 5.5 as a conservative scenario. Future bridge repairs or reconstruction may also require temporary power shutdown.

The bridge superstructure replacement could be accomplished in a single construction season using accelerated bridge construction design and techniques. However, the accelerated construction schedule would require bridge closure from Columbus Day to Memorial Day. Although this full closure would allow for an unencumbered work zone and more efficient construction, it would significantly disrupt local traffic. It would likely be impossible to maintain one open lane while replacing the deck due to the change in deck height and approach grade. To facilitate construction, an existing 4-inch-diameter gas line and 12-inch-diameter water main supported under the existing bridge would need to be temporarily disconnected and relocated during construction. Similarly, overhead electrical and communication lines on the north side of the bridge would require temporary relocation during construction. The Company would work with the relevant utility provider to minimize or eliminate any interruptions in service associated with these relocations.

Replacement of the bridge superstructure would temporarily impact barrier beach, open water, salt marsh, and riverfront area (RFA) (see Figure 1-14c); these impacts are described in greater detail in Section 5.2.1.1.

Given the challenges associated with the bridge superstructure replacement, it is not the preferred method for achieving the river crossing.

1.5.1.4.2 Microtunnel

Microtunnel is defined as a pipe jacking operation that utilizes a microtunnel boring machine (MTBM) pushed into the earth by hydraulic jacks mounted and aligned in a jacking shaft. A concrete casing pipe is lowered into the shaft and inserted between the jacking frame and the MTBM or previously jacked pipe. Slurry lines and power and control cable connections are made, and the pipe and MTBM are advanced along the planned alignment. This process is repeated until the MTBM reaches the reception shaft. Upon completion of the tunnel, the equipment is removed, the carrier pipeline/conduits are pulled through the concrete casing pipe utilizing rollers or an alternative method, and the annular space is grouted.

To accomplish the Centerville River crossing, a single approximately 430-foot (130-m) long microtunnel drive would be used to install a 48-inch-diameter reinforced concrete pipe under the river. The reinforced concrete pipe would house eight 8-inch flexible polyvinyl chloride (FPVC) power conduits and three 2-inch HDPE conduits for communication and ground cables, as well as a number of grout lines. The annular space would be grouted using thermal cellular grout to dissipate heat.

The jacking shaft and staging area would be located on the southwest side of the Centerville River Bridge to align with the staging area for microtunnel and to minimize impacts on the traveling public on Craigville Beach Road (see Figures 1-15a and 1-15b). This design does require acquiring additional property rights on this side of the bridge. A minimum depth of 10 feet (3 m) of cover between the top of the casing and the bottom of the Centerville River is needed to complete the microtunnel drive and maintain tunnel face stability. The jacking shaft and staging area are within the MassDEP-classified barrier beach and also within the 200-foot RFA, but would not have any permanent impacts to these resources (see Figure 1-15c). All activities would be outside the river and riverbanks themselves (see Section 5.2.1.1).

A receiving shaft north of the river would be needed to recover the MTBM. The trenchless drive would extend to the north side of Craigville Beach Road to minimize impacts to private property and resource areas. An auger bore or open cut excavation could be used to transition the cable at depth up to the duct bank depending on geotechnical and hydrogeological conditions, duct bank connection locations, and the available staging area. The use of auger boring is shown on Figure 1-15a, and while representing a more technically complex approach, it minimizes dewatering requirements and footprint in the roadway compared with open-cut excavation. If permitted, open-cut excavation is a likely more cost-effective approach for constructing the two transition sections.

Microtunnel would have a smaller construction footprint compared to HDD by avoiding the need to have a pipe string laydown area; however, construction could be somewhat longer in duration than the HDD. It would also minimize impacts to traffic along Craigville Beach Road relative to the bridge replacement option and would avoid impacts to driveways on the west side of the Centerville River Bridge. The existing four-inch gas main on the west side of the bridge would need to be relocated prior to the work as it conflicts with the proposed receiving shaft location; Vineyard Wind would work with the relevant utility to minimize or eliminate service interruptions to gas customers. For the reasons discussed above, microtunnel is currently the preferred option for achieving the river crossing.

1.5.1.4.3 Horizontal Directional Drilling (HDD)

HDD is a surface-launched trenchless system widely used to install pipelines, often under rivers, roadways, or other surface features. A small diameter (1.5- to 6-inch) drilling string with a steering head penetrates the ground at the prescribed entry location and angle, is pushed through the ground along a predetermined alignment/profile and returns to the surface on the other side of the obstacle or waterway. Next, a reaming head is attached to the drilling string to cut an oversized bore for the carrier pipe to be pulled through. Finally, the pipeline or utility line, suspended and connected to the drill pipe using a pulling head and a swivel, is pulled back into the freshly excavated hole.

This option contains two separate approximately 660-foot-long (200-m-long) HDD bores, each used to install four 8-inch-diameter FPVC power conduits and up to four 2-inch-diameter HDPE conduits for communication/grounding cables. This approach utilizes a 28-inch-diameter HDD bore to install the pipe bundle (see Figures 1-16a and 1-16b). The twin HDD bores would have a five-foot horizontal offset and a six-foot vertical offset.

The HDD entry pit would be located on the southeast side of the Centerville River, outside the river itself but partly within the 200-foot RFA (see Figures 1-16c and 1-16d). The Company is also considering a feasible alternative that would locate the HDD on the other side of the bridge. The entry pit also lies within the barrier beach. This location would minimize disruption to residents and vehicles traveling on Craigville Beach Road relative to the bridge superstructure replacement alternative, and would achieve a sufficient depth of cover before crossing under the Centerville River. Staging for the exit pit would contain equipment and a small pit for collecting drilling fluids (a slurry of water and bentonite, a naturally-occurring, inert and non-toxic clay).

The HDD entry and exit angles would be approximately 12 degrees, and the selected bend radius of 425 feet for the vertical bends contains a factor of safety for the HDD drill pipe installation and the controlling 8-inch FPVC. The HDD has been designed with a horizontal offset of 13 feet from the existing Centerville River Bridge piles to avoid conflicts with potential future widening of the Centerville River Bridge.

This option has the advantage of being located within the public ROW without private property acquisition requirements. In addition, the construction period is relatively brief and relatively limited staging areas would be needed. Each circuit would be routed through a dedicated bore, providing separation. As shown in Figures 1-16a and 1-16b, the pipe laydown area would require the closure of approximately 400 feet (120 m) of the westbound lane of Craigville Beach Road for the duration of HDD operations. Temporary blockage of a single driveway along Craigville Beach Road would also be needed for a period of approximately 12 hours during final preparations for execution of the two pullback operations, which would be coordinated with the landowner. For these reasons, although HDD is a good and viable alternative, it is considered slightly inferior to microtunnel.

1.5.1.4.4 Direct Pipe

A direct pipe trenchless drilling method uses a drill head welded to a pipe casing, and as drilling progresses the pipe casing keeps getting extended. Once the drill path is complete through the receiving end, the head is cut off and the pipe remains in place, becoming the casing for the cables.

For the Centerville River crossing, the direct pipe option would commence at the Craigville Public Beach parking lot within the same general area as the landfall site. A minimum 42-inch-diameter MTBM would be required to complete the approximately 1,400-foot (430-m) long drive from the parking lot to the northern side of the Centerville River (see Figures 1-17a, 1-17b, and 1-17c). This would accommodate eight 8-inch-diameter nominal FPVC conduits and three 2-inch-diameter conduits for communications/ground cables, as well as grout lines. A 3,000-foot bending radius has been used to design the casing option with a 20-foot minimal depth of cover using a six-degree entry angle and four-degree exit angle. The exit trench would be located north of the Centerville River within the westbound lane of Craigville Beach Road.

This option would limit disruption to Craigville Beach Road by avoiding duct bank installation south of the Centerville River crossing. Most construction activity would occur within the paved Craigville Public Beach parking lot. Direct pipe is generally a faster process than HDD, but it does require a larger unobstructed staging area to weld pipe sections together. This staging area could extend onto the beach itself and also occupy a significant portion of the parking lot. On areas of the beach used for staging, geotextiles and matting would be used to avoid beach compaction or penetration, and the beach would be restored to preexisting conditions following completion of the direct pipe. Construction would also occur in the off-season, when the beach and parking lot would be in minimal use. However, due to these temporary impacts, direct pipe is considered slightly inferior to microtunnel.

1.5.1.4.5 Adjacent Utility Bridge

A fifth option involves an independent utility bridge constructed immediately north of the existing Centerville River Bridge, with a minimum three-foot clearance from the existing bridge. The utility bridge would support a 4x2 conduit array containing eight 10-inch-diameter steel conduits secured by plastic spacers (see Figure 1-18). The utility bridge would be a one-unit precast pre-stressed concrete section that would require new foundations consisting of cast-in-place concrete abutments on piles. The new foundations could be constructed by extending the foundations of the existing adjacent bridge.

Although this bridge would have the advantage of being independent from the existing bridge, this option does have a number of disadvantages. First, the new abutment/foundation would require new driven piles within the Centerville River, and riprap would also need to be relocated. The utility bridge would also be visible from the adjacent sidewalk, and an anti-climb fence would need to be installed on the north side of the existing bridge to prevent pedestrians from climbing from one to the other, a potential public safety risk. Routine bridge inspections every two years would also require temporary power shutdown or full EMF shielding to allow inspection personal hands-on access to the adjacent existing bridge for a duration of 6 to 8 hours. In addition, temporary lane closures would be required for crane operations while the utility bridge is being erected. Overhead electrical and communication lines on the north side of the existing bridge would also require temporary relocation during construction.

Due to these reasons, and because other preferable alternatives exist, the Company does not anticipate advancing this option for the Centerville River crossing at this time.

1.5.2 Onshore Grid Interconnection Routes (Proposed Substation Site to Interconnection Location)

The Preferred and Noticed Alternative routes for transmission from the proposed substation site to the interconnection at the 345-kV West Barnstable Substation are described below.

1.5.2.1 Preferred Route (ROW #343 to ROW #381)

As shown on Figure 1-3, the Preferred Route begins on the south side of the proposed substation site, entering ROW #343 for less than 0.1 miles before turning southwesterly onto ROW #345. The route follows ROW #345 for approximately 0.5 miles before turning northwesterly onto ROW #381 and entering assessor map parcel #214-001, located immediately southeast of the West Barnstable Substation, before entering the substation site (see Figure 1-11).

The less than 0.2-mile segment along ROW #381 includes a crossing of Route 6. Vineyard Wind began consulting with MassDOT about this crossing in Fall 2019, as well as with the Town of Barnstable. During these consultations, HDD, pipe jacking, and microtunnel were all considered as possible options. The Route 6 crossing is decribed in greater detail in Section 1.5.2.1.4.

The total length of this Preferred Route is approximately 0.7 miles, and the route is located entirely within existing utility ROWs. In January 2020, Vineyard Wind submitted a co-location request to Eversource describing the proposed use of the existing ROWs and initiating the Eversource review process. Depending on the final duct bank alignment within the utility ROWs, some vegetation and tree clearing within the existing utility ROW may be necessary since they have not been maintained to their full width.

The Company is also considering three variants to this Preferred Route; each variant is described below and is shown on Figure 1-3. The Preferred Route is preferable to the variants for a number of reasons. First, at the Route 6 crossing the approach from ROW #345 onto ROW #381 enables the pit for the trenchless crossing to be located south of Service Road, avoiding possible interference with a future bike path planned along Service Road as well as possible future widening of Route 6. Second, using ROW #345 avoids the need to work around the existing subsurface gas line in Service Road, and third it voids temporary construction-period impacts to residences with driveways along Service Road. Finally, the western option for crossing Route 6 (as opposed to the eastern option that would be utilized for Variants 2 and 3) is superior for the reasons described in Section 1.5.2.1.2, including impacts to adjacent residences among other considerations, and because the northern end of the trenchless crossing can occur on assessor map parcel #214-001, which Vineyard Wind is under contract to purchase.

Photographs of the Preferred Route are provided in Attachment C.

1.5.2.1.1 Variant 1 – Service Road to ROW #381

This variant of the Preferred Route shortens the amount of existing utility ROW occupied by the duct bank by exiting the northern side of the proposed substation site onto Shootflying Hill Road, traveling west for less than 0.1 miles before continuing west on Service Road for approximately 0.6 miles. The variant then enters ROW #381 and turns north for less than 0.1 miles before entering assessor map parcel #214-001 and the West Barnstable Substation.

The same Route 6 crossing that was discussed above for the Preferred Route is applicable to Variant 1, and the same trenchless crossing method would be used for the Preferred Route or Variant 1.

This variant is the same length as the Preferred Route, approximately 0.7 miles. Almost the entire length of the route utilizing this variant would be located within existing roadway layouts, where the proposed duct bank would be installed either beneath pavement or within ten feet of pavement.

This variant is similar to the Preferred Route, practically paralleling it, and would be utilized if it becomes infeasible to locate the duct bank within the utility ROW. However, although this variant is quite similar to the Preferred Route, it is not itself preferred for the following reasons. First, the Town of Barnstable has plans to construct a public bike path parallel to Shootflying Hill Road and Service Road, and MassDOT has informed Vineyard Wind of plans for widening Route 6 that could include grading that extends south between the Route 6 eastbound lane and Service Road. This would pose an engineering challenge where the ductbank transitions from Service Road to ROW #381. In preparation for the Route 6 crossing, the southern access pit for that trenchless crossing would need to be placed north of Service Road, and could conflict with the future plans for a bike path or Route 6 widening. Second, this variant would require traffic management along Shootflying Hill Road and Service Road, and would create a greater inconvenience for residents with driveways along this stretch of Service Road. Third, construction would need to be coordinated to avoid conflicts with the existing natural gas line and planned natural gas main upgrade within the roadway layout of Service Road. Collectively, these considerations make this variant less desirable than the Preferred Route.

1.5.2.1.2 Variant 2 – ROW #343 to ROW #342

After following the same segment of ROW #343 for less than 0.1 miles on the south side of the proposed substation site, this variant diverges from the Preferred Route by turning northwest onto ROW #345 for less than 0.1 miles, and then turns west into ROW #342 for approximately 0.4 miles before entering the northeast portion of the West Barnstable Substation (see Figure 1-3).

This variant would be utilized if it proves infeasible to use ROW #345, ROW #381, or Service Road but Eversource grants the co-location request for ROW #342. As with the Preferred Route, this variant includes a crossing of Route 6, but the crossing is within ROW #342 rather than ROW #381. It is likely the same trenchless crossing method would be used for the Preferred Route or Variant 2, but this more eastern crossing of Route 6 would be more challenging than the crossing proposed for the Preferred Route for the following reasons:

- When comparing the jacking shaft and receiving shaft locations, the western crossing exhibits flatter topography, allowing the tunnel to remain relatively flat which makes it easier to control soil removal during excavation.
- There are multiple possible locations for the receiving shaft at the western crossing, while available space for the receiving shaft at the eastern crossing is constrained, with very narrow available space on the south side of the highway and steep embankments on either side of Service Road.
- The western crossing allows for good separation between the proposed construction and residences, while the eastern crossing would need to occur relatively close to a residence near the corner of Service Road and ROW #342.
- The eastern crossing is impacted by overhead electrical transmission lines and towers that would challenge siting the trenchless crossing as well as the equipment used.
- The western crossing utilizes assessor map parcel #214-001, which provides ample space for construction and installation on the north side of Route 6 entirely separate from the Eversource substation and ROW, while the entirety of the eastern trenchless crossing would need to utilize the utility ROW.

With a total length of 0.6 miles, this variant is 0.1 miles shorter than the Preferred Route, and is located entirely within existing utility ROWs. In January 2020, Vineyard Wind submitted a co-location request to Eversource describing the proposed use of the existing ROWs and initiating the Eversource review process. Depending on the final duct bank alignment within the utility ROWs, some vegetation and tree clearing within the existing utility easements may be necessary since they have not been maintained to their full width.

While feasible, this variant is inferior to the Preferred Route for the following reasons. First, as described above, the western option for crossing Route 6 is superior to the eastern option for a number of reasons, including that the eastern crossing would occur in close proximity to a residence. Second, both ends of the Route 6 trenchless crossing on this variant would occur within the utility ROW, while on the Preferred Route the northern end of this crossing would occur on assessor map parcel #214-001, which Vineyard Wind is under contract to purchase.

1.5.2.1.3 Variant 3 – Service Road to ROW #342

This variant shortens the amount of existing utility ROW occupied by the duct bank by exiting the northern side of the proposed substation site onto Shootflying Hill Road, traveling west for less than 0.1 miles before continuing west on Service Road for approximately 0.1 miles. The variant then enters ROW #342 for approximately 0.4 miles before entering the northeast portion of the West Barnstable Substation.

This variant would be utilized if the substation design warrants the 345-kV cables exiting to the north and if it proves infeasible to use ROW #345, ROW #381, and Service Road but Eversource grants the co-location request for ROW #342. As with the Preferred Route, this variant includes a crossing of Route 6, but the crossing is within ROW #342 rather than ROW #381 (and is the same crossing as shown in Variant 2). As described in Section 1.5.2.1.2 in the context of Variant 2, it is likely the same trenchless crossing method would be used for the Preferred Route or Variant 3, but this more eastern crossing of Route 6 would be more challenging than the crossing proposed for the Preferred Route.

With a total length of 0.6 miles, this variant is 0.1 miles shorter than the Preferred Route. The first 0.2 miles would be located within existing roadway layouts, where the proposed duct bank would be installed either beneath pavement or within ten feet of pavement. The remaining 0.4 miles is located within an existing utility ROW. In January 2020, Vineyard Wind submitted a co-location request to Eversource describing the proposed use of the ROW and initiating the Eversource review process. Depending on the final duct bank alignment within the ROW, some vegetation and tree clearing within the existing utility easement may be necessary since it has not been maintained to its full width. While feasible, this variant is inferior to the Preferred Route for the same reasons Variant 2 is inferior to the Preferred Route.

1.5.2.1.4 Route 6 Trenchless Crossing

As discussed in Section 1.5.2.1, the preferred grid interconnection route will extend through ROW #381 and cross under Route 6 (the Mid-Cape Highway) to assessor map parcel #214-001, which is located immediately southeast of the West Barnstable Substation and is under contract to be purchased by Vineyard Wind (see the engineering plans provided in Attachment F as well as Figure 1-11). The duct bank would then enter the West Barnstable Substation property from assessor map parcel #214-001.

The trenchless crossing of Route 6 will be accomplished with a single steel casing pipe that will be installed through use of a trenchless technique known as pipe jacking (see Figures 1-19a and 1-19b). Pipe jacking uses hydraulic jacks to thrust a specially designed casing pipe through the ground, led by a guidance system, to excavate a tunnel from a jacking shaft to a receiving shaft.

The bore is advanced behind a shield at the leading edge or face of the tunnel, providing instant support of the soil as excavation is taking place at the face of the tunnel within the shield. Pipe jacking methodologies include microtunnel, earth pressure balance machines, conventional non-pressurized tunnel-boring machines, and open shield machines. The open shield method is preferred for the Route 6 crossing because it allows for the removal of any large boulders and is most appropriate for the expected low groundwater application and the relative depth of cover under Route 6. The ability to perform boulder removal is key to this method where pneumatic jack hammers can be used to breakup boulders. Meetings with MassDOT District 5 engineers and review of documentation related to the construction of Route 6 both indicated a likelihood of encountering large boulders. The open shield pipe arrangement will be equipped with a hoe, cutter boom, muck cars, or conveyor belt to remove excavated material, and the open shield pipe jacking method provides a flexible, structural, watertight, finished pipeline once the tunnel is completed.

A jacking shaft (approximately 30 feet by 30 feet) will be constructed on assessor map parcel #214-001, immediately southeast of the West Barnstable Substation and north of Route 6. A receiving shaft (approximately 24 feet wide by 15 feet long) will be constructed south of Route 6 immediately south of Service Road. The jacking shaft will include a thrust wall to provide a reaction support against which to thrust the steel casing pipe into the ground to advance the tunnel. The alignment will be controlled using a laser beam projected at the location of the jacking shaft toward the receiving shaft, which guides the excavation and shield through the planned tunnel alignment. The laser is the basic control device, and two lasers at the springline of the tunnel will be used to orient the excavation and shield.

To accomplish the Route 6 crossing, a single approximately 464-foot-long (140-m) drive will be used to install either a 60- or 72-inch-diameter steel casing pipe under the highway between the jacking and receiving shafts. The casing size was selected to provide access for manned entry to remove any underground boulders that may be encountered as the casing is advanced. The installation is planned to extend under the eastbound and westbound Route 6 travel lanes and the highway median with no intermediate excavations. The steel casing pipe will contain eight 8-inch-diameter FPVC power conduits (six active and two spare) and three 2.5-inch-diameter HDPE conduits for communication and ground cables, as well as a number of grout lines. The casing will be filled with thermal grout to dissipate heat. An open air cooled design was considered but not selected due to the added equipment and reliability risk of additional air cooling systems. Refer to the engineering plans in Attachment F.

In the highway median, the depth of cover between the top of the casing and at-grade elevation will range from approximately 5 to 11 feet as required to complete the pipe jacking and maintain integrity of the installation. The depth of cover under the eastbound and westbound lanes of Route 6 will range from approximately 26 to 40 feet.

The proposed design, including locations of the jacking and receiving shafts, has been arranged to accommodate the potential future widening and embankment of Route 6, a future bike lane adjacent to Service Road, and future upgrades to the existing National Grid utility gas pipeline located within Service Road. The location of the receiving shaft can be optimized to best accommodate the duct bank routing. Should Variant 1 of the preferred grid interconnection route be utilized, the receiving shaft could be relocated immediately north of Service Road.

As described above in Sections 1.5.2.1.2 and 1.5.2.1.3, grid interconnection route Variants 2 and 3 would cross Route 6 while within ROW #342, east of the crossing involved in the Preferred Route and Variant 1. It is likely the same crossing methodology would be used for either crossing, but as described in Section 1.5.2.1.2 the eastern crossing would be more challenging, and less desirable, for several reasons.

1.5.2.2 Noticed Alternative (In-Roadway layout)

As shown on Figure 1-3, the Noticed Alternative begins on the north side of the proposed substation site, exiting easterly on Shootflying Hill Road for approximately 0.2 miles before turning northwesterly onto Route 132/Iyannough Road for approximatley 0.9 miles to the intersection with Oak Street. The route then follows Oak Street southwesterly for approximately 0.7 miles before turning into the northwest corner of West Barnstable Substation.

The total length of the route is 1.8 miles, and the route is located entirely within public roadway layouts. The proposed duct bank would be installed either beneath pavement or within ten feet of pavement.

Photographs of the Noticed Alternative are provided in Attachment D.

1.5.3 Offshore Routing

Beginning in August 2017, the Company performed three seasons of marine surveys to identify and refine feasible routes for proposed offshore export cables that would avoid and minimize impacts to offshore and nearshore resources. The OECC shown on Figure 1-4 is the product of those surveys. As described in greater detail in Section 4.6, this OECC was originally identified for the two offshore export cables that will be installed for the Vineyard Wind Connector 1, and Project engineers have determined that largely the same corridor can accommodate the Vineyard Wind Connector 2. One difference is the OECC has been widened by approximately 985 feet (300 m) to the west, and along the stretch through the Muskeget Channel area it has also been widened by approximately 985 feet (300 m) to the east, bringing its typical width to approximately 3,800 feet (1,150 m) and its range from approximately 3,100 to 5,100 feet (950 to 1,550 m). Since the two cables from the Vineyard Wind Connector 1 will already be installed within the previously-identified OECC, this widening will enhance the ability to micro-site the offshore export cables for the Vineyard Wind Connector 2 and avoid and minimize impacts to sensitive habitats. Both proposed offshore export cables will be located within the OECC, and the areas of widening will be surveyed in 2020. Existing survey data within the OECC are shown in Attachment H.

The OECC provides a relatively direct route for connecting the offshore wind energy generation facility to the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site in Barnstable. The OECC maintains sufficient water depths for installation, avoiding and minimizing passage through shoals and large seabed slopes (see Section 4.6.2 for a more detailed discussion about OECC route selection). As described in Section 6.4.5, the OECC also avoids and minimizes impacts to SSU areas identified in the Massachusetts OMP, completely avoiding core habitat of the North Atlantic Right Whale and eelgrass. The OECC also minimizes impacts to hard/complex bottom.

The area in question between the islands of Martha's Vineyard and Nantucket and within Nantucket Sound is a high-energy environment and includes sand waves, which can be on the order of 15 feet high and move across the seafloor; the area also includes currents through Muskeget Channel that scour the seafloor and remove finer-grained materials. The presence of sand waves will necessitate some sand wave dredging prior to cable installation to ensure sufficient cable burial (target depth is approximately 5 to 8 feet [1.5-2.5 meters]) (see Sections 4.6.3.1.4 and 5.4.1.2). In addition, where the seafloor materials are so dense that reaching the target burial depth is unlikely, cable protection may be needed, although the Proponent is seeking to avoid the use of such armoring (see Section 4.6.3.1.3).

The discussion of offshore routing in Section 4.6 demonstrates that the OECC is the best option for installing the proposed export cables. The corridor avoids core habitat mapped for whales, avoids eelgrass, and minimizes passage through hard/complex bottom mapped in the Massachusetts OMP.

1.6 Project Benefits

The purpose of the Project is to deliver approximately 800 MW of clean, renewable wind energy to the New England electrical grid (see Section 1.2 for a discussion of offshore wind). By doing so, the Project will serve the public interest by increasing the reliability and diversity of the regional energy supply.

The Vineyard Wind Connector 2 and the Park City Wind project are expected to create a range of environmental and economic benefits for southeastern Massachusetts, the Commonwealth as a whole, and the entire New England region. These benefits will extend across the design, environmental review, and permitting phase, the procurement, fabrication, and construction/commissioning phase, the multi-decade operating phase, as well as the future decommissioning effort.

Project benefits are expected to include:

- Clean renewable energy at large scale and a high capacity factor: The location of the associated WTGs well offshore in a favorable wind regime, coupled with the efficiency of the WTGs, will enable the Project to deliver substantial quantities of power on a reliable basis, including during times of peak grid demand. The WTGs for the Project will be among the most efficient models currently available for offshore use. It is expected that the WTGs will be capable of operating with an annual capacity factor of approximately 50%. Assuming a Project generating capacity of approximately 800 MW, WTGs of this efficiency and capability will reduce ISO-NE CO_{2e} emissions by approximately 1.59 million tpy. This is the equivalent of removing approximately 320,000 automobiles from the road. In addition, NOx emissions across the New England grid are expected to be reduced by approximately 850 tpy with SO_2 emissions being reduced by approximately 450 tpy.

- Reducing winter energy price spikes: The Project adds high and stable winter capacity factor offshore wind generation to the region, increasing resources available to meet electric demand needs with offshore wind-generated energy, freeing up natural gas resources to be used for necessary home heating demands. The Project will therefore be unaffected by the risk of potential fossil fuel constraints and will help to alleviate price volatility. The Project could reduce the need for the gas- and oil-burning Canal units 1 and 2 to run, especially during winter peak events when winds are high and conditions ideal for wind energy generation.

- Improving the reliability of the electric grid in Southeastern Massachusetts: The Project will connect to the bulk power system on Cape Cod, and thus will increase the supply of power to Barnstable County and other parts of southeastern Massachusetts, an area which has experienced significant recent (and planned) generation unit retirements. Because of its interconnect location and generation type, adding an additional approximately 800 MW of offshore wind generation to the current power generation portfolio will provide fuel diversification and enhance the overall reliability of power generation and transmission in the region and in particular the southeast Massachusetts (SEMA) area, which has seen, and will continue to see, substantial changes in generation capacity. This will mitigate future costs for ensuring reliable service for Massachusetts customers.

- Additional economic benefits for the region: Project construction will generate substantial economic benefits, including opportunities for regional maritime industries (tug charters, other vessel charters, dockage, fueling, inspection/repairs, provisioning).

- New employment opportunities: Vineyard Wind is committed to spurring and facilitating the creation, development, growth, and sustainability of a long-term offshore wind industry in New England, including a robust local supply chain, a well-trained local workforce throughout development, construction, and operations activities, local port facilities capable of fabrication and construction of key project components, and advanced manufacturing capabilities, all of which will cement New England as a leader in offshore wind. Vineyard Wind estimates the Project will generate over 4,700 direct full-time equivalent (FTE) job years and 2,100 indirect FTE job years over its lifetime primarily in Connecticut and Massachusetts.

- Support for Massachusetts policies: The Project is entirely consistent with the Commonwealth's GWSA goals because supplying emissions-free energy to the New England electric grid will displace fossil fuel sources, including in Massachusetts, which would otherwise operate to supply that power.

1.6.1 Energy Reliability Benefits

The proposed Vineyard Wind Connector 2 would enhance the reliability and diversity of the energy mix on Cape Cod and in the Commonwealth of Massachusetts. This is particularly important given that several base load/cycling plants have already retired or are slated for retirement, including:

- Brayton Point Power Plant (Somerset, MA): 1,600 MW, shut down in 2017;
- Pilgrim Nuclear Power Plant (Plymouth, MA): 690 MW, shut down in 2019;
- Vermont Yankee Nuclear Power Plant (Vernon, VT): 620 MW, shut down in 2014;
- Montaup Power Plant (Somerset, MA): 174 MW, shut down in 2010;
- Mt. Tom Station (Holyoke, MA): 136 MW, shut down in 2014; and
- Mystic Station (Everett, MA): 2,000 MW, planned for closure in 2024.

In addition, other plants such as Canal Generating Station (1,200 MW, oil/natural gas-fired, two units commissioned in 1968 and 1976), located in Sandwich, are approaching their normal end of life, making it important for other energy generation alternatives to fill the gap. Along with the plants mentioned above, ISO-NE has identified over 5,000 MW of oil and coal capacity "at risk" for retirement in the coming years.[23]

Between the decommissioning of nuclear power plants at Pilgrim and Vermont Yankee and the 1990s closings of Yankee Rowe (185 MW) and Maine Yankee (900 MW), New England has lost or is about to lose a significant portion of its large "zero-carbon" base load plants.

Lastly, Cape Cod is at the outer edge of the regional transmission system. The Cape is essentially supplied by one 345-kV and two 115-kV radial feeds. While recent significant investments in transmission reliability have strengthened the electricity supply to Cape Cod, the Vineyard Wind Connector 2 would further improve reliability by feeding power into the center of the Cape transmission system. Connecting a substantial electricity supply to Cape Cod will mitigate future costs for ensuring reliable service to Massachusetts customers.

Park City Wind will be a major source of zero-carbon energy delivered by the Vineyard Wind Connector 2. Approximately 800 MW can supply more than the peak load for all of Cape Cod. As the offshore wind industry has developed, wind turbines have moved further offshore. When coupled with higher hub heights and longer, more efficient blades, the WTGs will take full advantage of a superior wind regime that is found far from shore. Accordingly, Park City Wind is

[23] ISO-NE. https://www.iso-ne.com/about/regional-electricity-outlook/grid-in-transition-opportunities-and-challenges/power-plant-retirements

expected to operate at an annual capacity factor of approximately 50%, and the Company's engineers expect that the Vineyard Wind Connector 2 will be delivering at least some energy from the offshore wind turbine array more than 95% of the time. Moreover, summer offshore wind patterns will allow Park City Wind to produce substantial power during summer afternoons/early evenings, which coincides with typical peak power demand periods on the Cape and the Islands.

The Vineyard Wind Connector 2 will also reduce winter electricity price spikes because of Park City Wind's high and stable winter capacity factor. It will enhance energy supply diversity, and as a wind project will not be affected by possible cold weather gas limitations or supply shortages. As such, it will help to promote price stability and energy security.

1.6.2 Economic Benefits

The Project is expected to generate numerous economic benefits in Massachusetts and across New England. Economic benefits will be realized throughout the preconstruction, construction, operations and maintenance, and decommissioning phases, and including the following:

- In October 2018, Vineyard Wind finalized an HCA with the Town of Barnstable, where the onshore cable and substation are proposed. In addition to tax assessments, the pact guarantees a total Host Community Payment of $16 million, plus an additional $60,000 (adjusted upward annually by 2.5%) for each year the Project is in operation beyond 25 years for each of Vineyard Wind Connector 1 and Vineyard Wind Connector 2. To accomplish this, the HCA requires Vineyard Wind to make annual payments to the Town of at least $1.534 million in combined property taxes and Host Community Payments for each of Vineyard Wind Connector 1 and Vineyard Wind Connector 2. Additional revenues are also anticipated for the Commonwealth and municipalities in the form of higher tax payments resulting from Project activities and employment (including personal income taxes, sales taxes, corporate and payroll taxes, and real and personal property taxes) in every Project phase. Thus, when both Vineyard Wind Connector 1 and Vineyard Wind Connector 2 are operating, the annual payments would be $3.068 million/year with total Host Community Payments of $32 million over 25 years. In January 2019, the Town of Barnstable dedicated future host community payments from Vineyard Wind to a Water Stabilization Fund that will support water resource protection and new water wells within the Town. As summarized in the Town council order dedicating these funds (2-19-074), *"The Host Community Agreement Payments will allow the Town to protect its valuable drinking water resources by making storage, distribution and treatment improvements to the system as well as the development of new wellheads up gradient of the proposed substation. This will also significantly reduce the impact on water rates charged to property owners tied into the town's water system."* The Company has also been working with Town staff to collaborate on sewer line construction in conjunction with onshore construction of the Vineyard Wind Connector 1. This collaboration is anticipated to result in significant cost savings for the town as it builds necessary wastewater infrastructure alongside Vineyard Wind's project, and the collaboration will result in a single construction period for each individual project's execution phase, significantly reducing community disturbance. Vineyard Wind anticipates and is in discussion with Town staff to create a similarly beneficial arrangement for the Vineyard Wind Connector 2.

- The Company operates offices in New Bedford and Boston, and the Project has many full-time professionals working on design, permitting, and financing efforts in Massachusetts. The Company plans to maintain these positions as Vineyard Wind continues offshore wind project development efforts. In addition, Vineyard Wind's extensive offshore survey campaigns over the past three years have drawn on support services from across the southeastern Massachusetts region, including services such as vessel maintenance and repair, fuel and provisioning, protected species observers, inspection and HSE consulting, and pilotage.

- Vineyard Wind engaged Leidos Engineering LLC, as Independent Transmission Consultant, to conduct an analysis of the impact of the proposed offshore wind energy generating facility on the ISO-NE system and ISO-NE administered energy markets, including the potential demand cost savings. Based on the resulting study, the Project is expected to reduce the load-weighted Locational Marginal Prices across ISO-NE, largely driven by the reduced generation by natural gas power plants in winter months when gas prices are highest. The lower Locational Marginal Prices will result in System Demand Cost savings for Load Serving Entities purchasing power from ISO-NE to serve demand. The annual Demand Cost Savings as a result of the approximately 800-MW project are estimated at $76 million across ISO-NE. Over the projected 30-year life of the Project, it will save the ISO-NE system approximately $2.28 billion.

- Construction and installation processes will utilize existing port facilities. Vineyard Wind is committed to investing in the redevelopment of port facilities to facilitate local outfitting, assembly, and load-out of the Project's foundation transition pieces in Bridgeport Harbor, bringing labor-intensive construction activities and heavy steel works to southern New England. Ports in Massachusetts, including the New Bedford Marine Commerce Terminal and an O&M facility in Vineyard Haven, may also provide construction and/or operations support.

- Vineyard Wind estimates the Project will create over 2,800 direct FTE job years[24] and more than 1,300 indirect FTE job years in Connecticut through the development, construction, and operations phases. Section 1.7 describe the use of potential port facilities. These jobs will be in areas such as crane and heavy lift operations, steel fabrication, electrical construction, and civil construction, and will be with firms such as engineering and construction management firms, construction firms utilizing building and maritime trades, and vessel and port operations companies. Outside of Connecticut,

[24] One full-time-equivalent job year is the equivalent of one person working full-time for one year.

Vineyard Wind expects the Project could result in over 1,900 direct FTE job years and as many as 845 indirect FTE job years. The bulk of these jobs would be located in Massachusetts where onshore construction activities for the Vineyard Wind Connector 2 will take place.

- Project construction will create opportunities for area maritime industries, including but not limited to tug charters, other vessel charters, dockage, fueling, inspection/repairs, and provisioning. To the extent feasible, construction materials and other supplies, including vessel provisioning and servicing, will be sourced from within the region. The Project may also perform fabrication work in southern New England.

- The first American Tier 1 supplier for offshore wind will be established through a Vineyard Wind partnership with Marmon Utility to generate jobs and economic opportunity. The agreement calls for Marmon Utility to establish manufacturing capabilities at its Connecticut facility producing cables to supply some or all of the inter-array cable cores that will be needed for Park City Wind. The supply contract would lead to nearly $40 million in direct expenditures, while the facility expansion would create an estimated 35 permanent FTE jobs. Over the next decade, the expanded facility could create up to 350 FTE jobs and almost $400 million in direct revenue.

- Substantial new jobs in the region supporting this new industry will also have a multiplier effect. Vineyard Wind estimates that Park City Wind/Vineyard Wind Connector 2 will induce more than 1,350 additional FTE job years in Connecticut and Massachusetts. These and other benefits will result from the new workforce supported by the Project, which will spend locally, supporting additional jobs in all facets of the regional economy. The Project's contractors will utilize local companies for portions of its offshore and onshore work, and will make lease or other payments to local landowners to support onshore construction on Cape Cod. The Project will also make local and regional purchases of goods and services across the multi-decade operations and maintenance period.

- In accordance with the Company's lease for use of outer continental shelf lands for offshore wind generation, which is with BOEM, the Project will make substantial annual lease and operating fee payments to the Federal Treasury. Prior to commercial operations, the Company will make annual lease payments of $500,658 to the federal government. Once operations begin, the Company will make annual operating fee payments in accordance with the terms of the lease. Under BOEM's revenue-sharing provisions, up of 27% of those revenues could be allocated to Massachusetts.

- As an element of its Chapter 91 license, the Project will pay a Tidelands Occupation Fee to the Commonwealth. This fee will be calculated based on the area of jurisdictional seafloor occupied by the Project in state waters. It is anticipated that the precise amount of the fee will be determined at the completion of construction based on actual permanent occupation of Commonwealth tidelands, and that the fee will be substantial. The fee for Vineyard Wind Connector 1 was $1,978,980, subject to adjustment based on final as built impact calculations.

- In accordance with a requirement of the Massachusetts OMP review process, the Project will pay an Ocean Development Mitigation Fee. This fee is intended to compensate the Commonwealth for unavoidable impacts on public interests and rights in the Ocean Management Planning Area and to support planning, management, restoration, or enhancement of marine resources and uses. This fee is in addition to the tidelands occupation fee, and other direct and indirect contributions by the Company, and will be finalized during MEPA review. The base fee for Vineyard Wind Connector 1 was $240,000, subject to adjustment based on final as-built impact calculations.

- Supply Chain Network Initiative: Vineyard Wind is committing to invest up to $9 million in projects and initiatives to accelerate the development of the offshore wind supply chain and businesses. This initiative aims to establish a Connecticut supply chain development database and facilitate further development of the local offshore wind supply chain in Connecticut. Vineyard Wind recognizes the need for regional collaboration on supply chain efforts, and as such the Supply Chain Network Initiative will aim to integrate with existing supply chain initiatives in Massachusetts, building a regional network.

- The Company will continue its efforts to work cooperatively with educational institutions in southeastern Massachusetts as well as Connecticut to help create opportunities for their students and faculty. These partnerships will establish training, academic, and apprenticeship programs to create an offshore wind-ready workforce in southern New England.

- Vineyard Wind will establish the Connecticut Windward Workforce Fund of up to $5 million to fund, develop, support, coordinate, and administer offshore wind workforce development, training, and educational programs in partnership with local vocational technical schools, colleges, universities, trade unions, and other workforce development organizations. This initiative will prepare the near-term skilled labor needed to construct the Project, build a pipeline of offshore wind-ready workers for operation and maintenance, and begin the development of the next generation offshore wind workforce of Connecticut. The $2 million investment in workforce development that the Company made as part of Vineyard Wind 1/Vineyard Wind Connector 1 has been designed to help build a workforce that would work on future projects, and many of the workforce resources created around Vineyard Wind 1/Vineyard Wind Connector 1 are anticipated to participate in Park City Wind/Vineyard Wind Connector 2 and other future offshore wind projects.

- Considering these various benefits, the Project will be an important foundational step in creating a thriving, utility-scale domestic offshore wind industry. The Company is committed to working with BOEM, Massachusetts, Connecticut, local and regional officials, local businesses, research and educational institutions, fishermen, environmental advocacy organizations, and other stakeholders to maximize this unique and timely opportunity to establish southern New England as a key center for the offshore wind industry in the United States.

1.6.3 Environmental Benefits

The Project offers significant environmental benefits. As described in Section 1.6.1, between the decommissioning of nuclear power plants at Pilgrim (600 MW) and Vermont Yankee (600 MW), and earlier Yankee Rowe (185 MW) and Maine Yankee (900 MW) retirements, New England has lost significant “zero-carbon” large-scale generation plants. These market changes increase the complexity and difficulty of achieving the Commonwealth’s aggressive greenhouse gas emissions reduction targets defined in the GWSA: 25% from 1990 levels by 2020 and 80% from 1990 levels by 2050.

The Vineyard Wind Connector 2 would deliver approximately 800 MW of zero-carbon electric power to the New England electrical grid. The substantial emissions reductions on the New England power grid due to the Project will quickly offset construction-phase emissions of regulated pollutants. Table 1-3 quantifies the emissions associated with conventional power generation that would be avoided by using electricity generated from the approximately 800-MW offshore wind project. The displacement analysis uses Northeast Power Coordinating Council (NPCC) New England air emissions data from EPA’s Emissions & Generation Resource Integrated Database (eGRID).[25] The analysis conservatively assumes an annual capacity factor of approximately 50% and total Project delivery of approximately 800 MW. Constituents included in the analysis are CO_2, NOx, and SO_2. The avoided annual emissions of 1.59 million tons of CO_{2e} is roughly equivalent to taking approximately 320,000 cars off the road.

Table 1-3 Avoided Air Emissions in New England (estimated)

Pollutant	*CO_{2e}*	*NOx*	*SO_2*
Annual Avoided Emissions (tons/year)	1.59 million	850	450
Avoided Emissions over Project’s up to 30-year Lifespan (tons)	47.6 million	25,452	13,513

[25] The displacement analysis uses subregion annual non-baseload output emission rates from eGRID2014(v2) released 2/27/2017 https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

As shown in this analysis, the Project would result in substantial emissions reductions in the New England region. The Project will significantly decrease the region's reliance on fossil fuels and enhance the reliability and diversity of the energy mix on Cape Cod, in the Commonwealth of Massachusetts, and across New England. Thus, the potential Project-related impacts should be considered in conjunction with the Project's energy reliability, economic, and environmental benefits.

The Company will also work to collaborate with the Town of Barnstable on sewer construction to the extent requested by the Town in conjunction with installation of the onshore portions of the Vineyard Wind Connector 2. The Town's planned sewer expansion is an important tool to address wastewater discharge and nutrient loading, which are among the most pressing local environmental issues on Cape Cod, and has the potential to greatly improve water quality in resources such as Wequaquet Lake. Working closely with the Town during its planning of the sewer project could result in a coordinated construction period with the Vineyard Wind Connector 2, reducing community disturbance and significantly reducing costs to the Town. In addition, the Town has dedicated Vineyard Wind's Host Community payments to its water stabilization fund, so that the town may direct this funding to address its water infrastructure needs.

Vineyard Wind is also committed to supporting scientific research focused on improving best practices and expanding fact-based understanding of the risks and benefits associated with offshore wind project development. The Company is establishing an Offshore Wind Protected Marine Species Mitigation Fund that will, through a partnership with Mystic Aquarium, fund and support research on best practices and new technologies to reduce potential sound impacts and collision threats from offshore wind project development, building on existing efforts by Vineyard Wind. Vineyard Wind, in collaboration with Greentown Labs, a cleantech incubator located in Somerville, MA, has also launched an accelerator program known as the Offshore Wind Challenge that seeks innovate data monitoring technologies focused on protecting marine mammals; the Offshore Wind Challenge will help startups explore potential partnership outcomes with Vineyard Wind.

In addition, Vineyard Wind will participate in the Connecticut Initiative on Environmental Research of Offshore Wind, partnering with the University of Connecticut's Department of Marine Sciences to fund fisheries-related research in connection with the University's recently launched Connecticut Initiative on Environmental Research of Offshore Wind.

1.7 Port Facilities

Vineyard Wind has identified several port facilities in Massachusetts, Rhode Island, Connecticut, and elsewhere that may be used to support Project construction. These ports include the New Bedford Marine Commerce Terminal, Brayton Point Commerce Center, Vineyard Haven, and Fall River; Bridgeport and New London State Pier are being considered in Connecticut. Depending on final construction logistics planning, several ports may be used during construction.

Vineyard Wind expects to use one or more ports for frequent crew transfer and to offload/load shipments of components, store components, prepare them for installation, and then load components onto vessels for delivery to the SWDA for installation.[26] Some component fabrication and assembly may occur at the ports as well.

Once Park City Wind is installed, tested, and commissioned, the Project will enter a 30-year operating phase. In support of Project operations and maintenance (O&M) activities, Vineyard Wind's O&M facilities may include management and administrative team offices, a control room, and/or warehouse space for parts and tools. The O&M facilities will also include pier space for crew transfer vessels (CTVs) and other larger support vessels such as service operations vessels (SOVs). CTVs are purpose-built to support offshore wind projects, and are typically approximately 75 feet in length and set up to safely and quickly transport personnel, parts, and equipment. An SOV would provide accommodations and workspace for O&M workers and would remain at the SWDA for several days/weeks at a time.

Vineyard Wind will likely establish a long-term SOV O&M base at Barnum Landing in Bridgeport, Connecticut.[27] The SOV O&M base would be the primary homeport for the SOV and would likely be used for crew exchange, bunkering, spare part storage, and load-out of spares to the SOV. Related support infrastructure, warehousing, and a control room may also be located near the SOV O&M base. In addition to the SOV O&M base, Vineyard Wind has worked with its local partner, Vineyard Power, and the communities of Martha's Vineyard with the intention to base some O&M activities on Martha's Vineyard. Current plans anticipate that CTVs or SOV daughter craft would operate out of Vineyard Haven during O&M.

Although Vineyard Wind plans to locate the Project's O&M facilities in Bridgeport and/or Vineyard Haven, Vineyard Wind may use other ports to support O&M activities, including for major repairs.

1.8 Construction Overview

The Company has selected cable installation techniques to maximize efficiency while minimizing potential impacts. Onshore cable installation is proposed via open-cut trenching to accommodate a buried concrete duct bank; the Company has consulted with MassDOT regarding this methodology since crossings of some state roads are involved, and MassDOT did not express concern with this technique. The transition between onshore and offshore cables is proposed via HDD, which will avoid any direct impacts in the nearshore and along the Coastal Beach. Offshore

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[26] Monopiles may not be loaded onto vessels for transport but may instead be pulled by tugs while floating in the water.

[27] An existing industrial port may be needed as an alternative SOV O&M base on an interim basis if Barnum Landing is not available by the start of O&M.

cable installation is proposed via jetting, jet-plow, plow, or mechanical trenching; Section 5.4 contains a more detailed description of construction methodologies, including proposed mitigation measures.

1.9 Schedule

The Company anticipates onshore construction will likely commence in 2023 with work at the landfall site, onshore substation, and onshore duct bank. Offshore construction is anticipated to commence in 2023/2024. The start of commercial operations are expected in 2025. Vineyard Wind will provide additional detail on the anticipated schedule as further details are available.

On Cape Cod, there are general summer limitations on construction activities, which the Company has built into the Project schedule for construction at the landfall site and along the onshore transmission route where the route follows public roadway layouts. Activities at the landfall site where transmission will transition from offshore to onshore will not be performed during the months of June through September; activities along the onshore transmission route (particularly where the route follows public roadway layouts) will also likely be subject to significant construction limitations from Memorial Day through Labor Day, but could extend through June 15 subject to consent from the local Department of Public Works (DPW). The Company will consult with the towns regarding the construction schedule. Typical construction hours will extend from 7:00 AM to 6:00 PM. Nighttime work will be performed only on an as-needed basis, such as when crossing a busy road. When needed, nighttime work/extended construction hours, including possible work on weekends, will be coordinated through each Town.

The most efficient way to install offshore wind turbines is to be able to have power to them as soon as the physical installation is complete. This allows, for example, light, air conditioning, and the use of power tools in the enclosed areas of the turbine when the final work is being completed inside the turbine. It is also critical to Project success that the transmission system be prepared to receive the first power produced by the offshore wind turbine array, as to plan otherwise would mean that a significant capital investment would be idle and unable to generate revenue. Designing the construction schedule so that turbines can begin generating electricity a matter of hours after they are installed offshore also enables the expeditious realization of the benefits of offshore wind energy generation, including greenhouse gas emission reductions. For all these reasons, the construction schedule is carefully designed to ensure that there is a high probability the turbines can be connected to the grid very quickly after each one is installed. Due to the seasonal nature of construction periods, small delays or deviations from this schedule could significantly delay completion of the Project by a year or more.

The construction of the onshore transmission asset is expected to take a little more than a year including civil work, electrical installation, commissioning, and testing. To be ready for turbine commissioning in 2024 the Company will initiate onshore transmission work in 2023. As the onshore construction has time-of-year limitations due to summer traffic on Cape Cod in addition to anticipated time-of-year restrictions offshore, Project construction is carefully sequenced. Duct banks must be fully prepared prior to cable installation and cable installation must be complete and tested prior to turbines being energized. Windfarm construction is currently scheduled to begin in 2024. As offshore construction will continue through the summer, onshore construction will be limited to off-road areas and therefore will not progress extensively during that time. Given all these factors, the prudent course is to begin onshore construction before the windfarm construction.

There are no additional environmental or financial risks associated with initiating Project construction prior to construction of the windfarm compared to initiating Project construction after construction of the windfarm. To the contrary, the greatest schedule risk to the Project is to have the windfarm constructed and no ability to bring the power to the grid. That is why effort is made to ensure these facilities are ready to receive power. Environmental risks are not increased by beginning the construction prior to windfarm construction. In fact, there will be environmental harm if the Project is not able to be sequenced so as to come online as soon as possible, because every month of delay prevents the offset of CO_2 emissions and also delays the other benefits associated with the Project; in addition, if WTGs are not energized to transmit power to shore, diesel generators may be required to maintain turbines in warranty. As a result, the sequencing of the project to allow for an early operation date is itself a method to minimize risks and harms to the Company and the environment.

1.10 Agency and Community Outreach

Vineyard Wind's consultations with agencies, tribes, and municipalities for the first 800-MW project (Vineyard Wind 1/Vineyard Wind Connector 1) began in April 2015 and created pathways for stakeholder consultation for future projects. As the Vineyard Wind Connector 1 progressed through permitting, Vineyard Wind built collaborative relationships with federal, state, and local regulators along with a diverse array of stakeholders. Because of its pioneering role, Vineyard Wind has also gained unique insight into the process for permitting offshore wind projects, which is reflected in the permitting plan for the Vineyard Wind Connector 2.

The Vineyard Wind Connector 2 will be installed largely within the same OECC as the Vineyard Wind Connector 1. While separate and new permits are needed for the Vineyard Wind Connector 2, the similar cable routes mean that Vineyard Wind has prior experience working with the relevant permitting authorities and local officials, which will facilitate permitting.

1.10.1 Agency Meetings and Consultations

The Company has been consulting with BOEM, federal and state agencies, regional commissions, affected municipalities, and federally-recognized tribes regarding the status of the Vineyard Wind Connector 2 and Park City Wind, planned studies, issues of concern, and related matters. A list of meetings related to the Vineyard Wind Connector 2 and Park City Wind conducted to date with agencies, municipalities, and tribes is provided in Table 1-4. In addition to these meetings, Vineyard Wind has participated in hundreds of meetings with agencies, tribes, and municipalities since 2015 regarding the development of Vineyard Wind 1/Vineyard Wind Connector 1. The Company plans to maintain an active level of consultation and outreach as the design effort continues and the Project proceeds through the licensing and permitting phase.

Following the submittal of initial filings in 2020, there have been and will continue to be a number of agency-convened public hearings and informational meetings. These include BOEM/National Environmental Policy Act (NEPA) scoping sessions, EFSB public statement hearing(s), and a MEPA consultation session.

Table 1-4 Consultations with agencies, municipalities, and tribes

Group	***Date***	***Topic***
Federal Agencies		
BOEM	July 2019 September 2019 November 2019 January 2020 March 2020	Project overview and kick-off meeting Survey updates Project review and update COP Lease Area discussion
EPA	December 2019	Project overview
NOAA/NMFS	January 2020	Early consultation meeting & overview
State and Regional Agencies		
CZM	February 2020 April 2020	Project introduction Project update
DMF	February 2020	Project introduction
EFSB	January 2020	Project introduction
MassDOT	September 2019 December 2019, Jan/March 2020	Project introduction Bridge & Route 6 crossing engineering and permitting considerations
MEPA	February 2020 April 2020	Project introduction Project update

Table 1-4　　Consultations with agencies, municipalities, and tribes (Continued)

Group	Date	Topic
State and Regional Agencies		
NHESP	February 2020 April 2020	Project introduction Project update
Ocean Team (EEA, MassDEP, MEPA, DMF, CZM)	February 2020	Project introduction
Rhode Island Coastal Resources Management Council	February 2020	Cable working group
Local Agencies/Municipalities/Tribes		
Barnstable: Town Manager, Assistant Town Attorney	November 2019 August 2019 July 2019 June 2019	Project overview and cable route Status update Status update Project introduction
Aquinnach Wampanoag Tribe	March 2020	Pre-survey meeting
Mashpee Wampanoag Tribe (THPO)	March 2020	Pre-survey meeting
Shinnecock Tribe	March 2020	Pre-survey meeting
Stakeholder Groups		
Rhode Island Fisheries Advisory Board	March 2020	Project update & CT fisheries Liaison introduction

1.10.1.1　Massachusetts Energy Facilities Siting Board Staff

As part of a broader introductory meeting with senior staff from the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), Project representatives met with the EFSB Director and staff on January 31, 2020 to introduce the Project and discuss its background, design, and schedule.

1.10.1.2　Massachusetts Environmental Policy Act Office

As part of a broader introductory meeting with the Massachusetts Ocean Team, Project representatives met with the MEPA Office on February 27, 2020 to review Project background, design, and schedule. A follow-up discussion was held on April 15, 2020. In May 2020, the Company submitted an Environmental Notification Form (ENF) to the MEPA Office.

1.10.1.3　Massachusetts Ocean Team

On February 27, 2020, the Company and its Project representatives met with the Massachusetts Ocean Team (CZM, MassDEP, MBUAR, DMF, and MEPA) to review Project background, marine surveys, and use of the same OECC as for Vineyard Wind 1 for the offshore portion of the proposed transmission cables. Previous surveys within the OECC were also the subject of earlier discussions with the Massachusetts Ocean Team, and feedback from those discussions was incorporated into the Survey and Sampling Plans. CZM joined the subsequent April 15, 2020 meeting with the MEPA Office.

1.10.1.4 Massachusetts Department of Transportation

On September 19, 2019, the Company and its Project representatives met with MassDOT Chief Strategy Officer Scott Bosworth to discuss Project routing and coordination with the agency. Follow-up meetings were held in December 2019, January 2020, and March 2020 at which the Company and MassDOT staff from the highway division discussed specific alternatives for completing the Route 6 and Centerville River crossings. These consultations are ongoing.

1.10.1.5 Municipalities and Tribes

As listed in Table 1-4 above, the Company and its representatives have held several meetings with officials in Barnstable to keep them informed about the Project and to solicit Town input on potential routing and construction sequencing.

1.10.2 Stakeholder Coordination

Prior to the Massachusetts offshore wind lease auction in January 2015, Vineyard Wind and Vineyard Power Cooperative signed a Community Benefit Agreement (CBA), which was recognized by BOEM. This CBA called for, among other items, Vineyard Power to advocate for and support offshore wind legislation in Massachusetts, support the Project through education and outreach, and called for Vineyard Power to provide advice and guidance through the permitting and financing processes. Community outreach and education have been primary objectives for Vineyard Power since its formation in November 2009. Vineyard Power accomplishes these objectives by informing the public about federal and state renewable energy goals and processes, including regulatory frameworks, and ensuring that communities have a voice in reaching desired outcomes. As the Project transitions into permitting and ultimately development and construction, Vineyard Wind and Vineyard Power are committed to continuing the outreach efforts to ensure that local communities understand, welcome, and benefit from the proposed Project. Community outreach, education, and engagement within the communities of Martha's Vineyard, Nantucket, and Cape Cod will continue along with outreach to state and local agencies and local tribes.

In addition to the consultations described in Table 1-4, extensive and ongoing consultations have been conducted by Vineyard Wind and Vineyard Wind's community partner, Vineyard Power, with key stakeholders. Vineyard Wind frequently advertises outreach events in local newspapers, social media, press releases, emails, and other media outlets to reach an array of stakeholders. Vineyard Wind regularly invites the public to learn more about Vineyard Wind's projects through office hours, where Vineyard Wind's team members exhibit information in a public space and are available for questions or comments on Vineyard Wind projects. Vineyard Wind has held dozens of information sessions and continues to hold monthly office hours sessions in Barnstable, Covell's Beach, Martha's Vineyard, and across Cape Cod. Vineyard Wind also sponsors and staffs information tables at a variety of environmental, fisheries-related, and local events to reach a variety of stakeholders.

Vineyard Wind is a member of, and active participant in, the Massachusetts Fisheries Working Group on Offshore Wind Energy, the Habitat Working Group on Offshore Wind Energy, the Responsible Offshore Development Alliance (RODA), the Responsible Offshore Science Alliance (ROSA), and the New York State Energy Research and Development Authority (NYSERDA) Fisheries Technical Working Group. Vineyard Wind also attends the Rhode Island Fishermen's Advisory Board (FAB) meetings and has had numerous communications with its chairman, Lanny Dellinger. Vineyard Wind is in near daily communication with individual fishermen from the commercial (fixed and mobile gear) and recreational fishing sectors. Vineyard Wind's Fisheries Liaisons and Fisheries Representatives have also been consistently meeting with fisheries stakeholders (see Appendix III-E).

In addition to the agencies, tribes, and municipalities listed above, the following list includes, but is not limited to, the groups that Vineyard Wind has been and will continue to consult with:

- Alliance to Protect Nantucket Sound
- Anglers for Offshore Wind
- Association to Preserve Cape Cod
- Barnstable Clean Water Coalition
- Buzzards Bay Coalition
- Cape and Islands Self-Reliance
- Cape and Vineyard Electrical Cooperative
- Cape Cod Fishermen's Alliance
- Cape Cod Chamber of Commerce
- Cape Cod Climate Change Collaborative
- Cape Cod Community College
- Cape Cod Technology Council
- Cape Light Compact
- Centerville Civic Association
- City of Bridgeport, CT
- Climate Action Business Association
- Coalition for Social Justice
- Commercial Fisheries Center of Rhode Island
- Connecticut Green Bank

- Connecticut Roundtable on Climate and Jobs
- Conservation Law Foundation
- Coonamessett Farm Foundation
- Eastern Fisheries
- Environment Massachusetts
- Environmental Business Council of New England
- Environmental League of Massachusetts
- Falmouth Fishermen's Association
- Fishing Partnership Support Services
- Greentown Labs
- Hercules SLR
- Job Training and Employment Corporation, Cape Cod
- KSJ Seafood Inc.
- Long Island Commercial Fishing Association
- MA Fisheries Institute
- MA Fisheries Working Group
- MA Fishermen's Partnership and Support Services
- MA Habitat Working Group
- MA Historical Commission
- MA Lobstermen's Association
- Martha's Vineyard Fishermen Preservation Trust
- Massachusetts Audubon Society
- Massachusetts Clean Energy Center
- Mid-Atlantic Fisheries Management Council
- Mystic Aquarium
- Nantucket Rotary Club
- National Academies of Sciences, Offshore Renewable Energy Development and Fisheries Conference

- National Wildlife Federation
- Natural Resources Defense Council
- NE Fisheries Sciences Center
- NE Fishery Management Council
- NE Fishery Sector Managers VII, VIII X, XI, XIII
- New Bedford Earth Day Group
- New Bedford Harbor Development Commission
- New Bedford Port Authority
- New England Aquarium
- New England Energy and Commerce Association
- New York League of Conservation Voters
- Port of New Bedford
- PSEG Power- Connecticut
- Recreational Fishing Alliance
- RODA
- ROSA
- Rhode Island Department of Environmental Management
- Rhode Island FAB
- Rhode Island Habitat Advisory Board
- Rhode Island Marine Fisheries Council
- Rhode Island Salt Water Angler's Association
- Scallop Industry Advisors Meeting
- Seafreeze
- Sierra Club
- Southcoast Chamber
- Stoveboat- Saving Seafood
- Survival Systems USA
- The Nature Conservancy

- Town Dock
- Unitarian Church of Barnstable Green Sanctuary Committee
- University of Massachusetts (various campuses)
- Woods Hole Oceanographic Institution

Project updates and other information can be found at www.vineyardwind.com. Any interested parties can sign up for Project updates by visiting www.vineyardwind.com/connect.

Vineyard Wind plans to maintain an active level of consultation and outreach as the environmental review and permitting processes continue and is available to meet with any interested party

1.10.3 Abutter Outreach

The Company has planned and hosted dozens of community open house events in Barnstable dating back to 2016. Public notices and meetings will be held associated with this and other state filings, and the Company will send out additional mailers to abutters (and others) providing relevant Project details, contact information, and other means for residents to connect with Company representatives to obtain information and provide feedback. On numerous occasions, neighborhood-level conversations have resulted in important local insights that improve the Project and reduce potential neighborhood disruption during construction.

In addition, Vineyard Wind will continue to regularly host public informational events and will widely advertise those events utilizing numerous outlets, including email, web, digital and print media, direct mail, and posting in municipal and community bulletins. As with the Vineyard Wind Connector 1, Company representatives plan to continue the efforts to appear before community and civic groups and to host office hours, info sessions and community forums in a range of public venues, including libraries, community centers, senior centers, town offices, and recreational areas. Public event provide an opportunity for interested residents and officials to learn about Project details, connect with Project staff, to have their questions answered and provide meaningful feedback.

Following submittal of the Petition, EFSB staff will finalize an abutter notification letter. The letter will include a description of the Vineyard Wind Connector 2, including the Preferred Route and Noticed Alternative (with a supporting map). The letter will also include a description of the EFSB review process and will invite interested citizens to attend an EFSB-convened Public Hearing(s). As mentioned above, Vineyard Wind will continue its outreach efforts to the community at large.

The abutter notification letter will be sent to all direct abutters along the Preferred Route and Noticed Alternative (and variants), including and owners of property directly across any street or way from the right of way, and abutters to any of those owners within 300 feet for all routes described in the Petition. The letter will also be sent to Town officials and others as directed by the EFSB.

1.11 Project Team

The Company has assembled a capable and highly experienced team of project developers, planners, engineers, environmental scientists, attorneys, and outreach specialists for the Project. The team's principal organizations are described below.

1.11.1 Vineyard Wind

Vineyard Wind LLC is a New Bedford, MA-based company owned by Copenhagen Infrastructure Partners (CIP) and Avangrid Renewables. With more than 100 full-time staff covering all key positions, Vineyard Wind has the resources, capacity, and experience required to successfully shepherd the Project through development to construction and operations. The Project also benefits from the global offshore wind expertise and management capabilities of Vineyard Wind's shareholder companies, Avangrid Renewables and CIP. Together, these companies and their affiliates have experience across 32 offshore wind projects totaling more than 11,000 MW of capacity in the U.S., Europe, and Southeast Asia. The Project's development schedule also complements that of Vineyard Wind's first 800-MW project, providing the opportunity to transfer trained and experienced staff from the first project to the second as they transition to different stages of development and operation. Finally, the Project's ultimate success is further assured through the support of key project consultants, partners, and personnel who possess the experience and skills required to deliver the Project.

Vineyard Wind's New Bedford based team includes scientists, engineers, and managers with domestic offshore wind energy expertise and a strong knowledge of the local grid, infrastructure and coastline, and the ocean waters off Cape Cod and the Islands. The Vineyard Wind team includes Chief Development Officer Rachel Pachter, Technical Development Manager Jack Arruda, Park City Wind Project Manager Marcus Cross, and Technical Design and Permitting Manager Chris Rodstrom.

Vineyard Wind holds the lease for the 166,886-acre Lease Area OCS-A 0501 and is focused on developing and building a state-of-the-industry offshore wind energy facility. The privately financed Project will provide "zero carbon" electrical power to the New England electrical grid, and the Project will help Massachusetts to become an important hub for a growing Atlantic Coast wind energy business.

Vineyard Wind also has a close partnership with a local organization, Vineyard Power, to facilitate local input into the Project planning process and to help build community support for the Project (see Section 1.11.4 for additional information).

1.11.2 Copenhagen Infrastructure Partners (CIP) and Copenhagen Offshore Partners (COP)

Copenhagen Offshore Partners (COP) is a specialized team formed to develop and deliver offshore wind projects for institutional investors such as CIP, the co-owner of Vineyard Wind.[28] CIP makes long-term clean energy infrastructure investments on behalf of institutional investors, including several large Scandinavian pension funds. CIP currently has over 8 billion euros ($8.6 billion) under management.

Recent and notable offshore wind achievements include delivery of the Veja Mate project in record time. The project was completed four months ahead of schedule despite the installation of 67 foundations and 6-MW WTGs under challenging conditions almost 60 miles from shore and in water depths of up to 135 feet. In the process, the team set several world records, including the first use of the world's largest installation vessel (Seajacks Scylla) and installing a 1,300-ton monopile, the largest monopile foundation ever installed.

Other notable experience includes financing construction of the 900-MW DolWin3 Offshore Wind Farm Connection in Germany, an offshore high-voltage direct current (HVDC) transmission platform that was successfully completed in September 2018 when it began exporting power from two offshore wind farms. The platform is one of nine HVDC systems in the German North Sea, constructed and operated by TenneT, which exports more than 6,000 MW into the onshore grid. The converter platform is located approximately 31 miles offshore in the German North Sea.

COP is comprised of individuals with extensive direct experience developing, financing, constructing, and operating offshore wind projects. COP is currently leading the development of offshore wind projects on behalf of CIP as its exclusive development partner in Germany, UK, Taiwan, and Australia. For Vineyard Wind, COP is providing personnel to key project roles, including the Chief Executive Officer, Chief Technical Officer, Supply Chain and Procurement Management, Engineering, and Construction Management.

1.11.3 Avangrid Renewables

Avangrid Renewables, the other co-owner of Vineyard Wind, is a leader in the renewable energy industry in the U.S. and is amongst the nation's largest renewable operators. Avangrid Renewables' mission is to lead the transformation to a competitive clean energy future. Headquartered in Portland, Oregon, Avangrid Renewables has regional offices in Philadelphia, Chicago, and Austin. Avangrid Renewables controls over 6,000 MW of operating generation including thermal, wind, solar, and biomass projects, and has more than 25,000 MW of wind and

[28] COP has a long-term exclusivity arrangement to CIP in North America. However, there is no ownership or governance relationship between the two companies.

solar projects under active development. In ISO-NE, Avangrid Renewables has developed, constructed, and currently operates four wind projects in Vermont, Massachusetts, and New Hampshire.

Avangrid Renewables is a wholly owned subsidiary of Avangrid Inc., which is owned by Iberdrola SA.[29] At the end of 2019, Iberdrola had a market capitalization of approximately $64 billion with 52,082 MW of installed generation capacity. Of this capacity, 31,939 MW is renewable resources. More than half of Iberdrola's renewable energy capacity is wind; the remainder is hydropower and other renewable technologies.

Within the Avangrid/Iberdrola family, its considerable offshore wind energy expertise is positioned in Scottish Power. Scottish Power has completed several major offshore projects, including West of Duddon Sands, UK (389 MW, completed 2014); Wikinger, Germany (350 MW, completed October 2018); East Anglia ONE, UK (714 MW, generated first power in September 2019); East Anglia THREE, UK (1,200 MW, in development); and additional 2,400 MW currently in development across the UK, Germany, and France.

1.11.4 Vineyard Power

The Vineyard Wind team also includes Vineyard Power, a member-owned 501(c)(12) non-profit based on the island of Martha's Vineyard since November 2009. With a growing membership base of over 1,390 households and businesses, the 21st-Century energy cooperative aims to produce electricity from local, renewable resources while advocating for and keeping the benefits within the island community. Vineyard Wind has entered into a CBA with Vineyard Power. The relationship between Vineyard Wind and Vineyard Power has enabled significant input into the Project design process from members of the local community, such that the Project design addresses local concerns and enhances opportunities for local benefits. Vineyard Power is overseen by a nine-member elected Board of Directors that includes Ann Berwick, former Chair of the Department of Public Utilities (DPU) and Undersecretary for Energy at EEA, and Mike Jacobs, who is leading the Union of Concerned Scientists' work on electricity markets and regulatory reform.

1.11.5 Epsilon Associates, Inc. (Lead Environmental Consultant)

Epsilon Associates is an approximately 50-person engineering and environmental consulting firm based in Maynard, Massachusetts. For the Vineyard Wind Connector 2, Epsilon's role is lead environmental consultant for the necessary state, regional, and local permitting for the state-jurisdictional aspects of the Project. Epsilon is also the lead environmental consultant for federal permitting of Park City Wind.

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29 Avangrid Renewables is a subsidiary of Avangrid, a New York Stock exchange listed company (AGR). Other subsidiaries of Avangrid include Central Maine Power, United Illuminating (CT), New York State Electric & Gas and Rochester Gas and Electric.

Epsilon's engineers, scientists, planners, and regulatory specialists are engaged in environmental analyses, modeling, licensing, and permitting for energy infrastructure projects throughout the northeast. In recent years, Epsilon has worked with clients to complete the permitting for the Vineyard Wind Project and Vineyard Wind Connector 1, NSTAR Electric/Comcast Martha's Vineyard Hybrid Cable project, New England Power Company d/b/a National Grid's second Nantucket Cable project, the NSTAR Electric 345-kV Southeast Massachusetts (SEMA) Transmission Upgrade project, and the NSTAR Electric 115-kV Line 139 project. Other Cape projects include the New England Power Company d/b/a National Grid's Mid-Cape Main Replacement project, National Grid's Sagamore Line Reinforcement Project (multiple segments), and the KeySpan/National Grid Bourne Line.

Elsewhere in the Commonwealth, Epsilon has completed or is currently involved in permitting efforts for the Eversource HEEC Cable Project (offshore cable across Boston Harbor), New England Power Company d/b/a National Grid's 115-kV underground Worcester Cable project, the New England Power Company d/b/a National Grid/Eversource Energy d/b/a NSTAR 345-kV underground Woburn to Wakefield Line Project, and the NSTAR 345-kV Transmission Reliability Project (Stoughton to Boston, underground). Other Epsilon transmission project experience includes the 14.5-mile 345-kV Cricket Valley line and Niagara Mohawk's eight-mile 345-kV transmission line for the Besicorp Empire Development project.

1.11.6 Foley Hoag LLP, Counsel

Foley Hoag is a highly respected law firm with offices in Boston, New York, Washington DC, and Paris. The firm is known for its work in the energy, clean tech, and environmental sectors, including assisting Vineyard Wind in obtaining state, regional, and local permits for the Vineyard Wind Connector 1. Foley Hoag will continue these efforts, including before the Siting Board, for the Vineyard Wind Connector 2.

1.11.7 Stantec, Engineering Design support

Stantec is a multi-national engineering and professional services firm with more than 22,000 employees operating from over 400 locations. The firm provides a full range of power sector services including project management, conceptual project development, detailed engineering and design, and construction management, as well as start-up and commissioning services. Stantec's in-house staff has extensive experience in detailed engineering and design of underground electrical duct banks, transmission lines, and substations. Stantec has executed a multitude of underground electrical transmission projects up to 345 kV and overhead transmission projects up to 765 kV, as well as substations up to 500 kV DC and 765 kV AC. For the Vineyard Wind Connector 2, Stantec engineers based in Boston and Quincy, MA have provided engineering and design support for the onshore transmission lines and substation.

1.11.8 Gradient Corporation

Based in Boston, MA, Gradient is responsible for the electric and magnetic field (EMF) modeling and analysis. Peter Valberg, PhD and Christopher Long, ScD are widely recognized experts in the field. Drs. Valberg and Long have presented EMF modeling results and analysis before the EFSB for many above-ground and underground transmission projects. Recent examples include the Vineyard Wind 1 project, 345-kV NSTAR Lower SEMA project, the 115-kV Eversource Line 139 project on the Cape, the Eversource/National Grid 345-kV Woburn to Wakefield project, and the 115-kV Eversource Baker Needham project.

1.11.9 Geo SubSea

Jeff Gardner, President of Geo Subsea LLC, serves as the Field Program Manager for Vineyard Wind and subject matter expert on marine geology and geophysics. Having supervised and conducted hundreds of surveys in the U.S. and around the world for over 27 years, he is well versed in most aspects of marine operations, including geological, geophysical, geotechnical, and oceanographic studies. Mr. Gardner has been involved in the offshore wind industry since its infancy in the U.S., playing a significant role in survey programs for Deepwater Wind's Block Island Project, the Cape Wind Energy Project, and Vineyard Wind 1, not to mention performing surveys and consulting for most of the other offshore wind projects on the east coast and some overseas. Thus, he is very familiar with state and federal agency requirements and has been involved in most aspects of geophysical and geotechnical activities from pre-survey planning to field surveys to post-survey data processing, interpretation, and product development, as well as client representation at meetings. He holds a BS in Marine Geology and an MS in Oceanography along with national and state Professional Geology certifications. His specialty includes the use of geophysical methods to study coastal processes, marine sediments and stratigraphy, underwater archaeology, and benthic habitats.

1.12 Conclusion

The Project will directly advance Massachusetts and regional clean energy and carbon reduction goals by providing approximately 800 MW of clean, renewable offshore wind energy. The Petitioner seeks authority to construct the Vineyard Wind Connector 2, and for the reasons described in greater detail in the subsequent sections of this Analysis, the Project conforms to the Siting Board's standards on need, alternatives, routing, and minimization of environmental impacts and costs under G.L. c.164, § 69J.

Section 2.0

Project Need

2.0 PROJECT NEED

As described in Section 1.0, the purpose of the Vineyard Wind Connector 2 (the Project), which is the subject of this Petition, is to deliver approximately 800 MW of clean, renewable wind energy to the ISO-NE electrical grid. The Vineyard Wind Connector 2 is the Massachusetts-jurisdictional offshore and onshore transmission and the step-up substation necessary to deliver the offshore wind power generated in the central portion of Lease Area OCS-A 0501 by the Park City Wind offshore wind project to the regional power grid.

As discussed in Section 2.1 below, Park City Wind (and by extension the Vineyard Wind Connector 2) was developed in response to a competitive procurement authorized by energy legislation in the State of Connecticut,[1] together with efforts by BOEM and the Commonwealth, to facilitate the development of large-scale wind energy on the Outer Continental Shelf. Beginning in 2009, BOEM has spearheaded a focused effort to identify, study, characterize, and refine suitable offshore wind energy lease areas in federal waters along the Atlantic seaboard. As described in Section 1.2.1, the locations of the offshore wind lease areas, including the Lease Area OCS-A 0501, were determined through a process that involved significant public input over a period of several years. The process began with the formation of a Massachusetts-BOEM task force composed of representatives from federal, state, tribal, and local government agencies, as well as public stakeholder meetings. The process culminated with a January 2015 auction, which resulted in the award of a 166,866-acre Lease Area (OCS-A 0501) to Vineyard Wind. Vineyard Wind is currently developing an 800-MW project (Vineyard Wind 1 and the Vineyard Wind Connector 1) in the northern portion of the Lease Area, and the current proposal for Park City Wind/Vineyard Wind Connector 2 consists of developing the central portion of the Lease Area. The two projects are independent of one another.[2]

In addition to working closely with BOEM to define and refine the Massachusetts WEA, the Commonwealth's long-standing efforts to facilitate offshore wind energy include construction of a blade testing facility in Charlestown and construction of the New Bedford Marine Commerce Terminal. The latter is a purpose-built 26-acre facility, which will support the staging, construction, operation, and maintenance of offshore wind installations. The Massachusetts Clean Energy Center (MassCEC) has been the focal point for many of these efforts and continues to be an important clearinghouse for the exchange

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1 Connecticut Public Act No. 19-71, *An Act Concerning the Procurement of Energy Derived from Offshore Wind*.

2 Even if the Vineyard Wind Connector 2 had been planned in conjunction with the Vineyard Wind Connector 1, the siting and routing would not necessarily differ from what is described herein. The two projects together still would have required four circuits, likely necessitating two separate onshore routes to maintain reliability while minimizing cable heating in a single duct bank. Interconnection to the existing electrical grid would also stay the same, with the 800 MW associated with Vineyard Wind 1 connecting at the Barnstable Switching Station without any significant upgrades, after which additional energy generation would need to interconnect at the West Barnstable Substation.

of data and information within the wind energy community. As part of these ongoing efforts, the MassCEC released a report entitled "Massachusetts Offshore Wind Ports and Infrastructure Assessment". The October 24, 2017 report provides a comprehensive assessment of 18 waterfront properties together with a supply chain directory.

As summarized in Section 1.2 and discussed in further detail in Section 6, Consistency with Policies of the Commonwealth, construction of the Project will serve the public interest by increasing the reliability and diversity of the regional and statewide energy supply.

Section 1.6 discusses benefits the Park City Wind project and Vineyard Wind Connector 2 will bring to the Commonwealth and larger region. The discussion below describes why the Vineyard Wind Connector 2 is needed for those benefits to be realized.

2.1 Overview of Connecticut Offshore Wind Legislation

Connecticut Public Act 19-71, *An Act Concerning the Procurement of Energy Derived from Offshore Wind* (the "Act") is intended to ensure a diversified electrical energy portfolio for the State of Connecticut while strengthening the region's clean energy economy. The Act represents a significant and long-term commitment to renewable energy by Connecticut. In conjunction with policies of other New England States (such as Section 83C of the Green Communities Act in Massachusetts), it is expected to help spur the development of a major U.S. offshore wind industry, an industry in which New England is actively working to become a leader and major player. This industry will bring significant job creation and economic activity to the region.

The Act authorizes the Connecticut DEEP, in consultation with the procurement manager of PURA, the Office of the Attorney General, and the Office of Consumer Counsel to Connecticut's electric distribution companies, to solicit proposals, in one solicitation or multiple solicitations, for up to 2,000 MW of offshore wind.

In considering offshore wind proposals received in response to the solicitation, DEEP must consider, among other factors, whether a proposal: (1) is in the best interest of ratepayers; (2) promotes electric distribution system reliability; (3) has positive impacts on Connecticut's economic development; (4) is consistent with requirements and reduce greenhouse gas emissions; (5) is consistent with policy goals outlined in the state's Comprehensive Energy Strategy; and (6) uses practices to avoid, minimize, and mitigate impacts to wildlife, natural resources, ecosystems, and traditional or existing water-dependent uses. Successful proposals selected by DEEP are awarded long-term PPAs with Connecticut's electric distribution companies. These PPAs are intended to enable project developers to finance and construct offshore wind projects.

DEEP issued the first solicitation on August 16, 2019, and Vineyard Wind's bid to provide approximately 804 MW of offshore wind energy was selected for the award on December 5, 2019. Vineyard Wind has negotiated and finalized PPAs for that energy with the Connecticut electric distribution companies.

The Act is consistent with and reinforces many of the objectives of analogous policies in Massachusetts, specifically, Section 83C of An Act Relative to Green Communities, St. 2008, c. 169, as amended by St. 2016, c. 188, § 12 (Section 83C). Like Section 83C, the Act seeks to facilitate financing of offshore wind generation resources, enhance regional reliability (including during winter peak demand), mitigate environmental impacts, and promote economic development (*Compare* Section 4(b) of the Act *with* St. 2008, c. 169, § 83C; 220 C.M.R. § 23.05(1)). Together, the Act and Section 83C further the development of an offshore wind industry in New England that provides clean energy to the New England electric grid, improves reliability of that system, and offers significant economic and environmental benefits to the region.

2.2 Need for Vineyard Wind Connector 2

The Siting Board's review of proposed transmission facilities is conducted pursuant to G.L. c. 164, § 69J. In reviewing petitions for such facilities, the Siting Board assesses the need for proposed transmission facilities to meet reliability, economic efficiency, or environmental objectives (G.L. c. 164, §§ 69H, 69J). Pursuant to its review, the Siting Board requires an applicant seeking to construct a transmission line to interconnect a new or expanded generating facility to show: (1) that the existing transmission system is inadequate to interconnect the new or expanded generator; and (2) that the new or expanded generator is likely to be available to contribute to the regional energy supply.[3] If the new or expanded generator exists, or is under construction, the availability showing will be deemed to have been made. If the generator is planned, and is subject to the Siting Board's jurisdiction, that showing may be made by obtaining the Siting Board's approval of the generating facility.[4] If the generator is planned, and not subject to the Siting Board's jurisdiction, as is the case for the Project, the showing may be made on a case-by-case basis based on indicators of project progress (e.g., progress in permitting or in obtaining project financing).[5]

2.2.1 Inadequacy of the Existing Transmission System

As discussed in Section 1.0, the Company is in the process of permitting Park City Wind, an approximately 800-MW offshore wind energy generation project in federal waters under the jurisdiction of the BOEM. The location of the Massachusetts offshore wind lease areas, including Vineyard Wind's Lease Area OCS-A 0501, was determined through a process that involved significant public input over a period of several years (see Section 1.2.1). Currently, there is no existing transmission to connect this new wind energy generation project in the central portion

[3] *Vineyard Wind LLC*, EFSB 17-05/D.P.U. 18-18/18-19, at 11 (2019) ("Vineyard Wind 1").

[4] *Vineyard Wind 1* at 12.

[5] *Vineyard Wind 1* at 12.

of the Lease Area to the onshore electrical grid.[6] Therefore, the transmission proposed as the Vineyard Wind Connector 2 is needed to deliver power generated at the federal lease area to the electrical grid.

The Company has been engaged in an extensive analysis of offshore and onshore routing alternatives, described in detail in Section 4.0. As a result, the proposed Vineyard Wind Connector 2 avoids and minimizes impacts while enabling approximately 800 MW to interconnect at the existing 345-kV West Barnstable Substation.

2.2.2 Likelihood that new or expanded generation source will be available to contribute to regional energy supply

Multiple indicators establish and will establish that Park City Wind (i.e., the generation for which the Vineyard Wind Connector 2 transmission is proposed) is likely to be available to contribute to the regional energy supply. First, there is support for development of the project at federal and state levels, and the project has been developed in response to and in conjunction with federal and state policies. As described in Section 1.2.1 of this Petition, on January 29, 2015, BOEM held a competitive lease sale, conducted as an auction, for the four lease areas within the Massachusetts WEA. Vineyard Wind won Lease Area OCS-A 0501 in the auction.

The Project is also specifically supported by the Act, the primary purpose of which is to cause the development of offshore wind resources that will contribute to the regional energy supply. In accordance with the Act, the first solicitation for commercial-scale offshore wind was issued on August 16, 2019 (see Section 1.2.2). Responses to the RFP were due on September 30, 2019, and Vineyard Wind's bid was selected by DEEP on December 5, 2019.

Vineyard Wind has negotiated and finalized PPAs with the Connecticut electric distribution companies for the energy Park City Wind will produce, and expects to file them with PURA for review in 2020. Vineyard Wind further expects the PPAs will be approved by PURA consistent with the Act.[7] By legislative design and purpose, the Act makes it likely that projects selected and contracted for under its processes are likely to be developed and to contribute to the regional

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[6] The Vineyard Wind Connector, which has been permitted to connect Vineyard Wind's first project in the northern part of the same lease area, could not be used to interconnect the Project for several reasons. First, the Vineyard Wind Connector lacks the capacity to manage the additional generation. Second, the first project's interconnection at the Barnstable Switching Station would not be able to accommodate the additional approximately 800 MW of generation for which the Vineyard Wind Connector 2 transmission is proposed. Third, the onshore duct bank could not accommodate the two additional proposed circuits due to space constraints within roadway layouts as well as the desire to limit cable heating and maximize reliability.

[7] That approval will include a conclusion by PURA under Section 1(d) of the Act that Vineyard Wind "has the technical, financial and managerial capabilities to perform pursuant to [the PPAs]," further supporting a conclusion that, following approval by PURA, the Project is likely to be constructed.

energy supply. Once Vineyard Wind has approved PPAs with the Connecticut electric distribution companies that commits those counterparties to known prices for the output of the project, that price certainty provides a further economic basis for concluding that the project is likely to be built and put into operation.

Development of Park City Wind is also likely because of the valuable nature of the wind resource in Lease Area OCS-A 0501. In the opinion of Vineyard Wind, its SWDA for Park City Wind is as good as any offshore wind site in the world. It has high wind speeds, excellent seafloor conditions, moderate water depths, reasonable proximity to multiple grid interconnection locations in an area of high electrical load, and an identified need for new generation capacity. These characteristics alone, but even more so in connection with the strong federal and state policies in place, support a conclusion that Park City Wind is likely to be available to contribute to the regional energy supply.

Many significant indicators of progress have already been achieved, and will continue to be achieved during the review of this Petition, that establish that Park City Wind is likely to be available to contribute to the regional energy supply. Relevant indicators include: attaining permitting milestones, reaching a host community agreement(s) with Barnstable, legislative and regulatory actions that make it more likely the Park City Wind project will be developed (such as legislation specifically setting forth procurements for offshore wind generation and regulatory actions implementing that legislation or selecting the project), execution of PPAs for the project output, regulatory approval of the PPAs with regulated electric distribution companies, steps taken to vet and pre-authorize offshore areas as suitable and desirable for offshore wind development, information demonstrating that the areas at issue have characteristics that make it desirable for the development of offshore wind generation, and participation in forward capacity auctions. These types of indicators represent steps that each increase the likelihood that the Park City Wind project is "likely to be available."

Park City Wind and the Vineyard Wind Connector 2 have achieved significant indicators of progress, which show they are likely to be available to contribute to the regional energy supply. For instance:

- ♦ Lease Area OCS-A 0501, in which the offshore wind energy generation facility for Park City Wind will be built, was delineated through a process that involved significant public input over a period of several years and was intended to select an area that addressed concerns and was appropriate for offshore wind generation. That process culminated in the award of Lease Area OCS-A 0501 to Vineyard Wind. The process is described in more detail in Section 1.2.1.

- ♦ On May 10, 2018, BOEM approved a Site Assessment Plan (SAP) for Lease OCS-A 0501 for Vineyard Wind 1. Vineyard Wind subsequently installed a meteorological-oceanographic buoy (metocean buoy) in the Lease Area that has provided data used to inform the design and permitting strategy for Park City Wind.

- ♦ Vineyard Wind reached an HCA with the Town of Barnstable on October 3, 2018, which addresses the Vineyard Wind Connector 1 and addresses subsequent transmission projects such as the Vineyard Wind Connector 2. For instance, in Section 6(a) it states that "[t]he Town shall work cooperatively with Vineyard Wind on the selection of the final route(s) for the Transmission Lines on both the Project [Vineyard Wind Connector 1] and any subsequent project, including minor modifications to the foregoing identified routes" and that "[t]he Town agrees to support either route selected by Vineyard Wind for the Project and the route for any subsequent Project…" Vineyard Wind is in the process of negotiating a supplemental agreement with the Town of Barnstable to address the Vineyard Wind Connector 2 more specifically.

- ♦ The adoption of the Act on June 7, 2019 sets forth a process under Connecticut law for the solicitation of proposals for offshore wind facilities and the provision of PPAs between electric distribution companies in Connecticut and successful bidders.

- ♦ On December 5, 2019, the Connecticut DEEP announced the selection of Vineyard Wind's Park City Wind bid of approximately 804 MW of offshore wind energy generation connecting with a generator lead line as the winning bidder in the competitive solicitation for commercial-scale offshore wind.

- ♦ Both the Commonwealth and Vineyard Wind have each conducted extensive outreach to stakeholders to address concerns at early stages of project development. For example, Vineyard Wind has met with numerous fishing groups and/or individuals, and the Commonwealth of Massachusetts has facilitated ongoing working groups for fisheries and habitat concerns. Vineyard Wind has met with the local Native American tribes several times and has conducted regular outreach to local municipalities on the south coast and in Cape and Islands communities. Section 1.10 contains additional information about Vineyard Wind's ongoing outreach efforts.

- ♦ Negotiation of long-term contracts between the DEEP, Connecticut utilities, and Vineyard Wind are underway, and long-term contracts for the output of Park City Wind are expected to be filed with PURA in 2020.

- ♦ The federal permitting process will kick off soon after the state permitting process begins when Vineyard Wind files its Construction and Operations Plan (COP) for Park City Wind in summer 2020, with BOEM as the lead federal agency and the agency responsible for completing the NEPA process. A third-party Environmental Impact Statement (EIS) contractor will be selected to support BOEM in producing the NEPA documents. Vineyard Wind anticipates that BOEM will issue a Record of Decision (ROD) within several months after the issuance of a Final EIS under NEPA. Additional permitting with the U.S. EPA and the USACE will be initiated around the same time to facilitate approvals either prior to, or in the same time frame, as the state permitting is expected to be completed.

- ♦ PURA will review the long-term contracts subject to Section 1(d) of the Act, which will require, among other things, a determination that Vineyard Wind "has the technical, financial and managerial capabilities to perform pursuant to [the PPAs]." Thus, approval of the long-term contracts will entail a determination by PURA that there has been such a demonstration. Vineyard Wind anticipates that PURA will issue a final order on long-term contracts between Vineyard Wind and the Distribution Companies in late 2020.

- ♦ BOEM is enacting the One Federal Decision MOU (Executive Order 13807) dated April 9, 2018 by all federal agencies required to permit the project to streamline the federal permitting timeline. In addition, BOEM has had working groups with relevant federal agencies preparing for coordinated effort and timing.

2.3 Conclusion

In accordance with Siting Board precedent, the Company has evaluated the need for the Vineyard Wind Connector 2, which in turn would enable benefits such improving the reliability and diversity of the energy mix in the Commonwealth. Based on this information, the Company has demonstrated or will be able to demonstrate that the Vineyard Wind Connector 2 is necessary to achieve these goals and that it satisfies the demonstration of need in G.L. c. 164 §§69H, 69J.

Section 3.0

Project Alternatives

3.0 PROJECT ALTERNATIVES

In accordance with G.L. c. 164 § 69J, this section presents a description of alternatives to the Vineyard Wind Connector 2 (the "Project"). Section 69J indicates that alternatives could include other methods of transmitting or storing energy, other site locations, other sources of electrical power or gas, or a reduction of requirements through load management. This section, together with Sections 4 and 5, assess relevant alternatives at several levels, including fundamental Project alternatives (e.g., No Build), alternative transmission routes, and technology or design alternatives for the transmission cables, which are the core of the Vineyard Wind Connector 2 project.

With respect to project alternatives, the Vineyard Wind Connector 2 is distinguishable from certain other projects previously considered by the Siting Board because it is being proposed in response to a specific Legislative mandate. As described in Section 2.1, legislation enacted in June 2019 by the State of Connecticut[1] calls for the procurement of up to 2,000 MW of offshore wind capacity. This Connecticut initiative is similar to the 2016 Massachusetts legislation[2] requiring the Commonwealth's electric distribution companies to enter into agreements for the long-term purchase of a minimum of 1,600 MW of offshore wind energy via a series of competitive procurements.

Given that Vineyard Wind Connector 2 is tailored to meet specific legislative requirements for offshore wind energy, typical project alternatives (i.e., non-transmission alternatives such as energy efficiency, large-scale demand response, solar, onshore wind, combustion-based generation) are only briefly addressed in this section. None of these alternatives would meet the necessary Project purpose. Alternative transmission routes, substation locations, and interconnection locations are considered in Section 4 of this Petition.

3.1 Project Alternatives

In support of the preferred solution to advance the region's goals for utility-scale, zero-carbon offshore wind energy generation, the Company evaluated "No-Build" and related alternatives and potential transmission system alternatives (e.g., different cable configurations and interconnection points). Through this analysis, the Company has demonstrated and confirmed that the proposed Vineyard Wind Connector 2, on balance, best meets the identified need with a minimum impact on the environment and at the lowest possible cost.

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1 Connecticut Public Act No. 19-71, An Act Concerning the Procurement of Energy Derived from Offshore Wind.

2 Section 83C of An Act Relative to Green Communities, St. 2008, c. 169, as amended by St. 2016, c. 188, § 12.

3.1.1 No-Build and Related Alternatives

Under the No-Build Alternative, the Company would not pursue the Vineyard Wind Connector 2, preventing approximately 800 MW of essential zero-carbon energy from interconnecting with the regional electrical grid. This would preclude realization of the Project's extensive environmental and economic benefits (benefits of the Vineyard Wind Connector 2 and Park City Wind are discussed in Section 1.6).

Non-transmission alternatives, sources of power other than offshore wind, and load management would similarly not allow the delivery of offshore wind energy to the regional grid nor meet the legislative mandate.

None of these alternatives would meet the region's offshore wind energy generation requirements (see Section 2.1).

For these reasons, these alternatives were not considered further.

3.1.2 Proposed Vineyard Wind Connector 2

The purpose of the Vineyard Wind Connector 2 is to deliver approximately 800 MW of clean, renewable wind energy to the New England electrical grid. The Vineyard Wind Connector 2, which is the subject of this Petition, is the Massachusetts-jurisdictional offshore and onshore underground transmission and the step-up substation necessary to deliver the offshore wind power generated in the central portion of Lease Area OCS-A 0501 by the Park City Wind project to the regional power grid. Specifically, the Vineyard Wind Connector 2 will connect to the onshore electrical grid via two new 220-kV or 275-kV three-core AC offshore export cables that will travel through federal and state waters, make landfall in Barnstable, and then travel in a buried concrete duct bank to a proposed step-up substation, from which the Project will connect with the regional electrical grid at the 345-kV West Barnstable Substation.[3]

Specific alternative transmission routes, substation locations, and interconnection locations are considered and assessed in Section 4 of this Petition. After eliminating excessively long route concepts, Vineyard Wind assessed seven grid interconnection locations, five landfall sites, four potential substation sites, and a number of potential onshore and offshore transmission routes (see Sections 4.3 through 4.5).

The Vineyard Wind Connector 2 offshore export cables are proposed to make landfall at one of two Town-owned paved parking lots at either Craigville Public Beach or Covell's Beach. As was proposed for the Vineyard Wind Connector 1, HDD will be used to accomplish the transition from offshore to onshore, thus avoiding construction impacts to the beach, intertidal zone, and

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[3] The Project's grid interconnection is proposed at the 345-kV West Barnstable Substation constructed as part of the NSTAR Lower SEMA Project, as distinguished from the 115-kV Oak Street Substation located on the northern side of the same Eversource-owned parcel.

nearshore area. As more fully described in Section 4.6, Vineyard Wind has identified a single OECC for Park City Wind/Vineyard Wind Connector 2, which could provide access to either landfall site. The OECC is largely the same corridor that will be utilized by Vineyard Wind 1/Vineyard Wind Connector 1).[4] The corridor is the product of detailed marine surveys, consultations with the Massachusetts Ocean Team, and input from federal resource agencies.

Once onshore, each three-core offshore export cable will transition to three separate single-core XLPE-insulated cables. This transition will be accomplished via buried transition vaults/joint bays in the paved portion of the landfall site (one vault for each three-core offshore export cable). From the transition vaults/joint bays, the single-core onshore cables will be contained within an underground concrete duct bank that will be installed primarily within existing Town road layouts. The underground duct bank will extend from the landfall site to the proposed Project substation site, a distance of approximately four miles for the Preferred Route. The proposed step-up substation (220 kV or 275 kV to 345 kV) is proposed on an approximately 6.7-acre previously-developed property located near the intersection of Route 6 and Route 132. Vineyard Wind has an exclusive option to purchase the site, the northern portion of which is occupied by a motel building, from the current owner. Some substation equipment may also be relocated from the 6.7-acre property to an approximately 2.8-acre parcel located immediately southeast of the West Barnstable Substation which Vineyard Wind is under agreement to purchase (see Section 1.3.4). Underground 345-kV cables contained within a concrete duct bank will be installed from the new substation to the grid interconnection at the existing 345-kV West Barnstable Substation. The preferred grid interconnection route for these 345-kV cables will cover a distance of approximately 0.7 miles.

The Preferred and Noticed Alternative routes for the transmission routes (from the landfall site to the proposed substation) and the grid interconnection routes (from the proposed substation to the interconnection location) are compared and described in detail in Sections 1.5 and 5.0.

3.1.3 Transmission Alternatives

The subsections below describe potential transmission alternatives for the Project in terms of cable technologies and interconnection strategies. The discussion focuses on practical aspects of transmission alternatives as well as implications for reliability, environmental impacts, and cost.

[4] The OECC originally proposed as part of the Vineyard Wind Connector 1 had an eastern and a western option for the passage through Muskeget Channel. After a comprehensive review of engineering, constructability and environmental considerations, the western option has been dropped from further consideration.

3.1.3.1 Cable Technology Alternatives

HVAC vs. HVDC

The Vineyard Wind Connector 2 will employ high voltage alternating current (HVAC) technology for the proposed transmission. For Vineyard Wind Connector 2, HVAC is preferred to high-voltage direct current (HVDC) transmission as it is more cost effective, highly reliable, and consistent with the cable technology approved for the Vineyard Wind Connector 1. HVDC is used successfully for long-distance power transmission in overseas markets and has been proposed for long-distance projects in the Northeast such as the Champlain Hudson Power Express[5] and the Emera Atlantic Link project.[6] However, it requires large and expensive converter stations at both ends of the HVDC cable system. For the Vineyard Wind Connector 2, HVDC is not necessary based on distance (less than 75 miles [120 km]) between the offshore ESP and the grid interconnection point. Further, the higher cost of an HVDC system is not necessarily compatible with state procurement processes that are seeking and selecting cost-competitive projects. Vineyard Wind's successful bids into the first Massachusetts 83C procurement as well as the more recent Connecticut DEEP procurement were both based on AC cable technology. Similarly, Mayflower's recent successful bid in the second Massachusetts 83C procurement was based on AC cables (three 275 kV circuits, per Exhibit E of the Jan 10, 2020 PPA between NSTAR Electric d/b/a Eversource Energy and Mayflower Wind Energy, LLC, redacted version), and Orsted's successful bids into Rhode Island and New York also involve AC technology.

Transmission Voltage

The voltage of the proposed AC export transmission system will be 220 kV or 275 kV. For some time, 220 kV has been the standard and accepted operating voltage for comparable connections of offshore projects in Europe. These 220-kV offshore cables are available from multiple manufacturers, are type-tested,[7] and were proposed for the Vineyard Wind Connector 1. More recently, offshore wind projects have begun to consider 275-kV cables (see, for example, the Mayflower project noted above). The 275-kV cables are similar in construction and physical size to the 220-kV cables but operate at higher voltage/lower amperage for a given power rating. The higher-voltage cables typically have lower power losses and can have lower magnetic field levels for a given power flow, but result in higher charging currents for a similar length so a detailed load flow and voltage profile along the export cable must be performed to confirm acceptable voltages

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[5] As proposed, 1,000 MW HVDC, U.S./Canadian border, south the NYC metro area, 335 miles, $3 billion construction cost, according to the TDI website.

[6] As proposed, a 1,000 MW HVDC submarine interconnection between Coleson Cove, New Brunswick (Canada) and Plymouth, Massachusetts near the retiring Pilgrim nuclear station (375 miles), according to the project website. This project submitted a bid to the Commonwealth under Section 83D of the 2008 GWSA, but was not selected.

[7] A type test is a test performed to provide evidence that the design meets the requirements of the functional specification.

can be maintained over the full operating range. The 275-kV option will be evaluated in greater detail as the Vineyard Wind Connector 2 progresses to determine whether sufficiently reliable, tested, and proven products become available in the market.

An even higher voltage such as 345 kV could theoretically be used for an offshore wind project, but there are no tested offshore cables of this type, and a long type-testing process would be required.

Voltages lower than 220 kV are not desired for this 800 MW Project, as they would increase the number of cables required for the connection and increase overall losses. For example, using 115-kV cables would require additional cables, since each 115-kV cable would have approximately half the capacity of a 220-kV cable. Not only would this increase Project costs and extend the installation schedule, but it would also enlarge the impact areas in the offshore and onshore environments.

Cable Type

XLPE insulation will be used for the Project's offshore and onshore cables, and XLPE is considered state-of-the-art technology for offshore transmission worldwide. XLPE cables have proven to be more reliable with greater ease of handling than high-pressure fluid-filled (HPFF) and oil-impregnated cables. XLPE also allows for standard and quicker jointing and termination.

The proposed offshore and onshore export cables are described in greater detail in Sections 1.3.2 and 1.3.3, respectively.

3.1.3.2 Interconnection Locations

An analysis of potential interconnection locations is provided in Section 4.3.2 in the context of the routing analysis. The 800-MW Vineyard Wind Connector 1 will make a grid interconnection at the 115-kV Barnstable Switching Station, effectively utilizing the full interconnection capacity at that interconnection point. The Barnstable Switching Station is the easternmost ISO-NE Pool Transmission Facility (PTF) on Cape Cod.

Recognizing that the Barnstable Switching Station interconnection will be effectively at capacity and thus unavailable for the Vineyard Wind Connector 2, the Company considered whether the Vineyard Wind Connector 2 should connect to the regional electrical grid at a single interconnection point or multiple interconnection points. An interconnection load flow analysis confirmed that the Project could interconnect the full approximately 800 MW at the existing 345-kV West Barnstable Substation. The single point of interconnection, approximately four miles north of the landfall site, results in a cost-effective and efficient construction sequence. This eliminates the need for additional onshore cabling and avoids the need to construct Project substations in multiple locations.

As described in Section 4.3.2, multiple potential interconnection points were considered for the Project. As described in Section 4, the Company has been able to secure an option to purchase an approximately 6.7-acre commercial property near the intersection of Route 6 and Route 132, less than a mile east of the existing West Barnstable Station. West Barnstable is an excellent interconnection location where the Company holds two ISO-NE interconnection queue positions (QP 700 and QP 806).

3.1.3.3 Generator Lead Line Approach Compared to Shared or Independent Transmission

As the utility-scale offshore wind effort has emerged in federal waters off the southern New England coast, the subject of "shared transmission" (i.e., "networked transmission" or an "offshore transmission backbone") has been part of the conversation. This was the case beginning in 2009 with the BOEM/stakeholder lease area identification and evaluation process, and the conversation continues today. However, given the many significant challenges with shared transmission, the offshore wind industry and governmental support for the industry have been moving forward uniformly with generator lead lines and direct interconnections, including the projects discussed below.

Vineyard Wind considered a shared transmission option for Park City Wind, but rejected that approach. A generator lead line in the form of the Vineyard Wind Connector 2 is the superior strategy and the only strategy that could be implemented within the timeline required for the Project under the legislatively authorized procurement. Under current circumstances and pursuant to current state procurements, shared transmission projects are not competitive, as demonstrated by the sole selection of generator lead line projects in such procurements to date. Coordinating shared transmission solutions could conceivably provide some benefits in the future, but is not a viable solution today. Moreover, because of the unique characteristics of Park City Wind and Vineyard Wind's Lease Area OCS-A 0501, a generator lead line is superior to a shared transmission alternative on cost, reliability, and environmental grounds. The Lease Area is relatively close to attractive interconnection locations on Cape Cod where a direct route enables the transmission from multiple projects (Vineyard Wind Connector 1 and Vineyard Wind Connector 2) within the same corridor. Such projects can be developed expeditiously to deliver the benefits of offshore wind generation to New England in a timely manner without the inherent risks associated with shared transmission investments.

Advocates for shared transmission assert that such systems can reduce costs and minimize impacts relative to a scenario in which each project identifies, permits, builds, and owns its own generator lead. Early discussions about build-out of the offshore wind resource envisioned individual offshore wind generation projects of relatively modest scale (250-500 MW) as well as HVDC transmission for reasons of capacity and distance.

However, as the offshore wind industry has unfolded, the typical project size has grown to 800 MW or more, and AC cables have proven to be a technically sound and economic solution (a pair of 220-kV cables can transmit 800 MW). Moreover, the relative proximity of Vineyard Wind's

Lease Area OCS-A 0501 to shore, coupled with the orderly use of existing 115-kV and 345-kV interconnection points in the mid-Cape area, will enable Vineyard Wind to connect multiple projects using a common offshore corridor. This approach provides reliability and minimizes costs and temporary impacts from cable-laying activities while enabling the developer to maintain control of transmission routing, permitting, construction, and commissioning schedule. Given this fortuitous combination of geography, grid access, and timing, Vineyard Wind has achieved a cost-effective solution which looks much like "shared transmission" but with none of the attendant drawbacks (from a wind energy developer's perspective).

Given the orientation of the Lease Area relative to the interconnection locations considered, the most direct path for transmission is one that extends almost due north; any other scenario involving a shared transmission system in this instance would result in longer cable length. The generator lead line strategy also results in greater reliability benefits by delivering energy generated by offshore wind to multiple interconnection locations.

The shared transmission strategy has additional drawbacks, including substantial technological, development, and regulatory risks, which are currently not present in the generator lead line approach. For example, any delay or other issue that affects timing, cost, or design of shared transmission infrastructure could significantly impact the timing, cost, or design of an offshore wind project and vice versa. In a generator lead line approach, a single party is responsible for the generation and transmission component of an offshore wind project, and can take an integrated approach to design, development, financing, construction, and operation, internalizing the costs thereof. In addition to these drawbacks, shared transmission introduces significant coordination challenges with respect to project development, permitting, stakeholder engagement, and other processes that determine project impacts and mitigation techniques.

Moreover, shared transmission infrastructure is not necessarily preferable from an environmental perspective. Consider a scenario in which a shared transmission network was developed for the remaining 1,600 MW of offshore wind capacity authorized under Section 83C in Massachusetts. The current maximum loss of source for a Normal Design Contingency, utilized for planning purposes in ISO-NE, is 1,200 MW. This effectively limits the amount of capacity that can interconnect to the grid from a single source to 1,200 MW regardless of whether transmission is independently developed or a project-specific generator lead line. To comply with this limit, a shared transmission infrastructure designed to support 1,600 MW of offshore wind capacity would, at a minimum, have to include two sets of two export cables to interconnect at two separate points of interconnection, likely through separate onshore landings and onshore transmission routes. In this scenario, the resulting shared transmission infrastructure does not yield any environmental advantages relative to project-specific generator lead lines developed for the same capacity of offshore wind. On the contrary, in some instances, shared transmission infrastructure has the potential to result in greater impacts to the extent that it necessitates the development of more infrastructure (e.g., offshore substations), both on- and offshore, as compared to project-specific generator lead lines. Finally, to the extent that shared transmission infrastructure is likely to increase complexity and development timelines for offshore wind deployment, it would delay and potentially frustrate the region's efforts to reduce greenhouse gas emissions in line with state-mandated targets leading to greater environmental impacts.

In 2014, MassCEC published a study[8] of potential wind energy grid interconnection scenarios and locations. The study focused on opportunities for interconnection at 345 kV in southern Massachusetts as well as Rhode Island, Connecticut, and Long Island; it examined build-out/interconnection scenarios ranging up to approximately 6,000 MW. The report described HVDC and HVAC technologies, albeit with an emphasis on HVDC, and provided insight for the then-fledgling offshore wind industry.

Page 39 of the CEC study expressed concerns about separating transmission from generation:

> *One fundamental issue with developing the transmission system (HVDC and HVAC infrastructure) independent of the generating system (wind turbines and inter-array cabling) is the question of which one should come first. The generating system has no value if it cannot deliver its power to market and similarly the transmission system has no value if there is no power to deliver. Under the scenario where the leaseholder does not construct, own and/or operate the transmission system it would be important that the transmission developer work closely with the leaseholder (wind energy developer) to ensure schedule alignment and the ability to meet any in-service date commitments made to the utility. Other questions regarding financing ability and risk apportionment also present issues insofar as the ability of a wind developer to finance a project without a firm and enforceable commitment to have transmission available or vice versa in the case of an "independent" cable developer*.

The first Massachusetts Section 83C procurement, issued in Fall 2017, included a provision for a shared transmission option. DOER did not select this option, but rather awarded the initial 800 MW PPA to Vineyard Wind. The Vineyard Wind offering was based on a wind turbine array in the northern portion of Lease Area OCS-A 0501 and a 220-kV export cable system. Use of proven, cost effective 220-kV AC cable technology, together with a modest cable length and an interconnection which could be accomplished without significant system upgrades, was a significant element of Vineyard Wind's cost-competitive 800-MW proposal for Vineyard Wind 1/Vineyard Wind Connector 1. The state, regional, and local permitting of the Vineyard Wind Connector 1 was completed in approximately two years.

Since the initial Section 83C award to Vineyard Wind, a number of other offshore wind projects have been advanced from lease areas in the RI/MA WEA, all involving generator leads (i.e., direct transmission interconnections). They include (in approximate chronological order):

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[8] Offshore Wind Transmission Study, Final Report, prepared for Massachusetts Clean Energy Center, prepared by ESS Group, East Providence RI, September 2014.

- ♦ South Fork Wind (Orsted), 130 MW (connection into Long Island Power Authority [LIPA] system, eastern end of Long Island);
- ♦ Revolution Wind (Orsted and Eversource), 700 MW (interconnection to ISO-NE grid at Brayton Point);
- ♦ Sunrise Wind (Orsted and Eversource), 880 MW (grid interconnection into Holbrook and West-Bus substations in Brookhaven, NY in east-central Long Island);
- ♦ Mayflower Wind (Shell and EDP Renewables); 804 MW (connection to ISO-NE grid in Bourne MA); and
- ♦ Vineyard Wind's Park City Wind (501 South Phase 1), 804 MW (connection to ISO-NE grid at the 345-kV West Barnstable Substation).

While these offshore wind energy projects based in the RI/MA WEA have been awarded PPAs and are in or are preparing to enter permitting, capacity for additional direct transmission interconnection remains. To date, direct project interconnections proposed into the ISO-NE grid total approximately 3,100 MW.[9] A 2019 ISO-NE study found that up to 6,000 MW of offshore wind capacity could be added to the New England grid without major upgrades. In addition to Barnstable, MA and Kent County, RI, the study identified Brayton Point (1,600 MW) and Montville, CT (800 MW) as favorable interconnection locations.

While the offshore wind development community, working within the framework of competitive solicitations in Massachusetts, Connecticut, Rhode Island, and New York, is developing a series of generator lead or direct interconnection projects, the subject of shared or independent transmission continues to be examined for future projects.[10] While Vineyard Wind has demonstrated why shared transmission is not the preferred alternative for the Vineyard Wind Connector 2, it is possible that the technology will be more viable for future projects.

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9 Vineyard Wind 1 (800 MW) to Barnstable Switch; Orsted/Eversource Revolution (700 MW) to Kent County; Mayflower (800 MW) to Bourne; Vineyard Wind Park City Wind/Vineyard Wind Connector 2 (800 MW) to West Barnstable.

10 In August 2019, the NY Power Authority released a report entitled "Offshore Wind, A European Perspective." The 18-page study provides a useful perspective based on the installation of 18,000 MW of offshore wind capacity in northern Europe (UK, Germany, Denmark, Netherlands). The report concludes that "the most cost effective path to low-cost wind power is through scale and healthy competition." The report also states that "The offshore transmission model used is dependent on a variety of physical and non-physical factors including geography. Regardless of the model chosen, the coordination and incentive alignment between all parties is critical and needs to match their levels of respective capabilities."

For example, Anbaric, an independent developer, has reportedly filed an interconnection request at Brayton Point for a 1,200 MW HVDC interconnection.[11] At that scale, even as shared transmission it could theoretically connect only one project of the size of Park City Wind/Vineyard Wind Connector 2. And while Brayton Point may be a viable connection location for some projects, for the reasons identified in Section 4.3.2.7 a Brayton Point interconnection is less preferable from a variety of energy, environmental, and cost perspectives for the Vineyard Wind Connector 2.

In November 2019, Anbaric also filed an "Unsolicited Right-of-Way/Right-of-Use & Easement Grant Application" with BOEM for non-exclusive rights-of-way to develop a Southern New England Ocean Grid. Anbaric's press release described the Southern New England Ocean Grid as an independent, open-access offshore transmission system. It would reportedly be developed in phases, connecting up to 16,000 MW of offshore wind to Massachusetts, Rhode Island, and Connecticut, with an anticipated build-out over 20 years.[12] The application is for an offshore network of subsea transmission cables approximately 337 nautical miles (388 statute miles) in length. The application also requests an authorization for siting up to eight offshore collector platforms, which would collect and distribute power generated from offshore wind facilities to landings at locations from Massachusetts to the Long Island Sound.[13] The project would require an unknown number of cables to connect with the onshore grid and an unknown number of interconnection points. Anbaric has reportedly filed three interconnection requests with ISO-NE to date, two in Massachusetts and one Connecticut, each of 1,200 MW;[14] at that interconnection size, to connect 16,000 MW, at least 14 interconnection points and at least that many cables would be required to construct its project. At its conceptual level of design, the permitting and construction timeline for such an effort would not accommodate the schedule for delivering the zero-carbon energy and benefits promised by Park City Wind/Vineyard Wind Connector 2.

Shared transmission will likely be considered in future Massachusetts solicitations. Building on the successful Energy Diversity Act in 2016, in 2018 Massachusetts passed An Act to Advance Clean Energy which required DOER to (1) investigate the necessity, benefits, and costs of requiring the electric distribution companies (EDCs) to conduct solicitations and procurements for up to

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11 https://anbaric.com/anbarics-renewable-energy-center-at-brayton-point/

12 https://anbaric.com/southernnewenglandoceangrid/ and https://www.boem.gov/sites/default/files/documents/renewable-energy/Anbaric-S-New-England-OceanGrid.pdf

13 https://www.boem.gov/renewable-energy/state-activities/regional-proposals

14 https://anbaric.com/southernnewenglandoceangrid/

1,600 MW of additional offshore wind; and (2) evaluate the previous solicitation and procurement process and make recommendations for any improvements. In response to this legislative mandate, DOER published an Offshore Wind Study in May 2019.[15]

DOER's 2019 study concluded that shared transmission should be considered for future Massachusetts solicitations. The DOER study found that "based on current market projections an additional procurement for 1,600 MW of offshore wind has the likelihood of cost-effectiveness that justifies additional solicitations." On the subject of timing, the report notes: "Ideally, solicitations should be at least 24-30 months apart to adequately capture lessons learned from prior solicitations, provide sufficient time for stakeholder feedback, create robust competition and to better align with the growth in the RPS and CES (Clean Energy Standards) markets.

Finally, with respect to the independent transmission, the study recommended more work be done to assess it prior to the next solicitation. The report states (page 14): "In order to evaluate benefits of independent transmission and maximize transmission competition, potential transmission solutions would need to be identified and evaluated prior to the solicitations for 1,600 MW of additional offshore wind." The report states further:

> *With the passage of the Clean Energy Act of 2018, DOER is now able to require distribution companies to jointly and competitively solicit and procure proposals for offshore wind energy transmission. Independent transmission has the potential benefit of minimizing impact of fisheries, optimizing the transmission grid and reducing costs. These potential benefits must be weighed against potential cost to construct the network and potential risk of stranded costs if the system is not operational when required by generation assets.*
>
> *In order for a transmission solution to be open to wider competition and for the benefits to be evaluated effectively, a transmission only solicitation would need to be separate from the energy generation and would need to be completed before the offshore wind generation is solicited.*
>
> *For example, following a one-time transmission only solicitation, a preferred option for independent transmission could be contingently selected. In subsequent solicitations for offshore wind generation, bidders would be required to pair their generation with both a generator lead line construction and the preferred independent solution from the previous one-time solicitation for independent transmission. This would allow evaluation of two options for each offshore wind generation bid: one with a generator-lead line and one with the independent transmission option. Then the most beneficial option to ratepayers could be selected.*

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[15] DOER. May 2019. *Offshore Wind Study*. Prepared with support from Levitan & Associates. https://www.mass.gov/files/documents/2019/05/31/OSW%20Study%20-%20Final.pdf.

The report recommended (page 16) that "DOER should conduct a technical conference to assess whether and/or when a solicitation for independent transmission should occur and if necessary, issue a separate contingent solicitation for independent transmission in 2020 prior to additional solicitations for offshore wind." The recommended technical conference was held on March 4, 2020. A procurement schedule on page 17 of the DOER report shows a possible transmission solicitation process in mid-2020 through late 2021. The next offshore wind solicitation (#3) would occur in early 2022 through 2023.

As previously stated, the relative proximity of Lease Area OCS-A-0501 to shore, coupled with the orderly use of existing 115-kV and 345-kV interconnection points in the mid-Cape area, will allow Vineyard Wind to connect multiple projects using a common cable corridor. Vineyard Wind submits that this approach ensures reliability and minimizes cost and temporary impacts from cable installation while enabling the developer to maintain control of transmission routing, permitting, construction, and commissioning schedule. Given this combination of geography, grid access and timing, Vineyard Wind has achieved a solution that looks much like "shared transmission" but with none of the attendant cost, schedule, risk, and environmental impact drawbacks discussed above. The debate on the merits of shared or networked transmission will continue into the future. Regardless of the outcome of that debate, shared transmission is neither necessary nor advantageous for the Vineyard Wind Connector 2.

3.2 Conclusion

The Project's analysis, as presented herein and in Sections 4.0 and 5.0, demonstrates that the proposed Project will best address the identified need with a minimum of environmental and construction impacts at the lowest possible cost. In reaching this conclusion, the Proponent evaluated No-Build and related alternatives as well as transmission alternatives. Since the Project is in direct response to Commonwealth and regional goals for offshore wind generation (see Section 1.2), there are no realistic alternatives to a transmission line connecting offshore wind generation to the onshore electrical grid (including non-transmission alternatives such as energy efficiency) that are suitable.

Furthermore, the Company concluded that given the Commonwealth's and regional goals for offshore wind generation, coupled with reliability needs stemming from the loss and expected loss of base load generation, the No-Build and related alternatives could be dismissed from consideration.

The cable technology alternatives considered were design-related decisions that, as articulated in Section 3.1.3, dictated selection of the proposed transmission infrastructure.

As a result of this analysis, proposed transmission infrastructure was advanced to the transmission routing analysis presented in Section 4.0. A more detailed comparison of the Preferred and Noticed Alterative routes is presented in Section 5.0.

Section 4.0

Route Selection

4.0 ROUTE SELECTION

As discussed in Section 2.0, Vineyard Wind is proposing a wind energy generation facility known as Park City Wind in the central portion of Lease Area OCS-A 0501. This approximately 800-MW offshore wind energy generation project necessarily requires construction of export cables through federal and state waters and onshore to a suitable interconnection point on the electrical grid. The Massachusetts-jurisdictional portion of the transmission system is referred to as the Vineyard Wind Connector 2.

This Section describes the process by which the Company identified and evaluated potential routes, leading to selection of the Preferred Route and a Noticed Alternative.

The objective of the Company's routing analysis was to identify a technically feasible and cost-effective design capable of delivering approximately 800 MW from the offshore wind energy generation project in federal waters to a suitable onshore interconnection point. Additional consideration was given to the potential impacts the candidate solutions may have on the developed and natural environment. In conducting the routing analysis, the Company followed the guidelines below:

- ♦ Comply with all applicable statutory requirements, regulations, and state and federal siting agency policies;
- ♦ Achieve a reliable, operable, and cost-effective solution;
- ♦ Maximize the reasonable, practical, and feasible use of existing linear corridors (e.g., utility ROW, roadway layout);
- ♦ Minimize/avoid the need to acquire property rights;
- ♦ Maximize the potential for direct routing options over circuitous routes; and
- ♦ Minimize/avoid routes requiring complex or expensive engineering and construction techniques.

For a Project of this complexity, there are interrelated aspects of the routing, each of which is important, that must work together to achieve the Project purpose. The offshore route, landfall site, onshore route, substation site, and interconnection location are all critical aspects of the overall routing, and each must be feasible from technical, environmental, legal/permitting, and municipal support perspectives. Therefore, none of these aspects of routing can have a fatal flaw, and the ultimate selection is a balancing of all of the factors discussed in this Analysis.

4.1 Overview of Route Selection Process

The siting methodology involved the following steps:

- ♦ Identify a study area for route selection;

- Assess potential routes that would connect the offshore wind energy generation facility to possible interconnection points, as well as potential locations for a new substation for converting the export cable voltage (220 kV or 275 kV) to either 115 kV or 345 kV;

- Analyze each alternative route based on length, environmental impact, constructability, permitting considerations, reliability, and cost; and

- Perform a comparative analysis based on these factors.

4.2 Project Study Area

To ensure that all reasonable options were considered, the Company delineated a Study Area that encompassed all of southeastern Massachusetts as well as eastern Rhode Island. Features within the study area of particular importance, all of which are included on the Study Area map provided as Figure 4-1, include:

- Locations of possible interconnection points to the electrical grid;

- Existing transmission infrastructure and its capacity for accommodating the approximately 800-MW Project; and

- Existing offshore cables and Vineyard Wind's previously surveyed OECC for its first 800-MW project (Vineyard Wind 1/Vineyard Wind Connector 1) from the northern part of Lease Area OCS-A 0501.

Within this Project Study Area, the Company defined a wide range of potential routing options starting at the offshore wind energy generation facility in the central portion of Lease Area OCS-A 0501 and the northern part of the SWDA. At its nearest point, the SWDA is just over 19 miles (31 km) from the southwest corner of Martha's Vineyard and approximately 23 miles (38 km) from Nantucket; the SWDA is approximately 41 miles (66 km) south of the Cape Cod mainland. As shown on Figure 4-2, Vineyard Wind considered offshore routing options through Narragansett Bay, Buzzards Bay, Nantucket Sound, and Cape Cod Bay – including the OECC identified for the Vineyard Wind Connector 1, which is a fully surveyed corridor passing between Martha's Vineyard and Nantucket on a relatively direct path to landfall in Barnstable on Cape Cod – and encompassed landfall sites ranging from municipal beach parking lots to unimproved ways and other developed and undeveloped areas. The potential export cable routes also encompassed possible interconnection locations at several substations in southeastern Massachusetts as well as Rhode Island (discussed in greater detail in Section 4.3.2).

The wide range of routing options included routes ranging in length from approximately 45 to 135 miles (see Table 4-1).

Table 4-1 Universe of Routing Options (all lengths approximate)

Route #	Interconnection Point	Approximate Export Cable Length					
		Offshore[1]		Onshore		Total	
		miles	km	miles	km	miles	km
1	Kent County Substation (National Grid), RI	87	140	3	*5*	*90*	*145*
2	Brayton Point	75	121	<1	*<1.6*	*76*	*122*
3	Pine Street Substation, New Bedford	71	114	<1	*<1.6*	*72*	*115*
4	Canal Station, via Cape Cod Canal	86	138	<1	*<1.6*	*87*	*140*
5	Canal Station, via onshore	80	129	7	*11*	*87*	*140*
6	Falmouth Tap Switching Station, via Buzzards Bay	67	108	4	*6*	*71*	*114*
7	Bourne Substation, via Buzzards Bay	74	119	10	*16*	*84*	*135*
8	Falmouth Substation/Falmouth Tap	53	85	2	*3*	*55*	*88*
9	Mashpee Substation or Hatchville Substation	51	82	14	*23*	*65*	*105*
10/10A	West Barnstable Substation or Barnstable Switching Station	58	93	5	*8*	*63*	*101*
11	Barnstable, via east end of Nantucket	72	116	6	*10*	*78*	*126*
12	Canal Station, via ocean route	144	232	<1	*<1.6*	*145*	*233*
13	Pilgrim Station, via ocean route	136	219	<1	*<1.6*	*137*	*220*

4.3 Initial Route Concepts

The Company assessed the "universe" of routes identified in Section 4.2 and performed an initial assessment of route concepts to eliminate routes with excessive length or where potential interconnection points lacked sufficient capacity to accommodate the Project. The analysis below explains this process and identifies routes carried forward to scoring as "candidate routes".

4.3.1 Route Concepts Eliminated for Excessive Length

The Company screened the wide range of routing options identified in Section 4.2 in several stages. As a first step, using current technology Project engineers identified roughly 71 miles (115 km) as the approximate maximum length of 220-kV or 275-kV AC export cable that could be built without the potential for mid-point reactive compensation and special switching devices. The actual maximum distance is not a definitive value, as it depends on the precise technology used, such as voltage level and cable design; Project-specific variables such as cable design, cable loading, power costs, technical requirements established by the connecting grid, and others may influence the distance at which midpoint reactive compensation is required. It is also a question of the targeted capacity of the cable, as increasing the distance of transmission lowers the capacity of the cable. Mid-point reactive compensation and special switching devices would entail an additional offshore electrical platform to house the necessary equipment and represent a considerable incremental capital cost to the Project (as well as life of Project operations and maintenance costs). In addition, if the associated equipment needed to be installed outside

[1] 1 mile = 0.87 nautical miles. Offshore distances do not include allowance for micro-siting.

Vineyard Wind's lease area, it could raise potential property rights concerns. An additional offshore platform outside of the lease area would also increase environmental impacts because of the need to install additional infrastructure offshore. Avoiding the need for this additional infrastructure also avoids the navigational, safety, and visual impact concerns it could create.

Moreover, for a cable length approaching or exceeding 71 miles (115 km), the capital cost of the cable itself is already far greater than the cost of shorter cable options as discussed herein, and the risk of requiring mid-point reactive compensation and incurring the additional related costs adds significantly to this cost difference. In the absence of compelling grid interconnection or environmental reasons to consider a longer route, it is the Company's opinion that an approximate maximum 71-mile (115-km) cable length is a useful and valid screening tool. In the case of the proposed Project, there are favorable interconnection locations within these technological boundaries that would not impose the significant additional costs and potential environmental impacts.

Accordingly, the first step in screening initial route concepts was to eliminate any option from the initial route concepts that significantly exceeded 71 miles (115 km) in total length; the options eliminated on the basis of excessive length are shaded in light gray in Table 4-1.

4.3.2 Potential Interconnection Points

The Company also assessed the viability of various interconnection points within feasible distance to the SWDA, as identified in Table 4-1, based on the capacity of existing transmission infrastructure. Results from this assessment, described below, indicate that after consideration of cable length and the viability of interconnection points, the West Barnstable Substation is the most viable interconnection point for the Project.

4.3.2.1 Falmouth Substation

Eversource has indicated that the two 115-kV circuits at Falmouth Substation are limited in capacity, and would not be able to accommodate the full Project capacity. To meet the ISO-NE interconnection criteria, this Falmouth interconnection point would necessitate significant transmission system reinforcements, potentially including a new transmission line. Since the Falmouth Substation could likely accommodate only up to approximately 360 MW without significant upgrades to the transmission system, this potential interconnection point was eliminated from further consideration.

4.3.2.2 Mashpee Substation

The Mashpee Station is a 115-kV distribution tap located on a single 115-kV line that runs between Falmouth and West Barnstable. Similar to the Falmouth Substation discussed above, this interconnection point would necessitate significant transmission system reinforcements. The single existing 115-kV line from Mashpee to West Barnstable does not have sufficient capacity to accommodate 800 MW. Typically, two properly sized 115-kV lines would be needed to handle 800 MW. Of equal importance, a single line carrying the full capacity of the Vineyard Wind

Connector 2 would not be acceptable from a Project reliability perspective. In the judgment of the Company, this location would not be able to support the Project's interconnection without adding another transmission circuit to West Barnstable (more than 15 miles to northeast). Therefore, this potential interconnection point was eliminated from further consideration.

4.3.2.3 Hatchville Substation

The Hatchville Substation is located in the Town of Falmouth, approximately two miles east of the Falmouth Tap and about four miles west of the Mashpee Substation. More specifically, the Hatchville Substation is located on a 1.85-acre parcel along Eversource's ROW #345, at a point where the ROW makes a 90-degree bend. The Hatchville Substation itself is a small tap in a fenced equipment area of approximately 0.7 acres. An interconnection at Hatchville would suffer from the same issues as Mashpee (Section 4.3.2.2), namely a single 115-kV line with insufficient capacity to reliably interconnect the full Project. Primarily for this reason, Hatchville was eliminated from further consideration early in the process. In addition, the existing site is far too small to accommodate the necessary Project substation.

4.3.2.4 Barnstable Switching Station

The Barnstable Switching Station, while currently having the capacity to accommodate the Vineyard Wind Connector 2 with a 115-kV interconnection, will be utilized as the interconnection for the Vineyard Wind Connector 1. That project will bring 800 MW into the Barnstable Switching Station, fully utilizing its available capacity without significant onshore reinforcement. Therefore, this interconnection point was eliminated from further consideration for the Vineyard Wind Connector 2.

4.3.2.5 West Barnstable Substation

Based on an ISO-NE Feasibility Study, the 345-kV West Barnstable Substation has the capacity to accommodate the Vineyard Wind Connector 2 with certain infrastructure improvements at the substation. In addition, the cable route to West Barnstable Substation would be of feasible length. Vineyard Wind has filed an interconnection request (QP700) with ISO-NE for an interconnection at the 345-kV West Barnstable Substation, and the Project is in the final phases of the System Impact Study, which may identify additional transmission system reinforcements.

The 345-kV West Barnstable Substation is located on a 12-acre parcel at the confluence of utility ROW #381 and ROW #342. The substation was originally constructed as part of a series of projects (known as NSTAR's Lower SEMA project) designed to improve reliability on the Cape. The core of the Lower SEMA project was to bring a new 345-kV line across the Cape Cod Canal from the Carver Substation to the West Barnstable Substation. This approximately 13-mile 345-kV line was created by changing the operating voltage on an existing line from 115 kV to 345 kV (the line had been constructed with 345-kV capability), and the West Barnstable Substation serves as the terminus of the 345-kV line (Line 399). The northern part of the same parcel contains the 115-kV Oak Street Substation.

The ISO-NE Feasibility Study for the Vineyard Wind Connector 2's planned 345-kV interconnection at the West Barnstable Substation determined bus work, feeders, a new autotransformer, and breaker bay will be required to accommodate the Project (see Section 1.3.5). It is expected that the work at the West Barnstable Substation will be designed and constructed by Eversource, but paid for by Vineyard Wind.

In November 2019, Eversource filed a Petition with the EFSB to construct the Mid Cape Project (EFSB 19-06), one of the final elements in a concerted effort to improve reliability on Cape Cod. The Mid Cape Project is a new 115-kV line on ROW #342 from the Bourne Switch to the West Barnstable Substation, and one variant proposed by Eversource was to build the new 115-kV line to 345-kV specifications. If required by system impact studies or other reasons, the line can be upgraded to 345 kV operation without physical modifications to the line itself, which would be a further advantage of interconnecting the Vineyard Wind Connector 2 at the West Barnstable Substation.

4.3.2.6 Pine Street Substation

Under existing conditions, the Pine Street Substation in New Bedford could accommodate up to 400 MW in capacity, but it could not accommodate more. Use of Pine Street to connect a full 800 MW, would, in the judgement of the Company's engineers, require substantial new transmission from Pine Street to other portions of the electrical grid. Moreover, the cable route to Pine Street Substation would be approximately 72 miles (115 km) in length, approximately 9 miles (14 km) longer than the route to a connection at West Barnstable Substation. This would increase environmental impacts during cable installation and would substantially increase costs as well, including costs for upgrades at Pine Street and its connecting 115-kV pipe-type cables. Accordingly, the Company did not carry a Pine Street interconnection further into the route selection process.

4.3.2.7 Brayton Point

Brayton Point is the site of a recently retired multi-unit coal/oil fired, steam cycle base load 1,600-MW power plant located on an approximately 300-acre site in the Town of Somerset on Mount Hope Bay and the Taunton River. The National Grid-owned substation which served Brayton Point is connected to the bulk power grid by two 345-kV lines which run north to Medway as well as a number of 115-kV lines running to the north, east, south, and west. With its existing grid interconnection, waterfront location, and prior major energy infrastructure, Brayton Point will likely be a part of the Commonwealth's offshore wind energy future. In fact, Baystate Wind has filed an interconnection request at Brayton Point, as has Anbaric as part of its Massachusetts OceanGrid project. Given the projects ahead of Vineyard Wind in the ISO-NE queue, it is unlikely that Brayton Point would have the capacity to accommodate the Vineyard Wind Connector 2.

At 76 miles (122 km) long, the route to Brayton Point is approximately 13 miles (21 km) longer than the route to Barnstable. This distance to Brayton Point assumes that cables are routed on the east side of Aquidneck Island (Sakonnet River) and traverse the narrow Sakonnet channel between the north end of Aquidneck and the mainland (Tiverton, RI area). The Sakonnet channel is crossed by both power cables and pipelines as well as a bridge. There are also two marked pipeline crossing areas further south along Aquidneck Island. A route on the west side of Aquidneck would add some distance to the 76-mile (122-km) preliminary route.

Aside from considerations of distance, Brayton Point poses other challenges for Vineyard Wind. The route to Brayton Point traverses a 20-mile stretch of Rhode Island waters, and cable installation in Rhode Island waters would require a suite of Rhode Island reviews and approvals, adding complexity to an already complex undertaking. Further, the route would require cable installation through nearly the full length of Mount Hope Bay. Mount Hope Bay is traversed by the dredged Taunton River Federal Navigation Channel (serving Brayton Point, Fall River, the former Montaup Station, and the former Shell marine fuels terminal, among others). Cable installation would need to cross the navigation channel at some point, and the installation would need to proceed through some areas of historic contamination and fine-grained sediments, likely leading to significant sediment dispersion concerns.

4.3.2.8 Conclusion/Summary (Interconnection Points)

Table 4-2 compares the various potential interconnection points considered for the Project and identifies West Barnstable Substation as the proposed interconnection point.

Table 4-2 Summary comparison of potential interconnection points for Vineyard Wind

	Falmouth	*Mashpee*	*Hatchville*	*Barnstable Switch*	*West Barnstable*	*Pine Street*	*Brayton Point*
Sufficient capacity	No	No	No	No	Yes	No	No
Cable route of acceptable length?	Yes	Yes	Yes	Yes	Yes	Yes	No
Retained for routing analysis?	No	No	No	No	**YES**	No	No

4.3.3 Landfall Sites

The initial routing assessment described above demonstrated that the West Barnstable Substation was the most favorable interconnection point for the Project. The next step in the initial route screening was to identify potential landfall sites where the transition from offshore cabling to onshore cabling could occur. Criteria used to identify potential landfall sites in this initial step included:

- Ideally, a beach-front public parking area or similar available land able to accommodate the offshore-to-onshore transition and the necessary transition vault(s);
- Clear egress onto a road of sufficient width to accommodate the duct bank;

- Enough space to accommodate the entry pit and drilling equipment associated with HDD;
- Ideally, sufficient water depths (of 10 to 20 feet) within approximately 3,000 feet offshore to accommodate support barges at the HDD exit location;
- Surrounding land uses, if residential, characterized as seasonal, rather than year-round, to avoid and minimize construction-period impacts to the public are preferred;
- Environmental considerations avoided and minimized to the extent practicable such as impacts to wetland resource areas and mapped eelgrass habitat; and
- Minimize onshore route length.

Initially, more than 50 possible landfall sites were identified along the south coast of Cape Cod and on the east coast of Buzzards Bay (see Figure 4-3). These initial landfall sites were reviewed in the context of cable length limitations and proximity to the potential grid interconnection points identified in Section 4.3.2. They were then evaluated and graded based on the availability of adequate workspace, adjacent environmental resources, and sufficient inland egress to a suitable grid interconnection point. Nineteen of the landfall sites were disqualified because they lacked sufficient workspace in which to stage construction operations or conflicted with private land ownership; nineteen others were designated as “less preferable” due to potential impacts to environmental resources or poor egress (i.e., potentially inadequate road width, or routing through densely developed business districts or year-around residential areas).[2] The remaining twelve landfall sites were graded as “promising”. This preliminary landfall site evaluation is summarized in Table 4-3.

Table 4-3 Preliminary Cable Landfall Site Evaluation (see corresponding Figure 4-3)

ID	Name	Town	Grade	Comments
1	Bell Ave	Bourne	Promising	Good egress on canal service road. Assumed grid interconnection at Canal Station.
2	Jeffersons Cove	Bourne	Disqualified	Insufficient space for HDD setup.
3	Causeway	Bourne	Disqualified	Insufficient workspace. Poor egress through dense residential area.
4	Chester Park	Bourne	Less preferable	Limited workspace within public recreation area. Potential conflicts with moorings.

2 For example, Kalmus Beach in Barnstable, where one of the existing Nantucket cables comes ashore, was initially considered as a potential landfall site but was eliminated from consideration for multiple reasons. First, an onshore route would have passed directly through downtown Hyannis, affecting many businesses in a high-traffic area. At a March 21, 2017 meeting with Barnstable town officials, the Town Manager, Mark Ells, strongly advised that the Project avoid this area because of congested buried utilities. Secondly, with the existing Nantucket Cable coming ashore at this location and its associated buried duct bank already in place, this location would not contain sufficient space for the proposed infrastructure for the Vineyard Wind Connector 2. For these reasons, the Kalmus Beach Landfall Site was eliminated after its initial consideration.

Table 4-3 Preliminary Cable Landfall Site Evaluation (see corresponding Figure 4-3) (Continued)

ID	Name	Town	Grade	Comments
5	Monument Beach	Bourne	Less preferable	Good egress, but potential conflicts with town marina and boat moorings.
6	Mashnee Island	Bourne	Disqualified	Insufficient space for HDD setup.
7	Wing's Neck Light	Bourne	Disqualified	Multiple conflicts with private land ownership.
8	Barlows Landing	Bourne	Disqualified	Insufficient space for HDD setup.
9	Patuissett Island	Bourne	Disqualified	Insufficient space for HDD setup.
10	Megansett	Falmouth	Less preferable	Poor egress on narrow streets through densely settled residential area.
11	Old Silver Beach	Falmouth	Less preferable	Egress requires bridge crossing and lengthy onshore transmission route.
12	Chapaquoit Beach	Falmouth	Less preferable	Egress requires bridge crossing through environmentally sensitive area.
13	Woodneck Beach	Falmouth	Less preferable	Poor egress through environmentally sensitive area.
14	Trunk River Lot	Falmouth	Disqualified	Insufficient space for HDD setup.
15	Elm Road Lot	Falmouth	Disqualified	Insufficient space for HDD setup.
16	Mill Road Lot	Falmouth	Promising	Good egress but lengthy onshore transmission route.
17	Surf Drive Lot	Falmouth	Promising	Good egress but lengthy onshore transmission route.
18	Clinton Avenue	Falmouth	Disqualified	Insufficient space for HDD setup.
19	Tides Motel	Falmouth	Promising	Good egress but lengthy onshore transmission route.
20	Falmouth Heights	Falmouth	Promising	Good egress but lengthy onshore transmission route.
21	Bristol Beach	Falmouth	Promising	Fair egress but lengthy onshore transmission route.
22	Maravista	Falmouth	Disqualified	Insufficient space for HDD setup.
23	In Season Resort	Falmouth	Promising	Fair egress but lengthy onshore transmission route.
24	Menauhant	Falmouth	Less preferable	Egress requires multiple bridge crossings through environmentally sensitive area.
25	Southcape West	Mashpee	Less preferable	Poor egress through environmentally sensitive area. Lengthy onshore transmission route.
26	Southcape East	Mashpee	Promising	State owned lands. Good egress, but lengthy onshore transmission route.
27	Popponesset Beach	Mashpee	Disqualified	Insufficient space for HDD setup.
28	Wading Place	Mashpee	Disqualified	Insufficient space for HDD setup.
29	Mashpee River	Mashpee	Disqualified	Inland location with significant impact to wetlands and rare species habitats required.
30	Loop Beach	Barnstable	Less preferable	May have insufficient space for HDD setup.
31	Cotuit Landing	Barnstable	Less preferable	Potential conflicts with moorings and shallow offshore water depths.
32	Prince's Cove	Barnstable	Less preferable	Potential conflicts with moorings and shallow offshore water depths.
33	Dowse's Beach	Barnstable	Less preferable	Less favorable egress, may require a bridge crossing.
34	East Bay Boat Ramp	Barnstable	Less preferable	Potential conflicts with commercial shellfishing and boating interests

Table 4-3 Preliminary Cable Landfall Site Evaluation (see corresponding Figure 4-3) (Continued)

ID	Name	Town	Grade	Comments
35	McCarthy's Landing	Barnstable	Less preferable	Potential impacts to estuarine habitat and possible conflicts with boating interests.
36	Centerville River	Barnstable	Less preferable	Inland location with anticipated impact to estuarine habitat.
37	Craigville Beach	Barnstable	Promising	Egress requires bridge crossing over Centerville River.
38	Covell's Beach	Barnstable	Promising	Egress requires bridge crossing over Centerville River.
39	Hyannisport	Barnstable	Disqualified	Insufficient space for HDD setup.
40	Keyes Beach	Barnstable	Promising	Egress requires routing through Hyannis commercial center
41	Kalmus Beach	Barnstable	Less preferable	Egress route through Hyannis commercial center is already occupied by buried duct bank.
42	Veterans Park	Barnstable	Less preferable	Egress route through Hyannis commercial center is already occupied by buried duct bank.
43	Hyannis Marina	Barnstable	Disqualified	Insufficient space for HDD setup.
44	Bayview Beach	Yarmouth	Less preferable	Egress requires routing past hospital entrance.
45	Grove Street	Yarmouth	Disqualified	Insufficient space for HDD setup.
46	Vernon Street	Yarmouth	Disqualified	Insufficient space for HDD setup.
47	Red Jacket Resort	Yarmouth	Less preferable	Landing site has limited workspace located on private property.
48	Colonial Acres	Yarmouth	Disqualified	Insufficient space for HDD setup.
49	Englewood Beach	Yarmouth	Promising	Potential conflicts with boating and other recreational interests and Lewis Bay impacts.
50	Great Island	Yarmouth	Less preferable	Multiple conflicts with private land ownership. Impacts to rare species habitat.
51	Seagull Beach	Yarmouth	Disqualified	Potential impacts to wide band of eelgrass directly offshore.

As the evaluation of the landfall sites proceeded, the West Barnstable Substation was determined to be the most favorable interconnection point for the Project. This narrowed the analysis of potential landfall sites to the stretch of the south coast of Cape Cod in Barnstable, particularly to the area of the Centerville Harbor bight, to provide the most efficient routing options to the interconnection location. The potential landfall sites identified along this section of coastline are shown on Figure 4-4 and are described below in no particular order.

In the same timeframe, the Company held initial discussions with local officials in the Town of Barnstable to discuss potential landfall sites and likely onshore routes. In this manner, specific guidance from town officials with respect to route selection was considered. Screening level environmental reviews were also conducted as reflected in Table 4-4 by comparing the landfall sites with respect to potential impacts to environmental resources, quality of inland egress, and workspace adequacy while also considering potential impacts related to the inland transmission routes leading to the grid interconnection point. These considerations included impacts to densely-developed inland business districts and residential areas, overall length of required inland transmission, as well as potential impacts to wetlands, stream and creek crossings. As a result of these discussions and reviews, some potential landfall sites and associated routes were eliminated from further consideration, as described below in Sections 4.3.3.3 through 4.3.3.5.

Table 4-4 Summary comparison of potential landfall sites for Vineyard Wind 501S

	Covell's Beach	***Craigville Public Beach***	***East Bay Boat Ramp***	***McCarthy's Landing***	***Centerville River Bridge***
Adequate space for HDD setup[3]	Yes	Yes	No	No	Yes
Clear egress on public roads	Yes	Yes	Yes	No	Yes
Adequate water depth	Yes	Yes	Yes	No	No
Seasonal residential occupancy	Yes	Yes	Yes	Yes	Yes
Environmental sensitivity	Low	Low	Moderate	Moderate	Moderate
Conflicts with boating interests	No	No	Yes	Yes	Yes
Retained for routing analysis?	**Yes**	**Yes**	No	No	No

4.3.3.1 Covell's Beach

This potential landfall site is located at a large paved parking area associated with Covell's Beach, a residents-only public beach that is owned and managed by the Town of Barnstable. The Covell's Beach Landfall Site has adequate staging area and favorable egress with onshore route options available to the proposed substation by way of public streets and/or existing utility ROWs. However, the parking lot at Covell's Beach and the associated egress routes are being utilized for the Vineyard Wind Connector 1, which may create engineering constraints and construction feasibility challenges. Nonetheless, the Covell's Beach Landfall Site is still considered a feasible landfall and was retained for further consideration for the Vineyard Wind Connector 2.

4.3.3.2 Craigville Public Beach

The Craigville Public Beach Landfall Site is located within a 3.5-acre paved parking area associated with a public beach that is owned and managed by the Town of Barnstable. The landfall site is located in the central part of the Centerville Harbor bight in an area where the shoreline is relatively stable. Egress from this landfall site will require crossing the Centerville River, where there is an existing bridge on Craigville Beach Road; possible options for accomplishing this river crossing are described in Section 1.5.1.4. Adjoining land uses include homes along the north side of Craigville Beach Road, a private beach club (Craigville Beach Club) and associated parking to the west, a private bath house and parking to the east (owned by the nearby Christian

[3] Criteria used to identify potential landfall sites included a consideration of whether there would be enough space to accommodate the entry pit and drilling equipment associated with HDD, which would require roughly a half-acre of level ground. This is largely because State agencies have come to consider HDD a standard and preferred methodology for offshore-to-onshore transitions.

Campground), and some open space. The area is most heavily used during the summer season. The Craigville Public Beach Landfall Site has adequate staging area and favorable route options to the proposed substation site. This landfall site has been retained as the preferred landfall site for the Project.

4.3.3.3 East Bay Boat Ramp

This site is located at a boat ramp owned and operated by the Town of Barnstable along the east-facing shore of East Bay (see Figure 4-4). Initial screening revealed that use of this site would require construction within environmentally sensitive areas within East Bay, which has been designated by the Massachusetts DMF as potential shellfish habitat for Quahog *(Mercenaria mercenaria)* and Softshell Clam *(Mya arenia)*. In addition, the entrance to East Bay has been mapped as an area where eelgrass has historically occurred, although this sensitive aquatic plant has not been observed in more recent MassDEP surveys conducted in 2015. The site also lacks sufficient space for HDD staging and operations, and would potentially conflict with boating interests since the ramp would be inaccessible during construction. For these reasons, the East Bay Boat Ramp Landfall Site was eliminated from further consideration in the routing analysis since other, more favorable options were available.

4.3.3.4 McCarthy's Landing

This site is a gravel parking area associated with a public boat ramp owned and operated by the Town of Barnstable located on the north side of the Centerville River approximately one mile upstream of East Bay (see Figure 4-4). DMF has designated this part of the Centerville River as suitable habitat for a variety of commercially important shellfish species including Quahog *(Mercenaria mercenaria)*, American Oyster *(Crassostrea virginica)*, and Softshell Clam *(Mya arenia)*. In addition, the site provides only limited space for HDD staging and would potentially conflict with boating interests since the ramp would be inaccessible during construction. Lastly, the routing of cable within the Centerville River could conflict with navigation since the waterbody requires periodic dredging to maintain adequate depths for vessel passage. For these reasons, McCarthy's Landing was eliminated from further consideration since other, more favorable options were available.

4.3.3.5 Centerville River Bridge

This site is located on the northern approach to the bridge over the Centerville River approximately 1.4 miles upstream of East Bay. As with the McCarthy's Landing site, use of this site would require construction in an environmentally sensitive area with potential impacts to shellfish and other sensitive environmental resources within the Centerville River and East Bay, and could result in potential conflicts with established navigation channels and boating interests, specifically private moorings and dredging operations within the waterway. In addition, the meandering river course was also considered unfavorable for the installation of the offshore export cables. For these reasons, the Centerville River Bridge site was eliminated from further consideration.

4.3.3.6 Conclusion on Landfall Sites

Initial screening was performed on five potential landfall sites within the Town of Barnstable. Three of the five landfall sites (East Bay Boat Ramp, McCarthy's Landing, and Centerville River Bridge) were removed from further consideration. The Craigville Public Beach Landfall Site and Covell's Beach Landfall Site were retained as the proposed landfall sites for the Project.

4.3.4 Sites for the Proposed Substation

As described in Section 1.3.4, the Project will require an onshore substation where the export cable voltage will step up to 345 kV for connecting to the grid at the West Barnstable Substation. Using the general criteria defined below, the Company searched for properties that could potentially accommodate the Project's substation with suitable buffering from residential areas and reasonable proximity to the West Barnstable Substation:

- An area of at least five acres;
- Suitable surrounding land uses;
- Suitable site topography and existing conditions;
- Availability of real estate; and
- Site access.

Four potential sites for the Project's onshore substation were identified and evaluated, all of which are located in the Town of Barnstable. These potential sites for the onshore substation are described below.

4.3.4.1 Clay Hill Parcels, off Oak Street

This site consists of two separate parcels in private ownership with a total area of approximately 14.7 acres located in a remote area approximately ¼ mile west of the West Barnstable Substation. The site has frontage on an unnamed private way that provides access to a Fire Tower, and it also has direct on-site access to utility ROW #342.

While having sufficient acreage for the Project's substation, the ability to establish rights to access the site by way of the unnamed private way is uncertain. In addition, the site's hilly topography would require significant grading that may further reduce the ability to provide an effective buffer for an abutting residential property. For these reasons, this site was eliminated from further consideration due to the presence of another, more favorable option.

4.3.4.2 Eversource Parcel, 661 Oak Street

This site is an undeveloped wooded parcel owned by Eversource at 661 Oak Street, directly west of the West Barnstable Substation. It has a total area of approximately 5.3 acres with direct frontage on Oak Street and on-site access to utility ROW #342 and the West Barnstable Substation property. At this size, the site could potentially accommodate an approximately 800-MW GIS substation.

The site's topography is favorable for development, and the location adjacent to an existing substation is considered an advantage in terms of land use consistency. However, two private residences are direct abutters to the west, and there is very limited space to provide adequate buffering/screening from a new substation. As a result, the two adjacent properties in addition to the Eversource property would need to be acquired. Due to this level of complexity and risk, this site was deemed inferior to other potential substation options and was eliminated from further consideration.

4.3.4.3 Previously Developed Commercial Property, 8 Shootflying Hill Road

This approximately 6.7-acre commercial property is located approximately 0.7 miles east of the West Barnstable Substation. It has approximately 400 feet of frontage on Shootflying Hill Road and on-site access to utility ROW #343 that leads to the West Barnstable Substation. The northern portion of the site is occupied by an existing motel, and the southern portion is undeveloped wooded upland except for that portion that is located within the utility ROW.

Site topography is favorable for siting the Project substation with minimal visual impact. Although two residences are located directly west of the site, in all other directions the adjacent land is undeveloped. The Company has secured an option to purchase the site, and thus has site control. The site is the preferred location for the proposed substation because of its relatively remote location and ease of access from major roadways.

4.3.4.4 MassDOT Parcel, 15 Shootflying Hill Road

This site consists of approximately eight acres of undeveloped wooded land owned by MassDOT at 15 Shootflying Hill Road and is the abutting property directly east of the proposed substation site described in Section 4.3.4.3. It is located just south of the Route 6/Route132 interchange and is approximately one mile east of the West Barnstable Substation as measured along the utility ROW. The site also has direct frontage on both Shootflying Hill Road and utility ROW #343. However, the process of acquiring property from a state agency is complex, and the timeline for establishing ownership over this parcel is considered uncertain. For this reason, the MassDOT site is regarded in principal as a good location for the proposed substation but inferior to the preferred site.

4.3.4.5 Conclusion

In summer 2019, the Company engaged the owners of the commercial property at 8 Shootflying Hill Road (described in Section 4.3.4.3), who expressed an interest in transferring ownership of the property to Vineyard Wind. The Company has secured an option to purchase the site, and thus has site control. Given the favorable characteristics of the parcel, including its size, surrounding land uses, access and egress, and the favorable reaction of the landowner, the previously developed commercial property at 8 Shootflying Hill Road is the Project's preferred substation location.

4.3.5 Onshore Routing

Using the Craigville Public Beach Landfall Site and Covell's Beach Landfall Site described in Section 4.3.3, the Company initially considered various options for onshore routes that would connect either landfall site to the interconnection location at the 345-kV West Barnstable Substation. Once the proposed onshore substation location at 8 Shootflying Hill Road was identified and positive communications with the owners were initiated, the onshore routing effort became more focused on routes between the two landfall sites and the preferred substation site and interconnection location.

Initial screening criteria considered for onshore routing from either landfall site to the proposed substation location and ultimately the West Barnstable Substation included:

- Use of public roadway layouts, other public ROWs, and/or existing utility ROWs;
- Sufficient road width to accommodate the cable duct bank;
- Subsurface utility density;
- Major roadway crossings/traffic impacts;
- Avoidance of busy commercial centers;
- Avoidance of dense residential areas; and
- Avoidance of sensitive receptors (e.g., hospitals).

By applying these criteria, the Company identified several potential onshore routes from the Craigville Public Beach Landfall Site or Covell's Beach Landfall Site to the proposed interconnection location at the West Barnstable Substation. Because of the location of the proposed substation and interconnection location, the Project's onshore routing has two distinct components: (1) transmission routes, which connect the landfall site to the proposed substation site; and (2) grid interconnection routes, which connect the proposed substation site to the West Barnstable Substation. Routing options for both types of onshore routes were evaluated independently. All potential onshore routes identified were further evaluated in terms of environmental sensitivity and construction feasibility, resulting in a set of "Candidate Routes" considered potentially viable for the Project's proposed onshore export cables, which were advanced for further analysis and comparison, as described below. Figure 4-5 identifies all onshore routes considered during the routing analysis; Candidate Routes carried forward for scoring evaluation are shown in green, while routes evaluated but eliminated from further consideration are shown in red.

4.3.5.1 Routes Evaluated and Eliminated

The identified onshore export cable routes, including both transmission routes and grid interconnection routes, were next subjected to initial screening using the criteria listed in the preceding section. As shown in Figure 4-5, a wide universe of potential onshore routes was identified using the existing roadway network and utility ROWs. This universe consisted of approximately a dozen potential onshore transmission routes and six grid interconnection routes.

Preliminary screening provided a basis for deferring most of these routes from further consideration due to clearly superior alternatives. Several were eliminated due to concerns related to construction feasibility and potential impacts to densely developed commercial and residential areas. One such route that was eliminated prior to scoring would have required construction along a busy commercial section of Route 28 (see Figure 4-5). Several other transmission routes originating at Covell's Beach that would require crossing or co-locating within the same roadway segments as the duct bank for the Vineyard Wind Connector 1 were eliminated due to construction feasibility and system engineering concerns. Other routes were eliminated to avoid working in very narrow streets within the Craigville Historic District or Wianno Historic District. One deferred route would have required construction over a private road with insufficient space for construction, and another would have required significant clearing of the wooded buffer of a utility ROW through a residential area.

The Company also initially considered a grid interconnection route between the proposed substation and the West Barnstable Substation along Route 6 and discussed this possibility with MassDOT. Following those discussions, a routing option following parallel to Route 6 was eliminated from consideration. MassDOT's Utility Accommodation Policy on State Highway Right of Way (May 2013) (the Policy) regulates utility facilities along, across, over, under, or on the ROW of all major highways and other transportation facilities and properties owned or under the jurisdiction of MassDOT, including the fully controlled access highway Route 6. Longitudinal installations of utilities within fully controlled access highways are specifically prohibited in Chapter 6, Section B(4)(a). Chapter 6, Section B(4)(a) further provides that exceptions may be allowed when there are no alternatives as specified in Chapter 8.C, but "[w]hen such installations are allowed… the utility facility shall not be installed or serviced by direct access from the fully controlled access roadways or connecting ramps." Accordingly, the Project would need to be sited between the edge of the paved way and the boundary of the state highway layout, with access entirely separate from the highway and its interchanges. Even assuming that MassDOT would grant an exception from the Policy, this would necessitate greater land disturbance and would likely require the acquisition of easements across private property to maintain access to the Project in perpetuity. In addition, it is far from certain that MassDOT would grant an exception from the Policy, since the Project has clear viable alternatives to using Route 6.

The onshore transmission routes and grid interconnection routes evaluated and advanced to scoring are described in Sections 4.3.5.2 and 4.3.5.3, respectively.

4.3.5.2 Onshore Transmission Cable Routes Evaluated and Advanced to Scoring

The Company identified and evaluated two onshore transmission routes, identified as "T1" and "T2," from the Craigville Public Beach Landfall Site to the proposed substation site that were found to be clearly superior to the other identified routes and were therefore advanced to the scoring phase of the analysis. Variants, or "workarounds", for these routes were also identified and evaluated, including use of Covell's Beach as an alternative landfall site for either Candidate Route. These Candidate Routes advanced into scoring are summarized below (and in Section 1.5); they are also shown in the context of final results of the routing analysis in Figure 1-2. The following section provides a basic description of the routes. The routes are scored and compared in more detail in Sections 4.4 and 4.5.

<u>*4.3.5.2.1 T1: Shootflying Hill Road Route from Landfall to Substation Site*</u>

As shown on Figure 1-2, route T1 (labeled as the Preferred Route for reasons described in Section 4.5.1) begins at the Craigville Public Beach Landfall Site and proceeds generally north on Craigville Beach Road for approximately 0.5 miles through moderate-density residential areas, then continues north on Main Street for approximately 0.5 miles through more developed mixed residential and commercial areas. Continuing north on Old Stage Road in Centerville Village for approximately 0.7 miles through mixed residential and commercial areas, the route passes through the Centerville Historic District. The route then crosses Route 28 and follows Shootflying Hill Road for approximately 2.1 miles through moderate-density residential areas before turning southeast onto ROW #343 for the final approximately 0.2 miles to the proposed Project substation.

The Craigville Beach Road segment includes an existing two-lane bridge over the Centerville River approximately 0.24 miles north of the landfall site. The Centerville River and methodologies for completing this crossing are discussed in greater detail in Section 1.5.1.4.

The total length of Route T1 is approximately 4.0 miles, and the route is almost entirely within public roadway layouts except for possibly the Centerville River crossing as well as the final 0.2 miles within ROW #343.

The Company is also considering three variants of Candidate Route T1 (see Figure 1-2):

- Variant 1 (Covell's Beach Landfall Site) provides an alternative landfall option at the Covell's Beach parking lot located approximately 0.4 miles east of Craigville Public Beach. The Town-owned paved parking lot at Covell's Beach is being utilized as the landfall site for the Vineyard Wind Connector 1 and through the permitting of that project was proven as an acceptable landfall location. For this reason, it is presented as a variant to T1 that could be utilized in case unforeseen challenges arise pertaining to the Craigville Public Beach Landfall Site. The Company would only expect to use this variant should it prove infeasible to make landfall at the Craigville Public Beach parking lot.

- Variant 2 (South Main Street) diverges from T1 at the intersection of Craigville Beach Road with South Main Street, following South Main Street eastward to Main Street, Mothers Park Road, Phinneys Lane, and Great Marsh Road. The variant then rejoins T1 north of Route 28 at Shootflying Hill Road. This variant is proposed as a means of avoiding the Centerville Historic District; however, construction through the historic district is feasible and this variant would only be utilized if the more direct route through the Historic District proves problematic. As described in Section 1.5.1.1.2, the South Main Street variant is approximately 1.2 miles longer than T1, with a total length of 5.2 miles, and is located almost entirely within existing roadway layouts except for possibly the Centerville River crossing as well as the final approximately 1,000 feet (0.2 miles) within ROW #343. However, the additional 1.2 miles in length does not offer any advantages except for avoiding the historic district, while in fact construction through the historic district is not only feasible but could even be beneficial if Project construction is coordinated with the Town of Barnstable's plans to install sewer infrastructure. Furthermore, this variant would pass two additional sensitive receptors relative to the Preferred Route (6 vs. 4) and would potentially add two sharp bends to the route (see Figure 1-2).

- Variant 3 (Northern Substation Access) is essentially the same length as T1, but provides an alternative for accessing the proposed substation site from the north directly from Shootflying Hill Road rather than from the south off of ROW #343. As described in Section 1.5.1.1.3, this variant is proposed as an alternative if it is not possible to use existing utility ROW.

4.3.5.2.2 T2: Oak Street Route from Landfall to Substation Site

As shown on Figure 1-2, route T2 (labeled as the Noticed Alternative) begins at the Craigville Public Beach Landfall Site and proceeds northerly on Craigville Beach Road for 0.5 miles. At the intersection between Craigville Beach Road and South Main Street, T2 essentially follows Variant 1 to route T1, continuing northeasterly on South Main Street for approximately 0.7 miles, turning sharply west on Main Street for approximately 0.4 miles to Mothers Park Road where it turns briefly to the north for approximately 0.1 miles to join Phinneys Lane, and then continues northeast on Phinneys Lane for approximately 0.4 miles, crossing Route 28 and turning west on Great Marsh Road. T2 follows Great Marsh Road for approximately 0.9 miles, crossing Shootflying Hill Road and ultimately turning northward onto Old Stage Road for approximately 1.4 miles to Oak Street, where it turns northeast and continues approximately 0.9 miles to Service Road. The route then follows Service Road for approximately 0.8 miles to Shootflying Hill Road, which it follows the remaining approximately 0.1 miles to the proposed substation.

The total length of Route T2, which is almost entirely within public roadway layouts except for possibly the Centerville River crossing, is approximately 6.1 miles.

The Company is also considering two variants of Candidate Route T2 (see Figure 1-2):

- Variant 1 (Covell's Beach Landfall Site) provides an alternative landfall option at the Covell's Beach parking lot located approximately 0.4 miles east of Craigville Public Beach, and the Company would only expect to use this variant should it prove infeasible to make landfall at the Craigville Public Beach parking lot. The Town-owned paved parking lot at Covell's Beach is being utilized as the landfall site for Vineyard Wind 1 and through the permitting of that project was proven as an acceptable landfall location. For this reason, it is presented as a variant to the preferred transmission route that could be utilized in case unforeseen challenges arise pertaining to the Craigville Public Beach Landfall Site (see Section 1.5.1.2.1).

- Variant 2 (ROW #345) shortens the route by approximately 0.7 miles by utilizing approximately 1.6 miles of utility ROW #345 between Old Stage Road and the proposed substation site, accessing the proposed substation site from the south (see Section 1.5.1.2.2). At a total length of approximately 5.4 miles, approximately 3.8 miles would be within existing roadway layouts while approximately 1.6 miles would follow the existing transmission ROW #345 and ROW #343.

4.3.5.2.3 Conclusion

Onshore transmission routes T1 and T2, along with their variants, are compared through the scoring analysis described in Sections 4.4 and 4.5.

4.3.5.3 Potential Grid Interconnection Routes Advanced to Scoring

The Company initially identified six grid interconnection routes between the proposed substation site and the Project's interconnection location at the 345-kV West Barnstable Substation and evaluated them through preliminary screening (see Section 4.5.2 and Figure 4-5). That preliminary screening included input from MassDOT regarding the feasibility of longitudinal routing along Route 6, which resulted in the elimination of that potential route. The remaining routes, which were clearly superior, were therefore advanced to the scoring phase of the analysis. These "Candidate Routes" advanced into scoring are summarized below (and are described in Section 1.5); they are also shown in the context of final results of the routing analysis in Figure 1-3. Ultimately, three of these five routes were classified as variants, and two routes were carried forward as base routes, identified as "G1" and "G2."

4.3.5.3.1 G1: ROW #343 to ROW #381

G1 follows three short sections of existing utility ROW westward from the Project substation (see Figure 1-3). The route follows ROW #343 for less than 0.1 miles, then ROW #345 for approximately 0.5 miles, finishing on ROW #381 for less than 0.2 miles, where it crosses Route 6 and enters assessor map parcel #214-001, a piece of land located immediately southeast of the West Barnstable Substation that Vineyard Wind is under contract to purchase, before entering the substation site.

The total length of Grid Interconnection Route G1 is approximately 0.7 miles, and the route is located entirely within existing utility ROWs. In January 2020, Vineyard Wind submitted a co-location request to Eversource describing the proposed use of the existing ROWs.

The Company is also considering three variants of Candidate Route G1 (see Figure 1-3):

- Variant 1 (Service Road to ROW #381) greatly shortens the length of existing utility ROW occupied by the duct bank by exiting the northern side of the proposed substation site onto Shootflying Hill Road and Service Road for approximately 0.7 miles before turning north and crossing Route 6 within ROW #381 for less than 0.1 miles. This variant is the same length, approximately 0.7 miles, as Candidate Route G1 and would be utilized if it becomes infeasible to locate the duct bank within the utility ROW (see Section 1.5.2.1.1).

- Variant 2 (ROW #343 to ROW #342) follows the same exit from the proposed substation on ROW #343 as G1 but then follows ROW #342 across Route 6 and enters the West Barnstable Substation at its northeast corner. With a total length of approximately 0.6 miles, this variant is 0.1 miles shorter than Candidate Route G1. This variant would be utilized if it proves infeasible to use ROW #345, ROW #381, or Service Road but Eversource grants the co-location request for ROW #342. As with the Preferred Route, this variant includes a crossing of Route 6, but the crossing is within ROW #342 rather than ROW #381. It is likely the same trenchless crossing method would be used for the Preferred Route or Variant 2, but this more eastern crossing of Route 6 would be more challenging than the crossing proposed for the Preferred Route (see Section 1.5.2.1.2).

- Variant 3 (Service Road to ROW #342) shortens the amount of existing utility ROW occupied by the duct bank by exiting the northern side of the proposed substation site onto Shootflying Hill Road, traveling west for less than 0.1 miles before continuing west on Service Road for approximately 0.1 miles. The variant then enters ROW #342 for approximately 0.4 miles before entering the northeast portion of the West Barnstable Substation. This variant would be utilized if the substation design warrants the 345-kV cables exiting to the north and if it proves infeasible to use ROW #345, ROW #381, and Service Road but Eversource grants the co-location request for ROW #342 (see Section 1.5.2.1.3). With a total distance of approximately 0.6 miles, Variant 3 is 0.1 mile shorter than the Preferred Route.

4.3.5.3.2 G2: All In-Road

G2 provides an all in-road alternative for connecting the proposed substation to the interconnection at West Barnstable Substation. The route follows Shootflying Hill Road eastward from the Project substation for 0.2 miles to Route 132, and then turns northwest to follow Route

132 for 0.9 miles, crossing under Route 6 to Oak Street. The route then turns sharply back to the southwest on Oak Street, which it follows for the remaining 0.7 miles to the West Barnstable Substation.

The total length of G2 is approximately 1.8 miles, and the route is located entirely within public roadway layouts. The proposed duct bank would be installed either beneath pavement or within ten feet of pavement.

4.3.5.3.3 Conclusion

Both grid interconnection routes and associated variants were included in the scored routing assessment, and are described further below.

4.4 Analysis of Candidate Routes for the Onshore Export Cables

As a key part of the process to identify the Preferred Route for the onshore portion of the Project, the Company conducted an environmental scoring analysis for the Candidate Routes identified in Section 4.3.5. The scoring analysis includes 11 individual criteria that compare the relative levels of potential impacts to the developed and natural environments along the Candidate Routes. The other two elements of the process to identify a Preferred Route are a cost analysis and a reliability analysis, which are provided in Sections 4.7 and 4.8, respectively.

The process of identifying a Preferred Route for this Project is unique and complex, since the offshore and onshore segments together form the complete Project route but different considerations apply to the evaluation of offshore and onshore routes. As discussed in Section 4.6, marine survey results, consultations with the Massachusetts Ocean Team, and considerations of constructability have been the primary determining factors for identifying potential offshore cable route within the route concepts identified in Sections 4.3.1 and 4.3.2. The purpose of the scoring analysis described in this section is to identify a Preferred Route for the onshore export cables by evaluating potential routes on the basis of reasonable criteria.

The following sections provide a detailed description of the environmental scoring analysis completed for the Candidate Routes for the onshore export cables.

4.4.1 Criteria and Weight Assessment

The Company evaluated the Candidate Routes using a set of criteria related to both developed and natural environment considerations. These criteria were developed to reflect the defined routing objectives, feedback from state agencies and municipalities, and environmental (developed and natural) considerations. The developed environment criteria, defined in Section 4.4.3.1, compare existing conditions of, and potential impacts to, the developed environment along each Candidate Route. The natural environment criteria, defined in Section 4.4.3.2, compare existing conditions of, and potential impacts to, the natural environment along each Candidate Route. As described below, constructability factors such as subsurface utility density, street width, and property acquisition are reflected in the cost analysis in Section 4.7.

After calculating a raw "score" for each criterion, the Company calculated a ratio score as defined in Table 4-5 to arrive at a relative score for each criterion on each route. The Company then assigned weights to all criteria based on an assessment of the potential for temporary and permanent impacts, as well as the magnitude of disruption from those impacts and regulatory importance for permitting. The weighting scale ranges from 1 to 3, with 1 being the lowest weight and 3 being the highest weight that could be applied to a particular criterion.

The scoring criteria identified by the Company to evaluate and compare each Candidate Route are defined in Table 4-5 and are described in greater detail in Section 4.4.3; weighting of each criterion is defined in Table 4-6.

Table 4-5 Scoring Criteria for the Vineyard Wind Routing Analysis

Criteria	*Purpose*	*Data Source*	*Scoring*	*Ratio Score*
Developed Environment Criteria				
Residential Units	Residents along a Candidate Route could be subject to temporary traffic disruption, noise, and/or dust.	MassGIS, aerial photography, municipal records (including large multi-unit complexes where possible)	# of residential units with parcels directly abutting the Candidate Routes.	Calculated for each Candidate Route based on total # of individual residential units determined for each Candidate Route divided by the highest # of units found along any individual Candidate Route.
Sensitive Receptors (hospitals, schools, police stations, fire stations, elder care facilities, daycares, district courts, religious facilities, and cemeteries)	Sensitive receptors could be subject to temporary traffic disruption, street closings, construction noise, and/or other temporary impacts due to project construction. If a receptor has multiple entrances, the impact can be less pronounced than under single-entrance scenarios.	property assessment data from MassGIS and local online databases, Google and Bing 2015-2016 aerial imagery as well as Google Earth/Google Maps data and imagery	# of sensitive receptors includes the # of parcels directly abutting each Candidate Route (ROW limits or roadway layouts) with a land use type identified as sensitive to the above temporary or permanent impacts.	Calculated by dividing the total # of sensitive receptor parcels for each Candidate Route by the highest # of sensitive receptor parcels found among all the Candidate Routes.
Potential for Traffic Congestion	Installation of a new underground export cables within public roadways could result in temporary increased traffic density and congestion, traffic disruption, street closings.	MassDOT class Characteristics also considered include MassDOT traffic counts where available, and MassGIS to determine # of lanes, # of intersections.	Road segments were assigned a ranking of 1 through 3 based on MassDOT class: Private ways are assigned a "1"; minor roads and major arterials are assigned a "2"; and limited-access and multi-lane highways are assigned a "3". Off-road segments such as utility ROW are assigned a zero. Then calculate the % of the total route each segment commands, multiply that percentage by the segment's score, and add the segment scores to generate a proportional score for the entire Candidate Route.	Overall score calculated for each Candidate Route to provide a comparison of traffic-related impacts along each Candidate Route. The ratio score is calculated by dividing the total proportional score for each Candidate Route by the highest proportional score found among all the Candidate Routes.
Historic Resources (*Archaeology also evaluated separately, below, given the relative regional importance of these resources to undeveloped areas of Cape Cod)*	Could potentially be affected by construction impacts.	GIS data from MHC's Cultural Resource Information System, as well as local historic district inventories	# of historic resources derived from the total number of historic sites directly abutting the Candidate Routes. If the abutting historic resource is an area or district with multiple historic parcels, then the area/district is counted and then the parcels directly abutting the route are counted as well (but non-abutting parcels are not counted). If identified archaeological sites abut the routes, they are also included in the count.	Calculated for each route based on the total # of historic resources determined for each route divided by the highest # of historic resources found along all of the routes.
Archaeological Resources	Archaeological sensitivity is limited to areas that have not been severely disturbed by previous construction activities, utility and access drive maintenance, and dumping, and which appear to maintain natural stratigraphic integrity. "High" sensitivity areas include those areas that contain known archaeological sites and those that have not been markedly affected by previous land-altering activities. Areas of "moderate" archaeological sensitivity primarily include those that are located in environmentally sensitive areas and that have only been minimally impacted by construction.	Archaeological Sensitivity Assessment by archaeology consultant	Extent of potential archaeological areas derived from the length (miles) of "moderate" and "high" sensitivity areas identified within the off-road ROW limits (all of the public roadway segments have been modified by construction of the road itself as well as above and below-ground utilities, and it is unlikely that natural/undisturbed soils or potentially significant archaeological deposits would be located below or immediately adjacent to them).	Calculated for each route based on the total # of miles of archaeologically sensitive areas determined for each route divided by the highest # of miles found along all of the routes.

Table 4-5 Scoring Criteria for the Vineyard Wind Routing Analysis (Continued)

Criteria	Purpose	Data Source	Scoring	Ratio Score
Developed Environment Criteria				
Potential to Encounter Subsurface Contamination	Subsurface contamination could add complexities to construction.	MassGIS AUL and C21E Tier Classified Sites data layers MassDEP Bureau of Waste Site Cleanup (BWSC) online database	Derived from the number of sites on or within 300 feet of each Candidate Route where a documented release of oil and/or hazardous materials occurred, or where past land uses potentially resulting in contamination have been documented in the BWSC database, pursuant to the MCP (310 CMR 40.0000).	Calculated by dividing the total # of documented sites determined for each Candidate Route by the highest # of documented sites found among all the Candidate Routes.
Natural Environment Criteria				
Wetland Resource Areas	This criterion considers wetlands from the landfall site to the onshore interconnection point.	MassGIS, field delineation as needed	Derived from the total length of each Candidate Route passing through state and local jurisdictional wetland resources, including 200-foot riverfront area, and 100-year floodplain (but excluding buffer zones).	Calculated by dividing the length of wetland resource areas each Candidate Route passes through by the longest length of wetland resource areas among all the Candidate Routes.
State-Listed Rare Species Habitat	Construction in utility ROWs could potentially impact protected habitats for state-listed rare species. Underground installation within public roadways assumed to have no impacts on state-listed habitat.	ArcGIS and applying MassGIS mapping of NHESP Priority and Estimated Habitat areas	Derived from acreage of each Candidate Route and associated landfall site or HDD staging area within protected habitat (Priority or Estimated habitats) for state-listed species. To be conservative, a 13-foot-wide trench was assumed for this analysis. If in-road, area in rare species habitat assumed as a zero regardless of NHESP mapping.	Calculated by dividing the total acreage of NHESP Priority and Estimated Habitat for each Candidate Route by the highest measured acreage among all the Candidate Routes.
Public Water Supplies	Public water supply areas considered in this routing analysis include Zone I and Zone II Water Supply Protection Areas.	MassGIS	The length of each route that passes through a public water supply resource area.	Calculated by dividing the total mileage of public water supply resources along each Candidate Route by the highest measured mileage among all the Candidate Routes.
Article 97-Jurisdictional Land	Conservation lands defined as those properties that were primarily protected for conservation purposes (subject to Article 97 jurisdiction) as identified through MassGIS.	MassGIS	Number of distinct areas subject to Article 97 jurisdiction as identified through MassGIS that are crossed by each Candidate Route. All work within roadway layouts is excluded from the count.	Calculated by dividing the total number of areas subject to Article 97 jurisdiction as identified through MassGIS crossed by each Candidate Route by the highest number of areas subject to Article 97 jurisdiction among all the Candidate Routes.
Tree Clearing	Naturally vegetated areas containing a mature forest canopy provide habitat for various wildlife species and can provide visual screening. Routes that minimize tree clearing impacts are preferred.	MassGIS and current aerial photography	Derived from the length of each Candidate Route requiring clearing of forested habitat (expected only along transmission ROWs). This length was generated based on the length following utility ROWs but excluding non-forested areas such as at road crossings, cleared areas, and ROW access roads.	Calculated by dividing the total length of tree clearing required for each Candidate Route by the greatest length of tree clearing required among all the Candidate Routes.

The assignment of weights to individual scoring criteria allows route scoring results to reflect the relative importance of individual evaluation criteria. Although input from local officials was applied in identifying potential routes for the inland transmission, these consultations did not involve direct discussion of weights for scoring criteria. General municipal concerns were taken into account when assigning weights (i.e., traffic congestion is a point of concern), but these weights are primarily assigned based on professional judgement and knowledge gained in siting similar projects. Using this approach, the criteria that carried the greatest risk for significant impacts, Project cost, and schedule are given the highest weighting. Those criteria that are least likely to affect these considerations are given the lowest weighting. Table 4-6 describes the weights applied to each evaluation criterion.

A weight of three (most important) was assigned to three of the 11 criteria: Residential Structures, Potential for Traffic Congestion, and Tree Clearing. A weight of two was given to five criteria: Sensitive Receptors, Potential to Encounter Subsurface Contamination, Wetland Resource Areas, Rare Species Habitat, and Article 97-Jurisdictional Land. The remaining three criteria (Historic Resources, Archaeological Resources, and Public Water Supplies) were given a weight of one.

Table 4-6 Weighting assigned to scoring criteria

Scoring Criteria	*Weight*	*Rationale Behind Assigned Weight*
Developed Environment		
Residential Units	3	The highest weighting was applied to residential units due to the potential for disruption during construction, albeit temporary.
Sensitive Receptors	2	A middle weighting was applied to sensitive receptors in acknowledgement of their susceptibility to temporary disruption from construction activities, and the need to maintain access to these facilities throughout construction. A weighting of three was not selected since the Company will work with the Town and sensitive receptors to maintain access during construction.
Potential for Traffic Congestion	3	The highest weighting was applied to the potential for traffic congestion since this is always an area of significant interest and concern during any significant infrastructure construction project. Since this Project is largely proposed within existing roadway layouts, it will have some unavoidable temporary impacts to traffic, although TMPs will help manage and mitigate these impacts.
Historic Resources	1	The lowest weighting was applied to historic resources, since the Project-related impacts to historic resources will be limited to temporary construction-related activities and since the completed Project, with the exception of the proposed substation, will have no visual impacts.
Archaeological Resources	1	The lowest weighting was applied to archaeological resources since the majority of the onshore export cables will occur within previously-disturbed existing roadway layouts.
Potential to Encounter Subsurface Contamination	2	A middle weighting was applied to the potential to encounter subsurface contamination in acknowledgement of the complications that would result from management of contaminated materials during construction.

Table 4-6 Weighting assigned to scoring criteria (Continued)

Scoring Criteria	*Weight*	*Rationale Behind Assigned Weight*
Natural Environment		
Wetland Resource Areas	2	A middle weighting was applied to wetland resource areas for the onshore route due to the sensitivity of these environmental resources as well as the permitting challenges associated with related impacts.
Rare Species Habitat	2	A middle weighting was applied to rare species habitat for the onshore route due to the sensitivity of these environmental resources as well as the permitting challenges associated with related impacts.
Public Water Supplies	1	The lowest weighting was applied to public water supplies since the Project's construction-related activities will be performed in a manner that will avoid impacts to water supply resources, and because the Project is not of a type that would pose a significant threat to these resources.
Article 97-Jurisdictional Land	2	A middle weighting was applied to this criterion due to the Project crossing an environmentally-sensitive property, although the Project will have no significant impacts and the impacts that will occur will be temporary.
Tree Clearing	3	The highest weighting was applied to tree clearing since, while limited to transmission ROWs, this clearing would be a permanent impact, albeit within a designated utility corridor.

Since the bulk of the proposed onshore export cable route is located predominantly within existing roadways, the great majority of potential impacts analyzed in the routing analysis are temporary in nature and associated with Project construction. Accordingly, the majority of the scoring criteria reflect the valuation of temporary, rather than permanent, impacts (except where noted). The weighting scale, therefore, reflects the importance of each criterion in relation to all other criteria regardless of the temporal duration of potential impacts.

4.4.2 Criteria Evaluation Methods

After identifying the environmental scoring criteria, the Company completed a scoring evaluation for each Candidate Route. The Company scored, weighted, and ranked each Candidate Route to reflect its potential for impacts to the developed and natural environments and its relative ease of constructability. For a project of this type, the relative ease of constructability is directly related to several factors including the amount of available workspace, extent of densely developed residential and commercial areas, traffic, and potential conflicts with other buried infrastructure. These parameters were considered in developing some of the human environment criteria and are therefore represented in the Company's scoring process. For example, the potential for traffic congestion was considered when scoring the route options. In addition, the Company captured considerations of constructability (e.g., existing utility density, sharp bends) in its evaluation of costs for the various routing alternatives. Therefore, constructability criteria were not included in the scoring process for Candidate Routes in the same way that developed and natural environment criteria were reflected in the analysis.

After gathering mapping and field data for each Candidate Route, the Company assessed each criterion and identified the Candidate Route that had the highest score. All other routes were then compared against this number to arrive at a "ratio score" for each Candidate Route on a scale of 0 to 1. For example, if Candidate Route X had 5 sensitive receptors, Candidate Route Y had 10 sensitive receptors, and Candidate Route Z had 15 sensitive receptors, the ratio scores would be calculated as shown:

Candidate Route	Number of Sensitive Receptors	Ratio Score
Candidate Route X	5	5 ÷ 15 = **0.33**
Candidate Route Y	10	10 ÷ 15 = **0.66**
Candidate Route Z	15	15 ÷ 15 = **1.00**

The lowest ratio score therefore equates to the lowest potential for impact. For each criterion, the ratio score was then multiplied by its assigned weight to produce a weighted score that reflected the relative importance of the criterion.

For each Candidate Route, the analysis generated a "total ratio score" by summing all of the individual ratio scores from the scoring criteria as well as a "total weighted score" by summing all of the individual weighted scores from the scoring criteria. The total weighted scores were then sorted in order, from low to high, to identify a given Candidate Route's "rank." The lowest weighted score equates to the lowest potential for impact with emphasis on certain criterion as previously described in this section. The ranks developed in this routing analysis are based on the total weighted scores.

4.4.3 Description of Scoring Criteria

The scoring criteria for the developed environment and natural environment used to evaluate the Candidate Routes as defined in Table 4-5 above are described in greater detail below. Constructability factors, such as subsurface utility density, street width, and property acquisition, are reflected in the cost analysis in Section 4.7; in general, subsurface utility density and street width are relatively homogeneous along the Candidate Routes, and are not significant for route differentiation.

4.4.3.1 Developed Environment Criteria

Developed environment criteria compare existing conditions of, and potential impacts to, the developed environment and surrounding population among the various Candidate Routes. The six developed environment criteria included in the scoring analysis are:

- Residential Units;
- Sensitive Receptors;
- Potential for Traffic Congestion;
- Historic Resources;
- Archaeological Resources; and
- Potential to Encounter Subsurface Contamination.

Each of these developed environment criteria is described in greater detail below.

Residential Units

Residents along a Candidate Route could be subject to temporary traffic disruption, noise, and/or dust. As described in Section 5.3.1, the Project will limit the extent of such disruption by developing and applying appropriate Traffic Management Plans (TMPs), observing normal work hours, using properly muffled equipment, and other measures. The Project construction schedule within public roadways will be the product of consultations with the towns. The number of residential units with parcels directly abutting the Candidate Routes (ROW or roadway layouts) was counted using MassGIS data, aerial photography, and municipal records to determine the number of units along each Candidate Route. Whenever possible, individual residential units were counted such that unit counts for apartment or condominium complexes were included.

A ratio score was calculated for each Candidate Route based on the total number of individual residential units determined for each Candidate Route divided by the highest number of units found along any individual Candidate Route.

Sensitive Receptors

Sensitive receptor land uses include hospitals, schools, police stations, fire stations, elder care facilities, daycare facilities, district courts, religious facilities, and cemeteries. Sensitive receptors along each Candidate Route could be subject to temporary traffic disruption, street closings, construction noise, and/or other temporary impacts due to Project construction. If a sensitive receptor has multiple entrances, the impact can be less pronounced than under single-entrance scenarios. In either case, access to the sensitive receptor will be maintained during normal operating hours, up to and including 24-hour access for facilities that require it (e.g., hospitals, fire and police stations, and elder care facilities). The Project will minimize disruptions to these resources by developing and applying appropriate TMPs, observing normal work hours, minimizing construction-period noise and dust, and other measures (see Section 5.0).

The number of sensitive receptors includes the number of parcels directly abutting each Candidate Route (ROW limits or roadway layouts) with a land use type identified as sensitive to the above temporary or permanent impacts. The number of sensitive receptors was evaluated using available property assessment data from MassGIS and local online databases, Google and Bing 2015-2016 aerial and street imagery, Google Earth/Google Maps data and imagery, and route drives.

A ratio score was calculated for each Candidate Route by dividing the total number of sensitive receptor parcels for each Candidate Route by the highest number of sensitive receptor parcels found among all the Candidate Routes.

Potential for Traffic Congestion

The installation of underground transmission cables within public roadways can result in temporary increased traffic density and congestion, traffic disruption, and street closings. The extent of traffic-related disruption from this Project will be limited by developing and applying appropriate TMPs and consulting with the towns to determine Project construction schedule within public roadways.

The traffic analysis was performed by dividing each Candidate Route into road segments, for which the MassDOT class was identified. Based on the MassDOT class of roadway, each segment was assigned a rank from 1 to 3, from lowest to highest potential for traffic impact. Private ways were assigned a "1"; minor roads and major arterials were assigned a "2"; and limited-access and multi-lane highways were assigned a "3".[4] Off-road segments such as utility ROW were assigned a zero.

The Company then calculated the percentage of the total Candidate Route each segment commanded, multiplied that percentage by the segment's score, and then added the segment scores to generate a proportional score for the entire Candidate Route.

The ratio score was calculated by dividing the total proportional score for each Candidate Route by the highest proportional score found among all the Candidate Routes.

Historic Resources

Historic resources could potentially be affected by construction impacts such as excavation, traffic disruption, street closings, and noise, as well as by the permanent placement of transmission facilities in or near cultural resources. Historic resources were evaluated using MassGIS data from the Massachusetts Historical Commission's (MHC) Massachusetts Cultural Resource Information System (MACRIS) to locate resources including buildings, local historic districts, and National

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4 The Proponent also reviewed Average Daily Trip (ADT) data as collected by MassDOT, but since traffic volume was not available for all road segments, it was not an appropriate means of comparing routes.

Register-listed individual buildings and districts. Historic Resources located along the Candidate Routes are either included in the Inventory of Historic and Archaeological Assets of the Commonwealth (Inventory) or listed on the National Register of Historic Places (NR) or State Register of Historic Places (SR). Resources are either singular historic properties or listed in the NR or SR as a district or included in the Inventory as a single property or as an Area containing multiple properties.

If identified archaeological sites abut the routes, they are also included in the count.

For the purposes of scoring, single historic properties, Areas, and Districts immediately adjacent the Candidate Routes were each counted once. If the Candidate Route passes through an Area or District, the Area or District was counted once along with designated historic properties within the Area or District immediately adjacent to the route. Each town in Massachusetts has its own recorded set of historic properties in the NR and Inventory. If an Area or District crosses town boundaries, it is often double listed (once per town); in these circumstances, an Area or District was only counted once.

Archaeological resources were evaluated separately, as noted below.

The number of historic resources was derived from the total number of historic sites directly abutting the underground segments (in roadway layouts) of the Candidate Routes. Historic resources included in the scoring analysis are described in Section 5.3.2.

A ratio score was calculated for each Candidate Route based on the total number of historic resources determined for each route divided by the highest number of units found along all of the routes.

Archaeological Resources

Archaeological resources can be impacted by the disturbance of subsurface artifacts through earth movement and excavation.

Archaeological sensitivity is limited to areas that have not been significantly disturbed by previous construction activities, and which appear to maintain natural stratigraphic integrity. "High" sensitivity areas include those areas that contain known archaeological sites and those that have not been markedly affected by previous land-altering activities. Areas of "moderate" archaeological sensitivity primarily include those that are located in environmentally sensitive areas and that have only been minimally impacted by construction.

Areas of "low" archaeological sensitivity include those that are perennially wet or have been extensively altered by development, construction, excavation, and/or erosion and are therefore unlikely to contain significant archaeological resources. Similarly, all of the public roadway segments have been modified by construction of the road itself as well as above and below-ground utilities, and it is unlikely that natural/undisturbed soils or potentially significant archaeological deposits would be located below or immediately adjacent to them.

Accordingly, the extent of potential archaeological areas was derived from the length (miles) of "moderate" and "high" sensitivity areas identified within the off-road ROW limits.

A ratio score was calculated for each Candidate Route based on the total number of miles of archaeologically sensitive areas determined for each route divided by the highest number of miles found along all of the routes.

Potential to Encounter Subsurface Contamination

Subsurface contamination could add complexities to construction. The potential to encounter subsurface contamination was derived from the number of sites on or within 300 feet of each Candidate Route where a documented release of oil and/or hazardous materials occurred, or where past land uses potentially resulting in contamination have been documented in the MassDEP Bureau of Waste Site Cleanup (BWSC) online database, pursuant to the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000). This criterion was evaluated using the MassDEP BWSC online database.

A ratio score was calculated for each Candidate Route by dividing the total number of documented active BWSC sites determined for each Candidate Route by the highest number of documented active BWSC sites found among all of the Candidate Routes.

4.4.3.2 Natural Environment Criteria

Natural environment criteria compare existing conditions of, and potential impacts to, the natural environment among the Candidate Routes. The five natural environment criteria included in the scoring analysis are:

- Wetland Resource Areas;
- State-listed Rare Species Habitat;
- Public Water Supplies;
- Article 97-Jurisdictional Land; and
- Tree Clearing.

Each of these natural environment criteria is described in greater detail below.

Wetland Resource Areas

Underground transmission cable construction can affect wetland resource areas. This criterion score was derived from the total linear footage of each Candidate Route passing through state and local jurisdictional wetland resources, including 200-foot riverfront area and the 100-year floodplain (but excluding buffer zones). Wetland resource areas applicable to the routing analysis, as defined in the Massachusetts Wetland Protection Act (WPA) regulations (310 CMR 10.00) and/or local wetlands regulations, include the following:

- Bordering Vegetated Wetland (BVW);
- Isolated Vegetated Wetlands or Lands Subject to Flooding (IVW or ILSF);
- Land Subject to Coastal Storm Flowage (LSCSF) (100-year floodplain);
- 200-foot Riverfront Area (RFA); and
- Certified or known Vernal Pools.

Wetland resource areas were identified using a combination of field observation and utilizing ArcGIS with the most current data available. Potential impacts to perennial streams were assumed to be accounted for within RFA. There were no Areas of Critical Environmental Concern (ACECs) or Outstanding Resource Waters (ORWs) present along any of the Candidate Routes.

A ratio score was calculated for each Candidate Route by dividing the total length of wetland resource areas crossed by each Candidate Route by the greatest length of wetland resource areas among all the Candidate Routes.

State-listed Rare Species Habitat

Underground transmission cable construction in off-road ROWs can potentially impact protected habitats for state-listed rare species. Scoring of protected habitats (Priority or Estimated habitats) for state-listed species was derived from the acreage of each Candidate Route and associated landfall site or HDD staging area passing through protected habitat for state-listed species. To be conservative, a 13-foot-wide trench was assumed for this analysis (see Section 5.4.3 for more detailed information regarding onshore trenching and duct bank installation). Underground installation within public roadway layouts was assumed to have no impacts on state-listed habitat.

A ratio score for each Candidate Route was calculated by dividing the total acreage of NHESP Priority and Estimated Habitat for each Candidate Route by the highest measured acreage among all the Candidate Routes.

Public Water Supplies

Public water supply areas considered in this aspect of the routing analysis included the boundaries of Zone I and Zone II Water Supply Protection Areas and Wellhead Protection Areas. These resources were identified using available data layers from MassGIS and zoning maps from the municipalities along the Candidate Routes. The length of each route that passed through a public water supply resource area was calculated using ArcGIS.

A ratio score was calculated for each Candidate Route by dividing the total length of public water supply resources along each Candidate Route by the greatest length among all the Candidate Routes.

Article 97-Jurisdictional Land

Underground transmission cable construction can potentially result in impacts to conservation lands. Conservation lands for this purpose were defined as those properties that were primarily protected for conservation purposes or otherwise protected under Article 97, as identified in available MassGIS data. Underground installation within public roadways was assumed to have no impact on adjacent conservation lands. The score for this criterion was derived from the total number of distinct areas shown as protected under Article 97 by MassGIS that are crossed by each Candidate Route. All work within roadway layouts was excluded from the count.

This criterion was selected due to the Project crossing environmentally sensitive and sometimes socially important properties, although any Project impacts would be temporary, limited to the construction period, would not result in any change in use (and hence would not be significant).

A ratio score was calculated for each Candidate Route by dividing the total number of protected areas crossed by each Candidate Route by the highest number of protected areas among all the Candidate Routes.

Tree Clearing

While only minor trimming activities are expected along in-road sections of the Candidate Routes, portions of the routes that follow utility ROWs may require tree clearing where those ROWs have not been maintained to their full widths. Naturally vegetated areas containing a mature forest canopy provide habitat for various wildlife species and can provide visual screening. Therefore, routes that minimize tree-clearing impacts are preferred.

A ratio score for each Candidate Route was calculated by dividing the total length of tree clearing required for each Candidate Route by the greatest length of tree clearing required among all the Candidate Routes. This estimated length was generated based on the length of the route following utility ROWs but excluding non-forested areas such as at road crossings, cleared areas, and ROW access roads.

4.5 Comparison of Routes and Selection of Preferred Route and Noticed Alternative

The Preferred Routes for the transmission routes and grid interconnection routes were selected by the Company based on the environmental evaluation criteria established in Section 4.4.1 and in consideration of cost, constructability, and municipal and regulatory input. As described in Section 4.3, the Company began with a broad routing analysis that resulted in the selection of a suitable landfall site, a site for the proposed substation, and an interconnection location at the

West Barnstable Substation. The subsequent onshore routing analysis resulted in a refined list of Candidate Routes to carry into scoring; all scored routes are shown on Figure 1-2 (transmission routes) and Figure 1-3 (grid interconnection routes).

The discussion below is focused on results from the environmental scoring developed for the onshore portion of the export cable route, and hence is targeted on the onshore routing. This discussion is separated into two parts: onshore transmission routes, which connect the landfall site to the proposed substation site; and grid interconnection routes, which connect the proposed substation site to the interconnection location.

The offshore routing analysis is presented in Section 4.6 and is included in the analyses of cost and reliability provided in Sections 4.7 and 4.8, respectively.

4.5.1 Transmission Routes (Landfall Site to Proposed Substation Site)

As shown in Table 4-7, Candidate Route T1 (Shootflying Hill Road Route) has a superior (i.e., lower) weighted ratio score than Candidate Route T2 (Oak Street). In addition, the Shootflying Hill Road route is approximately 2.1 miles shorter. Detailed scoring spreadsheets are provided in Attachment E, but the weighted ratio scores for both routes are contained within Table 4-7.

Table 4-7 Comparison of Weighted Ratio Scores – Candidate Transmission Routes

Scoring Criteria	*Candidate Route T1 (Shootflying Hill Road Route)*	*Candidate Route T2 (Oak Street Route)*
Developed Environment/Human Environment		
Residential Units	2.26	2.59
Sensitive Receptors	1.33	2
Potential for Traffic Congestion	2.85	3
Historic Resources	0.73	0.84
Archaeological Resources	0.12	0
Potential to Encounter Subsurface Contamination	1	0
Subtotal for Human Environment Criteria	*8.30*	*8.44*
Natural Environment		
Wetland Resource Areas	0.8	1.2
Rare Species Habitat	0	0
Public Water Supplies	1	0.45
Article 97-Jurisdictional Areas	0.67	1.33
Tree Clearing	0	0
Subtotal for Natural Environment Criteria	*2.47*	*2.99*
Total	**10.8**	**11.4**

In considering the relative merits of the routes, the Company began by assessing each on the basis of the human criteria defined in Section 4.4.1. On this basis, the two candidate routes have nearly identical scores. However, the Shootflying Hill Road route does pass fewer residential units (316 vs. 362), sensitive receptors (4 vs. 6) and historic resources (33 vs. 38) than the Oak Street Route; construction-related impacts to these receptors can be mitigated to avoid and minimize impacts. The potential for traffic congestion is the same between routes, although the Shootflying Hill Road route is two miles shorter than the Oak Street Route.

In terms of the natural environment criteria used in scoring, the Shootflying Hill Road Route has a slightly superior score to the Oak Street Route (2.47 vs. 2.99). The Shootflying Hill Road Route passes fewer wetland resource areas than the Oak Street Route, although due to the use of paved roadway layouts, neither route will have any direct impacts to wetlands. The Oak Street Route, on the other hand, passes through fewer public water supply areas, although construction of the onshore duct bank route will not have any impacts to public water supplies. Since Vineyard Wind anticipates locating the duct bank alignment within the existing access road in ROW #343, no tree clearing is anticipated on that segment. Both routes will cross the Article 97-jurisdictional area associated with Craigville Public Beach and the associated parking lot (or, if the variant Covell's Beach Landfall Site is used, Covell's beach and the associated parking lot). In addition, due to engineering constraints, it may be necessary to cross Aaron S. Crosby Park, which is presumptively Article 97-jurisdictional, to eliminate what would otherwise be a very sharp bend in the Oak Street Route between South Main Street and Main Street. To be conservative, the scoring for the Oak Street Route includes this additional Article 97 crossing.

Although both routes are feasible and similar, the Company has selected Candidate Route T1 (Shootflying Hill Road Route) as the Preferred Route and Candidate Route T2 (Oak Street Route) as the Noticed Alternative, primarily because the Shootflying Hill Road Route is much more direct (it is approximately 2.1 miles, or 34%, shorter than the Oak Street Route) and it passes fewer residential units and sensitive receptors. The significantly shorter route is expected to result in a shorter construction schedule, minimizing impacts on traffic and residents. In addition to these considerations, factors related to cost and reliability are discussed in Sections 4.7 and 4.8, respectively.

In addition to the Preferred Route and Noticed Alternative, the Company is noticing three variants to the Preferred Route and two variants to the Noticed Alternative. Each of these variants is described in detail in Section 1.5.1, and Section 4.3. Table 4-8 includes weighted ratio scores for each of the variants under consideration, illustrating how they relate to the Preferred Route and Noticed Alternative (see Attachment E for detailed scoring spreadsheets).

For the Preferred Route (Shootflying Hill Road Route) and variants, Variant 3 (ROW #345) scores the same as the base route. Variant 1 (Covell's Beach Landfall Site) and Variant 2 (South Main Street) score less favorably, primarily due to a greater number of residential units or sensitive receptors and, in the case of Variant 1, a greater length through mapped wetland resource areas (floodplain, although there will be no permanent impacts to this resource).

For the Noticed Alternative (Oak Street Route), both variants score higher (i.e., less favorably) than the base route. In the case of Variant 1, this difference is due to a larger number of residential units; for Variant 2, the primary difference is the potential need for tree clearing along a relatively long stretch of utility ROW.

Table 4-8 Comparison of Weighted Scores between Candidate Transmission Routes and Variants

Route	*Weighted Score*
Preferred Route (Shootflying Hill Road Route)	**10.8**
Variant 1 (Covell's Beach Landfall Site)	12.3
Variant 2 (South Main Street)	11.8
Variant 3 (ROW #345)	10.8
Noticed Alternative (Oak Street Route)	**11.4**
Variant 1 (Covell's Beach Landfall Site)	12.8
Variant 2 (ROW #345)	15.1

The reasoning behind each of the variants to the Preferred Route (T1) and Noticed Alternative (T2) is described below:

- **Variant 1 (Preferred Route), Covell's Beach Landfall Site:** The Company would only expect to use this variant should it prove infeasible to make landfall at the Craigville Public Beach parking lot. While the parking lot at Covell's Beach is being utilized as the landfall site for the Vineyard Wind Connector 1 and is a feasible alternative, it is not the preferred landfall site for a number of reasons. First, compared to the preferred Craigville Public Beach Landfall Site, the additional 0.4 miles of duct bank will affect more residential users (375 vs. 316) and will travel through approximately 0.4 miles more mapped wetland resource areas (floodplain). Second, utilizing a separate landfall site would mean some geographic separation between the proposed infrastructure to accomplish the offshore-to-onshore transition, improving reliability and avoiding a second winter season of disrupting the parking lot at Covell's Beach. Third, the Covell's Beach Landfall Site is physically constrained by the current design for Vineyard Wind Connector 1, which leaves limited and potentially inadequate space for Vineyard Wind Connector 2 landfall and equipment. Finally, this variant also passes more historic resources than the Preferred Route (40 vs. 33), although the Project will avoid significant impacts to those resources.

- **Variant 2 (Preferred Route), South Main Street:** This variant provides an alternative to passage through the Centerville Village Historic District on Main Street and Old Stage Road. This variant would only be utilized if the more direct route through the Historic District proves infeasible. While the score for this variant is similar to the Preferred Route, the additional 1.2 miles in length does not offer any advantages except for avoiding the historic district; construction through the historic district is feasible and could even be beneficial if Project construction is coordinated with the Town of Barnstable's plans to install sewer infrastructure. Furthermore, this variant would pass two additional sensitive receptors relative to the Preferred Route (6 vs. 4) and would potentially add two sharp bends to the route (see Figure 1-2).

- **Variant 3 (Preferred Route), Northern Substation Access:** This variant provides an alternative for accessing the proposed substation site from the north directly from Shootflying Hill Road rather than from ROW #343 to the south. While this variant scores the same as the Preferred Route, it is proposed as an alternative that would avoid any use of existing utility ROW. It is not preferred because it would also narrow the options for 345-kV cables exiting the substation site, increase temporary construction impacts in roadway layouts, impact three residential homes along Shootflying Hill Road during construction, and could potentially create a situation where the Vineyard Wind Connector 2 duct bank would need to cross itself, adding an unnecessary complication to construction, increasing costs, and potentially impacting reliability.

- **Variant 1 (Noticed Alternative (NA)), Covell's Beach Landfall Site:** This variant provides an alternative landfall option at the Covell's Beach parking lot approximately 0.4 miles east of Craigville Public Beach, and the Company would only expect to use this variant should it prove infeasible to make landfall at the Craigville Public Beach parking lot. The Town-owned paved parking lot at Covell's Beach is being utilized as the landfall site for Vineyard Wind 1 and through the permitting of that project was proven as an acceptable landfall location. For this reason, it is presented as a variant to the preferred transmission route that could be utilized in case unforeseen challenges arise pertaining to the Craigville Public Beach Landfall Site. The Covell's Beach Landfall Site is a variant, rather than part of the Noticed Alternative, for three main reasons. First, use of the Covell's Beach Landfall Site for the Vineyard Wind Connector 2 would add approximately 0.4 miles to the onshore route along Craigville Beach Road, for a total route length of 6.5 miles, which would increase the number of residences (419 vs. 362) affected by temporary construction impacts and would also increase Project costs. Second, utilizing a separate landfall site would mean some geographic separation between the proposed infrastructure to accomplish the offshore-to-onshore transition, improving reliability and avoiding a second winter season of disrupting the parking lot at Covell's Beach. Third, the Covell's Beach Landfall Site is physically constrained by the current design for Vineyard Wind Connector 1, which leaves limited and potentially inadequate space for Vineyard Wind Connector 2 landfall and equipment. Finally, this variant also passes more historic resources than the Noticed Alternative (45 vs. 38), although the Project will avoid significant impacts to those resources.

- **Variant 2 (NA), ROW #345:** This variant shortens the Noticed Alternative by approximately 0.7 miles by utilizing approximately 1.6 miles of utility ROW and accessing the proposed substation site from the south. While a shorter route with fewer construction-period traffic impacts and fewer potential conflicts with existing subsurface utilities, the score for this variant is significantly worse than for the Noticed Alternative

(15.1 vs. 11.1) largely because this variant would likely require tree clearing on private land within the transmission ROW where the ROW has not been maintained to its full width. In addition, this variant would likely require a trenchless crossing within the utility ROW to avoid impacts to a wetland, increasing costs and the complexity of construction. Finally, the variant would pass through more area mapped as public water supplies (1 mile vs. 0.5 miles) and would cross three Article 97-jurisdictional parcels instead of two.

4.5.2 Grid Interconnection Routes (Substation Site to Interconnection Location)

As shown in Table 4-9, Candidate Route G1 (ROW #343 to ROW #381) has a lower (i.e., better) weighted ratio score than Candidate Route G2 (In-Road). Detailed scoring spreadsheets are provided in Attachment E, but the weighted ratio scores for both routes are contained within Table 4-9.

Table 4-9 Comparison of Weighted Ratio Scores – Candidate Grid Interconnection Routes

Scoring Criteria	*Candidate Route G1 (ROW #343 to ROW #381)*	*Candidate Route G2 (In-Road)*
Developed Environment/Human Environment		
Residential Units	1.70	3
Sensitive Receptors	0	2
Potential for Traffic Congestion	0	3
Historic Resources	0.38	1
Archaeological Resources	1	0
Potential to Encounter Subsurface Contamination	0	0
Subtotal for Human Environment Criteria	*3.08*	*9.00*
Natural Environment		
Wetland Resource Areas	0	0
Rare Species Habitat	0	0
Public Water Supplies	1	0.83
Article 97-Jurisdictional Areas	0.67	0
Tree Clearing	0	0
Subtotal for Natural Environment Criteria	*1.67*	*0.83*
Total	**4.7**	**9.8**

In considering the relative merits of the routes, the Company began by assessing each on the basis of the natural environment and developed/human environment criteria defined in Section 4.4.1. In terms of the natural environment criteria used in scoring, neither route affects wetland resource areas or rare species habitat. Tree clearing is not anticipated for standard duct bank installation on either route. Both routes pass through almost the same length of mapped water resources (0.6 miles for G1 and 0.5 miles for G2), while G1 may cross one Article 97-jurisdictional parcel (see Section 5.3.3.2.1).

On the basis of the developed/human criteria used in scoring, the two routes are more distinct. Candidate Route G2 passes more residential units (37 vs. 21), sensitive receptors (4 vs. 0), and historic resources (8 vs. 3), and since it is an entirely in-road route it has a greater potential for causing traffic congestion during construction. Candidate Route G1, on the other hand, passes through a greater length of moderate to high archaeological sensitivity given its use of utility ROWs.

Based on the scoring analysis, the Company has selected Candidate Route G1 (ROW #343 to ROW #381) as the Preferred Route and Candidate Route G2 (In-Road) as the Noticed Alternative. In addition to the considerations of the natural environment and human criteria used in scoring, factors related to cost and reliability are discussed in Sections 4.7 and 4.8, respectively.

In addition to the Preferred Route and Noticed Alternative, the Company is noticing three variants to the Preferred Route. Each of these variants is described in detail in Section 1.5.2, and Section 4.3. Table 4-10 includes weighted ratio scores for each of the grid interconnection route variants under consideration, illustrating how they relate to the Preferred Route and Noticed Alternative (see Attachment E for detailed scoring spreadsheets).

For the Preferred Route (ROW #343 to ROW #381) and variants, the scores are all quite similar. Despite the similar scores, the Preferred Route is preferable for a number of reasons. First, at the Route 6 crossing the approach from ROW #345 onto ROW #381 enables the pit for the trenchless crossing to be located south of Service Road, avoiding possible interference with a future bike path planned along Service Road as well as possible future widening of Route 6. Second, using ROW #345 avoids the need to work around the existing subsurface gas line in Service Road, and third it voids temporary construction-period impacts to residences with driveways along Service Road. Finally, the western option for crossing Route 6 (as opposed to the eastern option that would be utilized for Variants 2 and 3) is superior for the reasons described in Section 1.5.2.1.2, including impacts to adjacent residences among other considerations, and because the northern end of the trenchless crossing can occur on assessor map parcel #214-001, which Vineyard Wind is under contract to purchase.

Table 4-10 Comparison of Weighted Scores between Candidate Grid Interconnection Routes and Variants

Route	*Weighted Score*
Preferred Route (ROW #343 to ROW #381)	**4.74**
Variant 1 (Service Road to ROW #381)	4.20
Variant 2 (ROW #343 to ROW #342)	4.55
Variant 3 (Service Road to ROW #342)	4.20
Noticed Alternative (In-Road)	**9.03**

The reasoning behind each of the variants to the Preferred Route is described below:

- **Variant 1, Service Road to ROW #381:** This variant shortens the amount of existing utility ROW occupied by the duct bank to less than 500 feet (0.1 miles). Almost the entire length of the route utilizing this variant would be located within existing roadway layouts, where the proposed duct bank would be installed either beneath pavement or within ten feet of pavement. This variant is simlar to the Preferred Route, practically paralleling it, and would be utilized if it becomes infeasible to locate the duct bank within the utility ROW. However, although the score for this route is quite similar to the score for the Preferred Route, it is not itself preferred for the following reasons. First, the Town of Barnstable has plans to construct a public bike path parallel to Shootflying Hill Road and Service Road, and MassDOT has informed Vineyard Wind of plans for widening Route 6 that could include grading that extends south between the Route 6 eastbound lane and Service Road. This would pose an engineering challenge where the ductbank transitions from Service Road to ROW #381. In preparation for the Route 6 crossing, the southern access pit for that trenchless crossing would need to be placed north of Service Road, and could conflict with the future plans for a bike path or Route 6 widening. Second, this variant would require traffic management along Shootflying Hill Road and Service Road, and would create a greater inconvenience for residents with driveways along this stretch of Service Road. Third, construction would need to be coordinated to avoid conflicts with the existing natural gas line and planned natural gas main upgrade within the roadway layout of Service Road. Collectively, these considerations make this variant less desirable than the Preferred Route.

- **Variant 2 ROW #343 to ROW #342:** This variant provides an alternative route to the West Barnstable Substation via ROW #342 rather than ROW #345 and ROW #381. It also provides an alternative access into the West Barnstable Substation, entering the northeast corner of the site rather than the south side of the site. This variant would be utilized if it proves infeasible to use ROW #345, ROW #381, or Service Road but Eversource grants the co-location request for ROW #342. While feasible, this variant is inferior to the Preferred Route for the following reasons. First, as described in Section 1.5.2.1.2, the western option for crossing Route 6 is superior to the eastern option for a number of reasons, including that the eastern crossing would occur in close proximity to a residence. Second, both ends of the Route 6 trenchless crossing on this variant would occur within the utility ROW, while on the Preferred Route the northern end of this crossing would occur on assessor map parcel #214-001, which Vineyard Wind is under contract to purchase.

- **Variant 3, Service Road to ROW #342:** This variant shortens the amount of existing utility ROW occupied by the duct bank and also utilizes ROW #342 rather than ROW #345 and ROW #381. This variant would be utilized if the substation design warrants the 345-kV cables exiting to the north and if it proves infeasible to use ROW #345, ROW #381, and

Service Road but Eversource grants the co-location request for ROW #342. While feasible, this variant is inferior to the Preferred Route for the same reasons Variant 2 inferior to the Preferred Route.

4.6 Analysis of Offshore Export Cable Corridor

With regard to the Project's offshore route, the basic initial route concepts were discussed in Sections 4.3.1 to 4.3.3. This section describes how the initial route concepts were refined and optimized to the OECC discussed here, which is sufficiently defined for review but allows for some flexibility during construction to adjust to new information and natural variability in the dynamic marine environment.

Offshore wind projects are unique infrastructure that utilize rapidly changing technologies deployed in a dynamic marine environment. The high-energy marine environment can mean that features like shoals are in a constant state of change, resulting in corresponding water depth changes. Experience in the offshore wind industry in Europe as well as offshore cable installations in the U.S. has demonstrated that use of an installation corridor can provide flexibility in the engineering and installation stages to maximize the likelihood of successful cable burial while also avoiding and minimizing environmental impacts.

Section 4.6.1 describes the marine surveys performed to identify and characterize the OECC. Section 4.6.2 describes the proposed OECC itself, and Section 4.6.3 describes environmental considerations along the OECC. This installation corridor was thoroughly evaluated and approved for Vineyard Wind 1/Vineyard Wind Connector 1, and it remains largely the same the Vineyard Wind Connector 2. One difference is the OECC has been widened by approximately 985 feet (300 m) to the west, and along the stretch through the Muskeget Channel area it has also been widened by approximately 985 feet (300 m) to the east, bringing its typical width to approximately 3,800 feet (1,150 m) and its range from approximately 3,100 to 5,100 feet (950 to 1,550 m). Since the two cables from the Vineyard Wind Connector 1 will already be installed within the previously identified OECC, this widening will enhance the ability to micro-site the offshore export cables for the Vineyard Wind Connector 2 and avoid and minimize impacts to sensitive habitats. Both proposed offshore export cables will be located within the OECC, and the areas of widening will be surveyed in 2020.

The Massachusetts OMP, initially released in 2009 and subsequently revised in 2015, creates a framework for managing uses and activities within the state's ocean waters, including offshore wind projects and associated transmission. As described in this section and in Section 6.4.5, Vineyard Wind considered it carefully in identifying potential offshore corridors. A large part of the planning process for the OMP was devoted to mapping and evaluating natural resources and existing water-dependent uses (e.g., navigation and fishing), and identifying which of these resources and uses may be sensitive to different types of projects, such as transmission cables. A transmission cable is an allowable use per the OMP, which defines siting and performance standards. More specifically, the OMP identifies special, sensitive, and unique (SSU) resources that particular types of projects must endeavor to avoid. For cable projects, SSU areas are: (1)

core habitat of the North Atlantic right whale, fin, and humpback whales; (2) hard/complex seafloor; (3) eelgrass; and (4) intertidal flats. For this Project, North Atlantic Right Whale core habitat, hard/complex seafloor, and eelgrass are all mapped within the general Project area. As described in Section 6.4.5, which addresses Project consistency with the Massachusetts OMP, the OECC has been selected to avoid the North Atlantic Right Whale core habitat and to minimize the areas of hard/complex bottom that may be affected. The landfall site has been assessed and selected partially on the basis of avoiding mapped eelgrass habitat.

In addition, the OMP identifies some preliminary corridors for offshore wind transmission cables that are in presumptive compliance with siting standards of the OMP. The Company considered these corridors while assessing offshore routing alternatives, but they were unsuitable for the Project given that water depths within the mapped preliminary corridors are frequently too shallow, a landing in Barnstable is needed to minimize routing distance (mapped preliminary corridors do not include a landfall site in that town), and the Project is proposed to cut through federal waters in Nantucket Sound to minimize distance. As discussed in the balance of Section 4.0, the routing process must consider all major elements of the interconnection route: the submarine corridor, landfall sites, onshore routing, grid interconnection points, and the Project substation location. The submarine routes cannot be considered in isolation, but rather must be combined with suitable landfalls, onshore routes, and perhaps most importantly, a workable grid interconnection point and substation location.

Figure 4-6 shows the proposed OECC along with SSU areas mapped in the OMP as well as modified delineation of SSU areas based on marine survey results.

The high-energy marine environment found in portions of the offshore Project area includes changing features such as sand waves and shoals. As a result, the Company has identified an installation corridor that will provide necessary flexibility during engineering and installation to adjust to any changes since survey, and will account for the lateral spacing that will be needed between cables; this lateral spacing is described in the context cable installation in Section 5.4.1. As shown on Figure 4-6, the width of the installation corridor varies: it is narrower where necessary to avoid features such as SSU areas, and it is wider in other areas to enable the avoidance of impacts.

4.6.1 Marine Surveys to Identify OECC

Vineyard Wind began an initial analysis of potential offshore routes in 2017 in the context of investigating transmission options for Vineyard Wind 1. This initial analysis considered a number of factors, including mapping of SSU areas from the Massachusetts OMP, bathymetric data, the locations of navigation corridors, water currents, and mapped obstacles such as rock outcroppings and shipwrecks.

In 2017, building off results from the initial desktop study, an initial geophysical survey was performed along more than 180 miles (156 nautical miles, or 290 km) of potential offshore route segments to find a suitable route for linking Lease Area OCS-A 0501 to the south shore of Cape Cod. Vineyard Wind also performed geotechnical surveys and environmental sampling (e.g., benthic grab samples and underwater video) of the potential corridors in 2017 (at the time focused on Barnstable and Yarmouth). This field program was performed in accordance with a Survey and Sampling Plan (provided as Attachment G) that was the product of consultations with the Massachusetts Ocean Team as well as consideration of the 2015 Massachusetts OMP; the Massachusetts Ocean Team consists of representatives from Massachusetts CZM, MassDEP, DMF, MBUAR, and the MEPA Office.

The initial geophysical survey included the following:

- A single geophysical trackline along each offshore route alternative, consisting of a 50-meter-wide (164-foot-wide) swath of multi-beam sidescan sonar and sub-bottom profiling;

- Additional geophysical tracklines in areas where route alternatives pass in proximity to mapped SSU areas to map the resources' areal extent and determine a path for avoidance; and

- Additional geophysical tracklines in areas where adverse site conditions were identified (e.g., shallow water depths, difficult surficial geology).

Results from the initial geophysical survey were used to identify potential routes for the OECC. Additional data collection as outlined below was then conducted:

- Vibracore sampling at a spacing of approximately 1,000 meters (3,280 feet), with additional vibracores added where needed to verify subsurface sediment horizons interpreted from subbottom data (vibracore locations were selected in consultation with the Proponent's Qualified Marine Archaeologist);

- Benthic grab samples (with still camera photographs), at a spacing of approximately 1,000 meters (3,280 feet), with locations alternating with video transects for a combined approximately 500-meter (1,640-foot) spacing; and

- Underwater video transects oriented perpendicular to the OECC at a spacing of approximately 1,000 meters (3,280 feet) along the corridors and additional transects as dictated by review of survey data and in the vicinity of mapped SSU areas.

The initial desktop study performed prior to the 2017 geophysical survey showed that the surficial geology within Nantucket Sound consists of Holocene sediments, mostly silt/clay or medium to coarse sand with minor amounts of gravel, and Pleistocene glacial drift deposits, mostly outwash sand and gravel and glacial lake silt and clay.[5] The 2017 survey, which included the acquisition of bathymetry, side-scan sonar, seismic profiling, magnetometer, underwater video, grab sample, and vibracore data, showed mostly loose to medium dense sandy sediments in the surveyed areas, confirming the findings of the desktop study. In addition, areas with significant sand waves and some hard-bottom areas with gravel, cobbles, and boulders were identified. Although the vibracores did not clearly indicate the presence of hard-bottom areas in Muskeget Channel, the geophysical survey showed a higher concentration of boulders and more extensive bottom coverage with coarse material in that area relative to areas outside of Muskeget Channel.

Results from the 2017 preliminary survey were used to narrow the focus of the routing analysis and distill the offshore route segments into two OECCs: a Western OECC and an Eastern OECC. The Eastern OECC traveled north between Martha's Vineyard and Nantucket via Muskeget Channel, passing east of the scoured channel itself and continuing northward on the east side of Horseshoe Shoals to landfall sites at New Hampshire Avenue in Lewis Bay and Great Island. The Western OECC also traveled north between Martha's Vineyard and Nantucket via Muskeget Channel, and included two possible variations through the channel: the western Muskeget option, which traveled through the channel itself, where water depths are greater but are accompanied by stronger currents, and the eastern Muskeget option, which avoided the scoured channel itself. The Western OECC then continued northward on the west side of Horseshoe Shoals. As the Western OECC approached the Cape Cod mainland, it initially included options for reaching landfall sites at Covell's Beach, New Hampshire Avenue, or Great Island.

After extensive review and based on the results of additional geophysical and geotechnical surveys of the OECC in the spring of 2018, the Eastern OECC was eliminated from further consideration. The Western OECC was selected as the optimal route because it is technically suitable for cable installation, is more direct, contains a smaller proportion of complex bottom, has a lower frequency of sand waves above 6.6 feet (2 m) than the Eastern OECC, and otherwise avoids or minimizes potential environmental impacts. A shorter route allows for less impact area, lower electrical line loses, and lower installation and operational costs.

The 2018 marine survey included data collection along multiple lines within the OECC still under consideration. After the 2018 survey, Covell's Beach in Barnstable was selected as the landfall site for Vineyard Wind Connector 1, and the site in Yarmouth was eliminated from the project.

Along the OECC, the 2018 survey consisted of a full geophysical equipment spread (i.e., multibeam echosounder, side scan sonar, magnetometer, high- and low-frequency subbottom profilers) used on the majority of lines to provide complete coverage of the survey corridor. Surficial ground-truthing was provided by benthic grab samples, underwater video, and shallow subsurface confirmation of lithologies obtained via vibracores and cone penetration tests (CPTs). The extensive 2018 survey effort in the OECC included more than 2,860 nautical miles (5,300 km) of

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5 Charles J. O'Hara and Robert N. Oldale. Maps showing geology and shallow structure of eastern Rhode Island Sound and Vineyard Sound, Massachusetts. U.S. Geological Survey, 1980.

geophysical trackline data, 147 vibracores, 100 CPTs, 75 benthic grab samples with still photographs, and 44 underwater video transects. The focus of the investigations was the upper 2 to 3 meters of seafloor sediments, where export cable burial is planned.

Results from the 2018 survey enabled the Company to confirm previous findings and to refine the extent of OMP-mapped SSU areas (i.e., hard bottom, complex bottom, and eelgrass). The resulting delineations of hard bottom, complex bottom, and eelgrass were used to develop initial cable alignments for the Vineyard Wind Connector 1 within the OECC that avoided and minimized impacts to these areas to the extent feasible. Additional engineering analyses performed during refinement of the Vineyard Wind Connector 1 cable alignments resulted in the identification of the eastern Muskeget option as the preferred means of traversing the Muskeget Channel area. Building on this assessment, the Vineyard Wind Connector 2 OECC only includes the eastern Muskeget option and eliminates the western Muskeget option, which would have passed through the deepest part of the channel with the strongest currents. A map set illustrating the physical characteristics of the seafloor within the OECC is provided as Attachment H.

In addition to the breadth of marine survey data already collected within the OECC, Vineyard Wind performed marine survey work in 2019 to widen the nearshore survey area to the west to encompass the Craigville Public Beach Landfall Site.

Vineyard Wind's extensive survey and engineering analyses of potential OECCs throughout 2017, 2018, and 2019 resulted in a thoroughly vetted and studied route that connects Lease Area OCS-A 0501 to the south shore of Cape Cod. Vineyard Wind therefore believes that using a substantial portion of this well-studied OECC provides the most optimal corridor for the Vineyard Wind Connector 2. Vineyard Wind's engineers have determined that the OECC can accommodate both the Vineyard Wind Connector 1's offshore export cables as well as the additional cables proposed for Vineyard Wind Connector 2. Project engineers have also widened the OECC by approximately 985 feet (300 m) to the west, and along the stretch through the Muskeget Channel area it has also been widened by approximately 985 feet (300 m) to the east, bringing its typical width to approximately 3,800 feet (1,150 m) and its range from approximately 3,100 to 5,100 feet (950 to 1,550 m). Since the two cables from the Vineyard Wind Connector 1 will already be installed within the previously identified OECC, this widening will enhance the ability to micro-site the offshore export cables for the Vineyard Wind Connector 2 to avoid and minimize impacts to sensitive habitats. Both proposed offshore export cables will be located within the OECC, and the areas of widening will be surveyed in 2020.

Results from the marine survey efforts in 2017, 2018, and 2019 have been compiled onto a plan set, provided as Attachment H, which presents information that includes, but is not limited to, bathymetry, select video still images, benthic habitat characterization, and delineation of hard bottom, complex bottom, and eelgrass. Table 4-11 summarizes the marine survey data and results along the OECC.

Table 4-11 Summary of Marine Survey Data and Results along the OECC

Item	Description
Data	• >5,500 km (> 2,970 nmi) of geophysical trackline data • 151 vibracores with 3-4 m (9.8-13.1 ft) recovery • 100 CPTs with over 75 penetrating 2-3.2 m (6.6-10.5 ft) • 117 benthic grab samples with still photos • 85 underwater video transects
Surface conditions	• water depths <2-45 m (<6.6-148 ft), local slopes up to 25-35° on bedforms • numerous natural slope/topography, <10° gradients • overall fairly homogenous surficial sediments, mainly sand • mobile surface layer with sand waves >2 m (6.6 ft) height locally • sand with some gravel, cobbles in shallow, higher current areas • sand with silt in deeper water areas, less tidal current • soft surficial layer offshore in deeper water • variable benthic habitats due to different substrates • SSUs present locally • RSDs offshore, bedform fields with sand waves over 5 m (16.4 ft) in Sound • coarse deposits with boulders in Muskeget Channel area • low concentration of man-made objects
Subsurface conditions	• overall relatively consistent, sand with coarse material and silt locally • abundant buried channels mainly north of Horseshoe Shoal • often acoustically transparent mobile sand layer
Hazards	• large sand waves in some areas • variable concentration of boulders in some sections • paleochannels with top sections in the upper 2 m (6.6 ft) • Limited gaseous sediments, not a concern • existence of SSUs for avoidance if possible
Assessment	• Predominantly sand with gravel in higher current areas and silt-fine sand in deeper, low flow locations. • Coarser deposits and associated habitats in Muskeget Channel area, as well as large sand waves and high currents to contend with during installation. • Export cables can be micro-sited within corridors to avoid most challenging conditions and SSUs where present. • Dredging may be necessary to remove the tops of large sand waves; only short-term disturbance to the habitat.

The principal technical and environmental considerations and constraints factoring into the geography of the OECC include:

- Feasibility of cable installation;
- Burial risk assessment/work to limit possibilities of cable failure;
- Avoiding and/or minimizing impacts to SSU areas mapped in the Massachusetts OMP;
- Avoiding and/or minimizing anchorage areas and areas with mapped shipwrecks and boulders;
- Environmental and/or permitting constraints and avoidance of impacts;
- Minimizing cable length to reduce transmission losses and cost;
- Adequate capacity delivered to the grid connection point;
- Available landfall locations;
- Maintaining a water depth of at least 20 feet, and avoiding shoals;
- The route should not turn more than 30 degrees at a time, with a minimum turn radius of 165 feet (50 meters);
- Avoiding slopes where the seafloor bathymetry changes dramatically;
- Crossing large seabed slopes and existing offshore cables in a perpendicular, or nearly perpendicular, orientation; and
- Crossing navigation corridors in a perpendicular orientation.

The OECC is described below.

4.6.2 Description of OECC

The OECC (shown on Figure 4-6) travels north between Martha's Vineyard and Nantucket east of an area mapped North Atlantic Right Whale core habitat; no other core habitat for whales is mapped by the OMP in the Project area. The corridor avoids the deepest part of Muskeget Channel, where water depths are greater but are accompanied by stronger currents and OMP-mapped hard/complex bottom, in favor of a route to the east, which avoids the scoured channel itself. The OECC then continues northward on the west side of Horseshoe Shoals.

As the cables approach the Cape Cod mainland, the OECC diverges from the corridor utilized for Vineyard Wind Connector 1 to provide access to the preferred Craigville Public Beach Landfall Site. As shown on Figure 4-7, mapped and/or surveyed eelgrass areas will be avoided.

As described in Section 1.3.2, from either landfall site to the Lease Area in federal waters, the OECC is approximately 39 miles (62 km) long. Depending on the final location of the ESP(s), the OECC within the Lease Area may be up to approximately 19 miles (31 km) in length, resulting in a total OECC length of up to approximately 58 miles (93 km). Due to micro-siting of cables within the OECC to minimize impacts to sensitive habitats, the maximum length per cable between the landfall site and ESP(s) is approximately 63 miles (101 km).[6] The length of the OECC within state waters is approximately 22 miles (35 km); assuming a 5% allowance for micro-siting, the maximum length per cable withn state waters is approximately 23 miles (37 km).

To assess and describe physical characteristics across the OECC, the area was divided into zones as shown on Figure 4-8. Conditions within each of these zones are described in Table 4-12.

Some areas of Vineyard Sound have active sand waves that can exceed 12 feet in height. As described in greater detail in the context of installation in Section 5.4.1, marine survey work has enabled the Company to assess these areas, which may require some pre-cable-laying dredging to ensure that the necessary burial depth can be achieved and maintained.

6 This length of offshore export cable includes a 5% allowance for micro-siting within the OECC outside the Lease Area, and a 15% allowance for micro-siting within the Lease Area.

Table 4-12 Physical conditions along OECC (see Figure 4-8 for definition of Zones)

Zone	*Section of OECC*	*Water Depth*	*Sand Waves*	*Sediment Conditions*	*Tidal Currents*
1	0-19 km	Generally >65 feet (20 m), shallower areas include the northern part of the corridor (water depth decreases to a minimum of 23 feet [7m]).	Typical heights do not exceed approximately 3 feet (1 m). No extreme sand waves.	Loose to medium dense SAND	Up to 1-2 knots
2	20-22 & 28-35 km	Generally 26-33 feet (8-10 m) but varying; deeper areas up to 49 feet (15 m) and shallow areas with a minimum depth of 20 feet (6 m).	Typical height = 5 feet (1.5 m). Sand wave fields with maximum heights up to 16 feet (5 m).	Loose to medium dense SAND with GRAVEL	Up to 4 knots
3	36-55 km	Generally 33-49 feet (10-15 m) with few shoals, with shallow water depths (minimum 20 feet [6 m]) or deep water depths (maximum 65 feet [20 m]).	Typical height = 5 feet (1.5 m). Few sand wave fields with maximum heights up to 4m.	Loose to medium dense SAND	Up to 1-2 knots
4	55-59 km	Very shallow water depths of less than 16 feet (5 m).	Typical heights do not exceed approximately 3 feet (1 m). No extreme sand waves.	Loose to medium dense SAND	Up to 1-2 knots
5	23-27 km	33-49 feet (10-15 m).	Typical heights of 6.5-10 feet (2-3 m). Few sand wave fields, with maximum heights up to 13 feet (4 m).	Mainly SAND with GRAVEL, COBBLES, BOULDERS	Up to 4 knots

4.6.3 Environmental Considerations along OECC

Environmental considerations related to the OECC are discussed below.

4.6.3.1 Wetlands

This section addresses coastal resource areas affected by the Project that are below mean low water (MLW). Wetland resource areas affected above MLW are discussed in Section 5.2.1. Direct impacts associated with installation of the offshore export cables are shown in Table 4-13 and are discussed in the subsequent sections.

Marine survey work performed in 2017, 2018, and 2019 enabled the Company to assess installation methods and challenges. While the OECC is suitable for cable installation, large sand waves are present in certain areas, and pre-cable-laying dredging may be needed to ensure sufficient cable burial beneath the stable seabed (see Section 4.6.3.1.4). Sand wave dredging is most likely to be necessary in the areas of bedforms shown on Figure 4-6, although some sand waves outside these areas are possible, since they are mobile features. Dredged material release (from a trailing suction hopper dredge [TSHD]) would also be allowed within surveyed areas identified as sand waves within the OECC, while such release would be prohibited within areas mapped as hard bottom.

While the priority will be to achieve sufficient cable burial depth areas along the entire cable alignment, if burial is unsuccessful it may be necessary to use cable protection (described in Section 4.6.3.1.3) to protect the cable; the Company will seek to avoid and/or minimize the use of such cable protection, thus minimizing potential impacts.

As described in Section 5.4.1.1, the same family of installation equipment proposed for Vineyard Wind Connector 1 will be utilized for Vineyard Wind Connector 2. However, advances in cable installation technology have resulted in some nuanced changes as well as the availability of larger equipment options. To complicate matters, these pieces of equipment are highly specialized and, in some cases, only one or two may be available globally, adding uncertainty about the specific piece(s) of equipment that will be available for Project installation. The range of installation tools described in Section 5.4.1, coupled with the conservative impact assumptions in the following sections, ensures that larger installation equipment remains an option for the Project, providing the greatest chance of achieving target burial depth.

For all portions of the OECC, recolonization and recovery to pre-construction species assemblages is expected given the similarity of nearby habitat and species. Nearby, unimpacted seafloor will likely act as refuge area and supply a brood stock of species, which will begin recolonizing disturbed areas post-construction. Recovery timeframes and rates in a specific area depend on disturbance, sediment type, local hydrodynamics, and nearby species virility.[7] Previous research conducted on benthic community recovery after disturbance found that recovery to pre-construction biomass and diversity values took two to four years.[8] Other studies have observed differences in recovery rates based on sediment type, with sandy areas recovering more quickly (within 100 days of disturbance) than muddy/sand areas.[9]

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7 Dernie, K. M., Kaiser, M. J., & Warwick, R. M. (2003). Recovery rates of benthic communities following physical disturbance. Journal of Animal Ecology, 72 (6), 1043-1056.

8 Van Dalfsen, J. A., & Essink, K. (2001). Benthic community response to sand dredging and shoreface nourishment in Dutch coastal waters. Senckenbergiana marit, 31(2),329-32.

9 (1) Freiwald, A., Fosså, J.H., Grehan, A., Koslow, T., Roberts, J.M. (2004). Cold-water Coral Reefs. UNEP-WCMC, Cambridge, UK; and (2) Rogers, A. (2004). The biology, ecology and vulnerability of deep-water coral reefs. International Union for Conservation of Nature and Natural Resources. 10 pp.

Table 4-13 OECC Characteristics and Impacts from Installation of 2 Offshore Export Cables (rounded to the nearest acre unless otherwise noted)

	State Waters Only	*State & Federal Waters*
Offshore Export Cable Corridor Characteristics		
Total Length (per cable, miles)[1]	23 (37 km)	63 (101 km)
Volume of sand wave dredging (nearest 1,000 m^3)[2]	81,000 (106,000 cy)	138,000 (180,000 cy)
Estimated length of dredging (miles)	4.2 (6.8 km)	10.1 (16.3 km)
Volume of sediment fluidized in trench (nearest 1,000 m^3)[3]	112,000	306,000
Impact Calculations		
Trench impact zone (acres)[4]	18	50
Disturbance zone from tool skids/tracks (acres)[5]	56	153
Direct dredging impacts (acres)[6]	25	55
Anchoring (acres)[7]	12.7	34.8
Cable Protection (acres)[8]	TBD	TBD

1 Route lengths provided in miles, with 1 mile = 0.87 nautical miles. This length of offshore export cable includes a 5% allowance for micro-siting within the OECC outside the Lease Area, and a 15% allowance for micro-siting within the Lease Area.

2 The dredging volume represents a best estimate based on bathymetry data. Significant variation in mobile sand wave features is observed spatially and temporally, and because these bedforms will inherently shift and change form over time the estimate is intentionally conservative.

3 It is assumed that an area up to 3.3 feet (1 m) wide may be fluidized during installation with a jet-plow.

4 Based on information from the Company's engineers, depending on the tool used for cable installation (e.g., jet-plow, mechanical plow, etc.), the direct trenching impact area will vary between 1.3 and 3.3 feet (0.4 – 1 m) in width. The impact area provided in the table reflects the most conservative 3.3-foot (1-m) impact width.

5 Depending on the tool used for cable installation (e.g., jet-plow, mechanical plow), each skid/track on the installation tool will have the potential to cause minor disturbance along an area approximately 5 feet (1.5 m) wide, although the functional impact is expected to be minor. The impact area identified in the table reflects the temporary impact from two skids/tracks, and therefore assumes a 10-foot-wide (3-m-wide) disturbance zone.

6 Direct dredging impacts are calculated based on the estimated length of dredging and assumed sideslopes of approximately 1:3. Since the dredging area will overlap with the 3.3-foot (1-m) wide trench impact zone and 10-foot (3-m) wide skid disturbance zone, these areas have been subtracted from the dredging impact area to avoid double-counting impacts. See Section 4.6.3.1.4 for more details.

7 See Section 4.6.3.1.2.

8 Although the Company's priority is to achieve sufficient burial depth and avoid cable protection, some cable protection may be required. Project engineers are currently working to estimate the possible length of cable protection that may be necessary along the two proposed offshore export cables. See Section 4.6.3.1.3 for additional details.

4.6.3.1.1 Cable Installation Tool

Cable installation tools are described in detail in Section 5.4.1.1. A variety of tools may be used for portions of the OECC, many of which are specialized and would be used only in limited areas where specific conditions are encountered. Typical techniques include jetting techniques (e.g., jet-plow or jet trenching) or a mechanical plow, either of which would have a temporary trench disturbance up to approximately 3.3 feet (1 m) wide. In addition to the trench impact on the seafloor, the cable installation tool may move along the seafloor on skids or tracks. These skids or tracks, each up to approximately 5 feet (1.5 m) wide, will slide over the surface of the seafloor, and as such have the potential to disturb benthic habitat; however, they are not expected to dig into the seabed, and therefore the impact is expected to be minor. Since the cable installation will affect a corridor that will pass similar habitats on adjacent sides, the area affected by cable burial or skids/tracks on the installation tool is expected to recolonize relatively quickly.

As described in Section 4.6.3.2, while cable installation activities will result in some temporary elevated turbidity and localized sediment dispersion in the water column, the sediment, which is briefly fluidized by the cable installation tool, will quickly settle out of the water column.

A BOEM study published in March 2017 assessed impacts from cable-laying activities associated with construction of the Block Island Wind Farm.[10] That study identified formation of a temporary 2.7-inch-high "overspill levee" on either side of the cable placement. The overspill levee consisted of material deposited outside of the trench during jet-plow activities. The BOEM study indicated that overspill levees were observed an average distance of 12.5 feet (3.8 meters) from the centerline of the trench (for an average total impact width of 25 feet) at an average thickness of 2.7 inches (7 cm). Importantly, the study described the overspill levees as very temporary features that were only apparent for a few days following cable installation, and that they were gone within one to two weeks. The study authors noted:

> *We attribute the ability to discern the overspill levees to surveying during jet-trenching and within a few days after the jet-trenching occurred from the mainland cable lay… We have noted that on post-lay surveys conducted 1 to 2 weeks after trenching, that overspill levees are rarely distinguishable.*[11]

Given the dynamic marine environment, the Company anticipates that the trench area, regardless of which cable installation method is used, will be quickly reworked by currents, refilling possible low portions of the trench as quickly as they would remove any potential

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10 James Elliott, K. Smith, D.R. Gallien, and A. Khan. 2017. *Observing Cable Laying and Particle Settlement during the Construction of the Block Island Wind Farm*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-027. 225 pp.

11 James Elliott, K. Smith, D.R. Gallien, and A. Khan. 2017. Observing Cable Laying and Particle Settlement during the Construction of the Block Island Wind Farm. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-027. p.46.

"overspill levees". Vineyard Wind will be formulating a Benthic Habitat Monitoring Plan that is intended to document habitat and benthic community disturbance and recovery following construction.

For some additional context, a post-construction marine survey conducted in 2015 within six weeks of installation of a submarine cable from Falmouth to Tisbury on Martha's Vineyard found that benthic disturbances were only visible along some parts of the cable route.

The Company will prioritize the least environmentally impactful cable installation alternative(s) that is/are practicable for each segment of cable installation. In addition to selecting an appropriate tool for the site conditions, Vineyard Wind will work to minimize the likelihood of insufficient cable burial. For example, if the target burial depth is not being achieved, operational modifications may be required. Subsequent attempts with a different tool (such as controlled flow excavation) may be required where engineering analysis indicates subsequent attempts may help achieve sufficient burial.

4.6.3.1.2 Anchoring

Vineyard Wind is assessing the potential use of Dynamic Positioning (DP) vessels, but many portions of the OECC are too shallow for DP cable-laying vessels. As a result, anchored cable-laying vessels are expected to be used along the entire length of the OECC, and particularly in areas of shallow water and/or strong currents. Anchored vessels will avoid sensitive seafloor habitats to the greatest extent practicable. Contractors will be provided with a map of sensitive habitats prior to construction with areas to avoid and shall plan their mooring positions accordingly. Vessel anchors will be required to avoid known eelgrass beds and will avoid other sensitive seafloor habitats and SSU areas (e.g., hard or complex bottom) as long as it does not compromise the vessel's safety or the cable installation. Where it is considered impossible or impracticable to avoid a sensitive seafloor habitat when anchoring, use of mid-line anchor buoys will be considered, where feasible and considered safe, as a potential measure to reduce and minimize potential impacts from anchor line sweep. Mid-line buoys are placed somewhere along the length of an anchor line to support the weight of the line and hold a portion of the line off the seabed. By suspending the anchor lines, mid-line buoys prevent the line from dragging and scouring the seafloor, which minimizes anchor sweep and associated impacts. Vessel operators will determine when the use of mid-line anchor buoys is considered infeasible and/or unsafe.

While Vineyard Wind is committed to avoiding anchoring except where necessary, the discussion below presents a conservative estimate of potential anchoring impacts.

Project engineers estimate approximately 323 square feet (30 m^2) of disturbance from each anchor (assuming an approximately 10-ton anchor), such that a vessel equipped with nine anchors would disturb approximately 2,900 square feet (270 m^2) per each anchoring set.[12] A nine-point anchor spread provides greater force on the cable burial tool than a spread with fewer anchors, enabling greater burial depth, and the assumptions herein include a larger anchor to accommodate larger installation vessels. In addition, anchored vessels may deploy up to two spud legs at each anchoring location to secure the cable-laying vessel while its anchors are being repositioned. Each deployment of two spuds would affect approximately 108 square feet (10 m^2) of seafloor, making the total disturbance per anchoring set approximately 3,008 square feet (280 m^2). Potential impacts from anchoring are summarized in Table 4-13, and the calculation of impacts from anchoring is shown in Table 4-14. Anchoring will not be performed in eelgrass.

Table 4-14 Estimated anchoring impacts from installation of 2 offshore export cables.

	State waters	State + Federal waters
Length of OECC (miles)	23	63
# of cables	2	2
Disturbance per anchoring set	3,008 sf	3,008 sf
# of repositioned anchoring sets per cable*	92	252
Total temporary impact	*12.7 acres*	*34.8 acres*

* Assumes an anchored installation vessel may need to reposition every approximately 1,312 feet (400 m).

To install the cable close to shore using tools that are best optimized to achieve sufficient cable burial, the cable laying vessel may temporarily ground nearshore, impacting an area of up to 2.4 acres (9,750 m^2) per cable. Any anchoring, spud leg deployment, or grounding will occur within surveyed area of the OECC.

4.6.3.1.3 Cable Protection

The Company's priority will be to achieve adequate burial depth of the two offshore export cables and to avoid the need for any cable protection. However, it is possible that achieving adequate burial depth may be unsuccessful in areas where the seafloor is composed of consolidated materials, making complete avoidance of cable protection measures infeasible. In the event sufficient burial depth cannot be achieved, alternative cable protection methods may be necessary. The Company will seek to avoid and/or minimize the use of such cable protections, and cable protection will only be used where necessary, thus minimizing potential impacts. If needed, the methods for cable protection will be:

12 The impacts from anchor sweep are not quantified at this time due to the difficulty of estimating potential anchoring practices at this planning stage.

- Rock placement: Rocks will be laid on top of the cable to provide protection. Rock will be installed in a controlled and accurate manner on the seafloor using a dynamic positioning fall-type vessel. Rocks used for cable protection will be sized for site-specific conditions; where feasible, this protection will consist of rocks 2.5 inches (6.4 cm) in diameter or larger.[13]

- Gabion rock bags: This method involves rocks encased in a net material (e.g., a polyester net) that can be accurately deployed on top of the cable and subsequently recovered, if necessary, for temporary or permanent cable protection. Each bag is equipped with a single lifting point to enable its accurate and efficient deployment and recovery. These rock bags have been deployed in other high-energy marine environments such as the North Sea, and the net material used for the rock bags is designed to have an approximately 50-year lifespan.

- Concrete mattresses: These "mattresses" are prefabricated flexible concrete coverings consisting of high-strength concrete profiled blocks cast around a mesh material (e.g., ultra-violet stabilized polypropylene rope) that holds the blocks together. This mattress construction provides flexibility, enabling the mattress to settle over the contours of the cable and seafloor. The mesh in this application would be designed to have a decades-long lifespan.

- Half-shell pipes or similar (only for cable crossings or where the cable is laid on the seafloor): These products are made from composite materials and/or cast iron with suitable corrosion protection and are fixed around the cable to provide mechanical protection. Half-shell pipes or similar solutions are not used for remedial cable protection but could be used at cable crossings or where cable must be laid on the surface of the seabed. The half-shell pipes do not ensure protection from damage due to fishing trawls or anchor drags (although they will offer some protection they will not prevent damage).

Project engineers are currently working to estimate the possible length of cable protection that may be necessary along the two proposed offshore export cables. Assuming concrete mattresses are used, the Company's engineers have determined that cable protection of approximately 10 feet (3 m) wide will be sufficient to protect the cable. Should rock placement be the required methodology of cable protection, a greater width of approximately 30 feet (9 m) would be needed to account for sideslopes.[14] Impact calculations are presented in Table 4-13.

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[13] Some rocks may be fragmented into smaller pieces during handling, transport, and installation.

[14] There are currently no anticipated cable crossings for the proposed Project. Should a cable crossing become necessary, cable protection of up to 30 feet (9 m) wide may be necessary. In addition, based on the actual conditions encountered at splice joint locations, cable protection width may vary, but if wider than 9 feet (3 m) the cable protection at splice joints is expected to fall within total cable protection estimates.

Vineyard Wind intends to avoid or minimize the need for cable protection to the greatest extent feasible through careful site assessment and thoughtful selection of the most appropriate cable installation tool to achieve sufficient burial. Areas requiring cable protection, if any, will be the only locations where post-installation conditions at the seafloor may permanently differ from existing conditions; however, such cable protection would only be expected within hard bottom areas, and the cable protection itself would function as hard bottom.

4.6.3.1.4 Sand Wave Dredging

As described in Section 4.6.2, some portions of Nantucket Sound have areas of complex bottom composed of active sand waves, which the Company has assessed over multiple seasons of marine surveys. Sand waves are dynamic features with changing morphology that move across the seafloor. As a result, where sand waves are large, it may be necessary to perform pre-cable-laying dredging to remove the tops of these features along the cable alignment to ensure sufficient burial within the underlying stable seabed.

The stretch of the OECC where sand wave dredging may be needed is largely coincident with areas mapped as complex bottom as shown on Figure 4-6. No dredging within 2.6 miles of the Cape Cod mainland is anticipated. It is important to note that dredging, if performed, would not occur along the entire stretch where sand waves may be present; rather, dredging would only be performed to remove the tops of each sand wave to the extent needed at the time of construction to ensure sufficient burial within the stable seabed.

Dredging will be limited to only the extent required to achieve adequate cable burial depth during cable installation. Where dredging is necessary, it is conservatively assumed that the dredged area will typically be approximately 50 feet (15 m) wide at the bottom (to allow for equipment maneuverability) with approximately 1:3 sideslopes for each of the two cables. The depth of dredging will vary with the height of sand waves, and hence the dimensions of the sideslopes will likewise vary with the depth of dredging and sediment conditions. This dredge corridor includes the up to 3.3-foot-wide (1-m-wide) cable installation trench and the up to 10-foot-wide (3-m-wide) temporary disturbance zone from the tracks or skids of the cable installation equipment.

For both offshore export cables combined, the Company's engineers anticipate that the length of dredging in state waters could be approximately 4.2 miles (6.8 km) and the area impacted by dredging in state waters would be approximately 25 acres (inclusive of sideslopes but excluding the overlapping impacts from trenching and tool skids). The estimated volume of dredged material in state waters is up to approximately 81,000 cubic meters (106,000 cubic yards). Actual dredge volumes will depend on the final cable alignments and cable installation method; a cable installation method that can achieve a deeper burial depth will require less dredging. The average dredge depth is expected to be approximately 1.6 feet (0.5 m) and may range up to a maximum of approximately 17 feet (5.25 m) in localized areas.

With respect to potential habitat impacts, sand wave areas are intrinsically dynamic and unstable, and while dredging will be avoided and minimized wherever possible, those areas are typically sub-optimal areas for benthic organisms.

Dredging could be accomplished by several techniques. European offshore wind projects have typically used a TSHD. A TSHD vessel contains one or more drag arms that extend from the vessel, rest on the seafloor, and suction up sediments. Dredges of this type are also commonly used in the U.S. for channel maintenance, beach nourishment, and other uses. For the Vineyard Wind Connector 2, a TSHD would be used to remove enough of the top of a sand wave to allow subsequent cable installation within the stable seabed. Where a TSHD is used, it is anticipated that the TSHD would dredge along the cable alignment until the hopper is filled to an appropriate capacity, then the TSHD would sail several hundred meters away and deposit the dredged material within an area of the surveyed corridor that also contains sand waves (see Figure 4-6).

A second dredging technique involves jetting by controlled flow excavation. Controlled flow excavation uses a pressurized stream of water to push sediments to the side. The controlled flow excavation tool draws in seawater from the sides and then propels the water out from a vertical downpipe at a specified pressure and volume. The downpipe is positioned over the cable alignment, enabling the stream of water to fluidize the sediments around the cable, which allows the cable to settle into the trench. This process causes the top layer of sediments to be sidecast to either side of the trench; therefore, controlled flow excavation would both remove the top of the sand wave and bury the cable. Typically, a number of passes are required to lower the cable to the minimum sufficient burial depth.

A TSHD can be used in sand waves of most sizes, whereas the controlled flow excavation technique is most likely to be used in areas where sand waves are less than 6.6 feet (2 m) high. Therefore, the sand wave dredging could be accomplished entirely by the TSHD on its own, or the dredging could be accomplished by a combination of controlled flow excavation and TSHD, where controlled flow excavation would be used in smaller sand waves and the TSHD would be used to remove the larger sand waves.

No dredging is proposed in hard-bottom areas (e.g., boulders, cobble bottom). The only dredging proposed for the Project is where large sand waves, features that can be considered "complex" due to their bathymetric relief, necessitate pre-cable-laying dredging to ensure that the necessary burial depth can be achieved. As noted previously, sand waves, although they do provide bathymetric variability, are seafloor features that change quickly and hence do not enable the formation of complex benthic communities.

4.6.3.1.5 Compliance with Massachusetts Wetlands Protection Act Regulations

The Massachusetts WPA Regulations describe various coastal wetland resource areas. This section addresses coastal resource areas affected by the Project that are below MLW. Wetland resource areas affected above MLW are discussed in Section 5.2.1.

Although Vineyard Wind believes the Project as proposed meets all relevant wetland performance standards, Vineyard Wind may also apply for approvals as a Limited Project. Under the Massachusetts WPA, certain activities are afforded Limited Project status, which allows permitting authorities to approve projects that are inherently unable to meet wetland performance standards that are specified for the various resource areas defined in the Act. The Limited Project provision for work affecting coastal resource areas Regulations at 310 CMR 10.24(7):

> *10.24 (7) Notwithstanding the provisions of 310 CMR 10.25 through 10.35, the Issuing Authority may issue an Order of Conditions and impose such conditions as will contribute to the interests identified in M.G.L. c. 131, § 40, permitting the limited projects listed in 310 CMR 10.24(7)(a) through (c), although no such project may be permitted which will have any adverse effect on specified habitat sites of Rare Species, as identified by procedures established under 310 CMR 10.37. In determining whether to exercise its discretion to approve the limited projects listed in 310 CMR 10.24(7)(a) through (c), the Issuing Authority shall consider the following factors: the magnitude of the alteration and the significance of the project to the interests identified in M.G.L. c. 131, § 40, the availability of reasonable alternatives to the proposed activity, and the extent to which adverse impacts are minimized and the extent to which mitigation measures including replication or restoration are provided to contribute to the protection of the interests identified in M.G.L. c. 131, § 40. Adverse effects to be minimized include without limitation any adverse impacts on the relevant interests of M.G.L. c. 131, § 40, due to changes in wave action or sediment transport or adjacent coastal banks, coastal beaches, coastal dunes, salt marshes or barrier beaches. The provisions of 310 CMR 10.24(7)(a) through (c) are not intended to prohibit the Issuing Authority from imposing such additional conditions as are necessary to contribute to the interests of M.G.L. c. 131, § 40 where the indicated minimizing measures are not sufficient.*

The Limited Project provisions specifically apply to the installation of an electric transmission system beneath Land Under the Ocean, Barrier Beach, and Land Subject to Coastal Storm Flowage:

> *10.24(7)(b): The construction, reconstruction, operation and maintenance of underground and overhead public utilities, limited to electrical distribution or transmission lines, or communication, sewer, water and natural gas lines, may be permitted as a limited project pursuant to 310 CMR 10.24(7) provided that the project complies with all applicable provisions of 310 CMR 10.24(1) through (6), (9) and (10), and (7)(b)1. through 9.*

The Project will comply with all applicable provisions of 310 CMR 10.24(1) through (6), (9) and (10) as well as (7)(b) 1 through 9 and therefore qualifies for Limited Project status.

The OECC is located entirely within Land Under the Ocean (310 CMR 10.25), and certain segments pass through Land Containing Shellfish as defined in the Regulations (310 CMR 10.34). These two resource areas and compliance with Massachusetts WPA regulations are described below.

Land Under the Ocean

Land Under the Ocean is defined as the submerged land that extends seaward from MLW out to the boundary of a municipality's jurisdiction. Where the Project is in Nantucket Sound, this municipal offshore boundary is coincident with the three-nautical-mile (3.45-statute-mile) limit that extends seaward from municipalities.[15] Submerged land in the central portion of Nantucket Sound, which is beyond these municipal boundaries, is under federal jurisdiction; Figure 1-4 distinguishes between state and federal jurisdictions.

The Massachusetts WPA Regulations require that projects located within Land Under the Ocean satisfy certain general performance standards when the resource is found to be significant to the protection of marine fisheries, protection of wildlife habitat, storm damage prevention, or flood control (310 CMR 10.25 (3) through (7)).[16] Of relevance to this Project, 310 CMR 10.25(5) states:

> *(5) Projects not included in 310 CMR 10.25(3) or (4)* [relating to dredging projects for navigational purposes] *which affect nearshore areas of land under the ocean shall not cause adverse effects by altering the bottom topography so as to increase storm damage or erosion of coastal beaches, coastal banks, coastal dunes, or salt marshes.*

Use of HDD will avoid offshore cable installation activities within approximately 1,000 to 1,200 feet (300 to 365 m) of the shoreline while also avoiding impacts to Coastal Beach (see Figure 4-9 for a depiction of wetland resource areas at the landfall sites). Installation of the offshore export cables will require the temporary disturbance of two narrow strips of the seafloor to achieve sufficient burial depth (see Sections 4.6.3.1.1 and 5.4 for more detailed discussions of offshore export cable installation). Cable burial will temporarily displace some marine sediments that do not immediately resettle back into the fluidized trench, but these displaced sediments will return to the seafloor in the wake of the cable installation tool generally within a few meters of the furrow created during cable installation. Particle sediment monitoring studies completed for the Block Island Wind Farm's offshore cable installation found that displaced sediments were an average distance from the trench centerline of 12.5 feet (3.8 meters) at a thickness of 2.8

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15 The municipal boundaries are presumed to extend out to sea three nautical miles (3.45 statute miles) to the outer limits of state waters as shown on a chart entitled "Nantucket Sound and Approaches" (NOAA Chart 13237).

16 General Performance Standards (3) and (4) are relevant to dredging projects that are for navigational purposes, such as maintenance or improvement dredging of harbor entrance channels. *See* 310 CMR 10.25(3) and (4). As described above, installation of the offshore export cables will require dredging where large sand waves are present; however, because the Project is not intended to improve or maintain navigation, these performance standards do not apply.

inches (7 cm).[17] Such a minor alteration to the bottom topography would not alter water circulation or sediment transport patterns, and would not increase erosion of coastal beaches, coastal banks, coastal dunes, or salt marshes.

Discontinuous sand wave dredging may be required in areas where currents have created large, mobile sand waves. These sand waves are located in high-energy marine environments in both Muskeget Channel and Nantucket Sound and more than 6,500 feet (2,000 meters) from the nearest coastal beach, coastal bank, coastal dune, or salt marsh. Where the offshore cable installation must cross a sand wave, it will be necessary to provide additional burial depth to achieve sufficient coverage beneath the stable seabed surface and prevent the cable from being exposed as the sand wave advances across the seafloor. Where large sand waves are encountered, it may be necessary to carve a notch into the sand wave of sufficient width and depth so the cable installation tool can proceed through it, installing the cables beneath the stable seabed.

A TSHD is the anticipated methodology for dredging given the heights of sand waves in the Project area, although jetting could be used in smaller sand waves (see Section 5.4.1.2). A TSHD uses suction to remove material from the seafloor, depositing it in the “hopper” of the vessel. With this methodology, it is anticipated that the TSHD would dredge along the cable alignment until the hopper is filled to an appropriate capacity, then the TSHD would sail several hundred meters away and deposit the dredged material within an area of the surveyed corridor that also contains sand waves. Such depositing of dredged material would be prohibited within areas identified as hard bottom.

Dredging will be limited to only the extent required to achieve adequate cable burial depth during cable installation. No dredging is proposed in hard-bottom areas (e.g., boulders, cobble bottom). The only dredging proposed for the Project is where large sand waves, features that can be considered “complex” due to their bathymetric relief, necessitate pre-cable-laying dredging to ensure that the necessary burial depth can be achieved. Sand waves, although they do provide bathymetric variability, are seafloor features that change quickly and hence do not enable the formation of complex benthic communities.

Any dredging required for offshore cable installation through sand waves will occur within narrow corridors in areas relatively far from shore (greater than one mile); therefore, regardless of the dredge method selected through sand waves, installation of the offshore export cables is not expected to increase the risk of erosion in coastal areas. The impacts will be modest and in compliance with performance standards.

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[17] James Elliott, K. Smith, D.R. Gallien, and A. Khan. 2017. Observing Cable Laying and Particle Settlement During the Construction of the Block Island Wind Farm. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-027. 225 pp.

Also potentially relevant to this Project, 310 CMR 10.25(6) states:

> *(6) Projects not included in 310 CMR 10.25(3) which affect land under the ocean shall if water-dependent be designed and constructed, using best available measures, so as to minimize adverse effects, and if non-water-dependent, have no adverse effects, on marine fisheries habitat or wildlife habitat caused by:*
>
> > *(a) Alterations in water circulation;*
> >
> > *(b) Destruction of eelgrass (Zostera marina) or widgeon grass (Rupia maritina) beds;*
> >
> > *(c) Alterations in the distribution of sediment grain size;*
> >
> > *(d) Changes in water quality, including, but not limited to, other than natural fluctuations in the level of dissolved oxygen, temperature or turbidity, or the addition of pollutants; or*
> >
> > *(e) Alterations of shallow submerged lands with high densities of polychaetes, mollusks or macrophytic algae.*

The Project is water-dependent as defined in the Massachusetts Waterways Regulations at 310 CMR 9.12(2)(b)10, which includes infrastructure facilities used to deliver electricity to the public from an offshore facility located outside the Commonwealth. As a water-dependent use, the Project must be designed and constructed using best available measures in order to minimize adverse effects.

The proposed cable installation methods are well documented as environmentally conscious operations with minimal temporary impacts to the seafloor and water quality. Installation of the export cables will require some displacement of marine sediments to achieve desired cable burial depths, but in most areas the method of installation will result in minimal alteration to the seafloor topography. More alteration will be required in high-energy areas where large sand waves are encountered, but these high-energy areas are characterized by constantly changing bathymetry, and any alteration due to the Project is expected to be temporary. None of the affected areas will be altered to the extent that any significant changes occur to water circulation or sediment grain size distribution.

The OECC has been sited to avoid areas of eelgrass or widgeon grass, and the installation methodologies will minimize impacts to benthic organisms. The only eelgrass identified through the Company's surveys is co-located with an area of hard bottom offshore from Covell's Beach. However, use of HDD in this location would entirely avoid impacts to the hard bottom and co-located eelgrass. Therefore, the Project will not impact eelgrass beds. The Company will consult with the DMF to minimize impacts to mollusks and other benthic organisms.

In addition, under 310 CMR 10.25(7), projects with certain adverse effects are presumed impermissible:

> *(7) Notwithstanding the provisions of 310 CMR 10.25(3) through (6), no project may be permitted which will have any adverse effect on specified habitat sites of rare vertebrate or invertebrate species, as identified by procedures established under 310 CMR 10.37.*

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) has mapped all state waters within Nantucket Sound as priority habitat of state-listed rare species (Massachusetts Natural Heritage Atlas, 14th Edition, 2017). As a result, the OECC will necessarily cross priority habitat within state waters. The Company will consult with the NHESP in accordance with the Massachusetts Endangered Species Act (MESA, 321 CMR 10.14) to ensure that impacts to offshore rare species are avoided or minimized to greatest extent practicable. These required consultations with NHESP are consistent with the procedures established under 310 CMR 10.37. Rare species are further discussed in Section 4.6.3.3.

Land Containing Shellfish

WPA Regulations define Land Containing Shellfish as land under the ocean, tidal flats, rocky intertidal shores, salt marshes, and land under salt ponds that is known to support the following species of shellfish: Bay Scallop *(Argopecten irradians)*; Blue Mussel *(Mytilus edulis)*; Ocean Quahog *(Arctica islandica)*; Oyster *(Crassostrea virginica)*; Quahog *(Mercenaria merceneria)*; Razor Clam *(Ensis leei)*; Sea Clam *(Spisula solidissima)*; Sea Scallop *(Placopecten magellanicus)*; and Soft Shell Clam *(Mya arenaria)*.

The OECC will cross areas deemed significant to shellfish habitat within state waters. According to maps published by the DMF, the corridors cross areas mapped as shellfish suitability areas for surf clam and blue mussel (see Figure 4-10).

Offshore export cable installation within these areas may result in some localized mortality of shellfish and other organisms in the direct path of the installation tool, and within the water column from water withdrawals. Soon after disturbance, recolonization and recovery to pre-construction species assemblages is expected given the similarity of nearby habitats and species, the limited area of disturbance, and the mobility of the organisms in some or all life stages. Nearby, unaffected areas will likely act as refuge areas and supply a brood stock of species, which will begin recolonizing disturbed areas post-construction. A post-construction marine survey conducted in 2015 within six weeks of installation of a submarine cable from Falmouth to Tisbury on Martha's Vineyard found that benthic disturbances only occurred along some parts of the cable route.[18]

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18 Epsilon Associates, Inc. and CR Environmental, Inc. 2015. Martha's Vineyard Hybrid Submarine Cable Post-Construction Marine Survey Report. Prepared for Comcast and NSTAR Electric Company.

Anchoring may be required along the entire OECC, particularly in areas of shallow water and/or strong currents, to enable the option of using these deeper penetration tools. Anchors would disturb the substrate and leave a temporary irregularity in the seafloor resulting in some localized mortality of infauna. In addition, an anchor cable would sweep portions of the seafloor as the installation equipment moves along the cable. Vineyard Wind will implement a monitoring plan to document disturbance and recovery of marine habitat along the cable installation corridor. A monitoring program focusing on benthic habitat and communities will be performed to measure potential impacts and the recovery of these resources comparable to controls outside the area of construction.

The Massachusetts WPA Regulations require that projects located in resource areas that are determined to be significant to the protection of land containing shellfish, and therefore marine fisheries, shall satisfy certain general performance standards (310 CMR 10.34 (4) through (8)). These performance standards are excerpted below:

> *(4) Except as provided in 310 CMR 10.34(5), any project on land containing shellfish shall not adversely affect such land or marine fisheries by a change in the productivity of such land caused by:*
>
> > *(a) Alterations of water circulation;*
> >
> > *(b) Alterations in relief elevation;*
> >
> > *(c) The compacting of sediment by vehicular traffic;*
> >
> > *(d) Alterations in the distribution of sediment grain size;*
> >
> > *(e) Alterations in natural drainage from adjacent land; or*
> >
> > *(f) Changes in water quality, including, but not limited to, other than natural fluctuations in the levels of salinity, dissolved oxygen, nutrients, temperature or turbidity, or the addition of pollutants.*

The Project is not anticipated to result in any permanent alterations to water circulation, relief elevation, or distribution of sediment grain size. There will be no change to natural drainage from adjacent land, and no compacting of sediments from vehicular traffic or installation gear. Offshore export cable installation may result in some temporary impacts to shellfish in the area immediately along the installation path.

> *(5) Notwithstanding the provisions of 310 CMR 10.34(4), projects which temporarily have an adverse effect on shellfish productivity but which do not permanently destroy the habitat may be permitted if the land containing shellfish can and will be returned substantially to its former productivity in less than one year from the commencement of work, unless an extension of the Order of Conditions is granted, in which case such restoration shall be completed within one year of such extension.*

Vineyard Wind will be assembling a Benthic Habitat Monitoring Plan intended to document habitat and benthic community disturbance and recovery because of construction and installation.

(6) In the case of land containing shellfish defined as significant in 310 CMR 10.34(3)(b) (i.e., those areas identified on the basis of maps and designations of the Shellfish Constable), except in Areas of Critical Environmental Concern, the issuing authority may, after consultation with the Shellfish Constable, permit the shellfish to be moved from such area under the guidelines of, and to a suitable location approved by, the Division of Marine Fisheries, in order to permit a proposed project on such land. Any such project shall not be commenced until after the moving and replanting of the shellfish have been commenced.

The Company will work with the DMF and the shellfish constables from any towns along the OECC to minimize impacts to shellfish habitat, but is not proposing to relocate shellfish prior to cable installation.

(7) Notwithstanding 310 CMR 10.34(4) through (6), projects approved by the Division of Marine Fisheries that are specifically intended to increase the productivity of land containing shellfish may be permitted. Aquaculture projects approved by the appropriate local and state authority may also be permitted.

The Company is not proposing an aquaculture project, nor is it undertaking any efforts specifically intended to increase the productivity of Land Containing Shellfish.

(8) Notwithstanding the provisions of 310 CMR 10.34(4) through (7), no project may be permitted which will have any adverse effect on specified habitat of rare vertebrate or invertebrate species, as identified by procedures established under 310 CMR 10.37.

The Massachusetts NHESP has mapped all state waters within Nantucket Sound as priority habitat of state-listed rare species (Massachusetts Natural Heritage Atlas, 14th Edition, 2017). As a result, the OECC will necessarily cross priority habitat within state waters. The Company will consult with the NHESP in accordance with the MESA (321 CMR 10.14) to ensure that impacts to offshore rare species are avoided or minimized to greatest extent practicable. These required consultations with NHESP are consistent with the procedures established under 310 CMR 10.37.

4.6.3.2 Water Quality and Sediment Dispersion Modeling

Installation of the proposed offshore export cables will have localized and temporary effects on water quality, primarily related to trenching and limited dredging where sand waves are encountered. Temporary sediment disturbance associated with Project activities will cause minor, short-term, and localized increases in total suspended solids (TSS) along the OECC. Jet-plowing and minimizing the amount of sand wave dredging will minimize sediment disturbance. Estimated dredge volumes are shown in Table 4-13 above.

Furthermore, the buried offshore export will have no thermal effect on the water column. As documented in the Rhode Island Ocean Special Area Management Plan, the effect of heat from cables on sediments or water table is negligible:

> *"Studies on the effects of radiated heat from buried cables have found a rise in temperature directly above the cables of 0.19℃ (0.342℉) and an increase in the temperature of seawater of 0.000006℃ (0.0000108℉). This is not believed to be significant enough to be detectable against natural fluctuations."*[19]

4.6.3.2.1 Sediment Dispersion Modeling

To gain a thorough understanding of the sediment dispersion resulting from the Project's cable installation operations, a Hydrodynamic and Sediment Dispersion Modeling Study is being prepared by RPS that will update the study performed for the Vineyard Wind Connector 1. The study will utilize modern sediment dispersal modeling that incorporates bathymetry and hydrography data to assess above-ambient (i.e., excess) total suspended sediment (TSS) concentrations and patterns of sediment deposition along the OECC for cable installation activities as well as associated sand wave dredging.

The completed Sediment Dispersion Modeling Study will be included in the Draft Environmental Impact Report (DEIR), which is expected to be filed in Fall 2020. Based on results from the previous modeling study, it is expected that the revised modeling will demonstrate that sediment mobilized during cable-laying will resettle rapidly (within a number of hours), meaning that sediment mobilized during installation of the first cable will settle well before installation of the second cable.

Given the coarseness of sediment along the OECC, bioassay testing is not necessary. This kind of testing, which is used to assess the potential for biological impacts from suspension of contaminated sediments, is more appropriate for finer-grained sediments where historical contamination may be evident.

4.6.3.2.2 Offshore Vessel Refueling and Spill Prevention

A variety of offshore vessels will be used for Project construction and will require refueling. The environmental risks associated with such refueling are small and will be minimized using appropriate best practices, compliance with all applicable requirements, and effective advanced planning. Smaller vessels will likely refuel in port. Offshore refueling of large installation vessels may occur. The method of refueling will be dependent on the final selection of contractors, their vessel spread, the type of fuel used by those vessels, and fuel availability. In the case of offshore

[19] Rhode Island Coastal Resources Management Council. 2010. Ocean Special Area Management Plan (Ocean SAMP). Vol I, Chapter 8, page 100. This assessment was based on a 115-kV cable buried at approximately 6 feet below the seafloor, but would be expected to be comparable to the proposed 220 kV offshore export cables.

refueling, a Jones Act-compliant bunker barge or vessel would likely be used. The offshore refueling process would consist of the following three steps: (1) mooring the bunker barge/vessel to the installation vessel; (2) pumping the fuel from the bunker barge/vessel to the installation vessel; and (3) de-mooring the bunker barge/vessel. Vessels may need to travel to a more sheltered location (i.e., an area with more quiescent seas) before refueling can take place.

Vessel fuel spills are not expected. Nonetheless, Vineyard Wind is drafting an Oil Spill Response Plan (OSRP) in accordance with the requirements of 30 CFR Part 254, Subpart B, Oil Spill Response Plans for Outer Continental Shelf Facilities that will pertain to construction activities. In accordance with 30 CFR 254, the OSRP will demonstrate that Vineyard Wind can respond effectively in the unlikely event that oil is discharged from the Project. The OSRP will provide for rapid spill response, clean up, and other measures that would minimize any potential impact to affected resources from spills or accidental releases, including spills resulting from catastrophic events. Routine training and exercises regarding the content of the OSRP will be carried out regularly to prepare personnel to respond to emergencies should they occur. Secondary containment systems will be provided at operating areas more prone to spillage.

In the event of a spill or incident, the vessels' and construction firms' plans will be used to contain and/or stop an incident in compliance with requirements of the Project's OSRP. As such, these plans will be checked and reviewed by Vineyard Wind to make sure that they are in accordance with regulatory and Project requirements and that a spill plan is in place.

4.6.3.3 Rare Species

The Massachusetts NHESP has mapped all state waters within Nantucket Sound as priority habitat of state-listed rare species for various shorebirds (e.g., piping plover, least tern, roseate tern) (Massachusetts Natural Heritage Atlas, 14^{th} Edition, 2017). As a result, the OECC will necessarily cross priority habitat within state waters. In accordance with the MESA (321 CMR 10.14), the Company is consulting with NHESP to ensure that impacts to rare species from offshore export cable installation in Nantucket Sound are avoided or minimized to greatest extent practicable.

4.6.3.4 SSU Areas

As described above, the Massachusetts OMP identifies the following SSU areas for cable projects: (1) core habitat of the North Atlantic right whale, fin, and humpback whales; (2) hard/complex seafloor; (3) eelgrass; and (4) intertidal flats. For this Project, North Atlantic Right Whale core habitat, hard/complex seafloor, and eelgrass are all mapped within the general Project area; core habitat for other whale species is not present in the Project area. The OECC has been aligned to avoid North Atlantic Right Whale core habitat, and the landfall site was assessed and selected partially on the basis of avoiding eelgrass.

In addition, the alignment of the OECC reflects an effort to minimize the areas of hard and complex bottom that may be affected by cable installation. As described above, an installation corridor has been identified to provide some flexibility for final cable alignments. As shown on Figure 4-6, the installation corridor is narrower where necessary to avoid features such as SSU areas (e.g., hard/complex bottom). Nonetheless, some areas of mapped hard/complex bottom cannot be avoided, and the anticipated impacts to hard and complex bottom are presented in Table 4-13 above.

Section 6.4.5 describes Project consistency with the Massachusetts OMP, including an expanded discussion of management standards applicable to SSU areas as well as efforts to avoid and minimize impacts.

4.6.3.5 Marine Archaeology

Vineyard Wind is commissioning a marine archaeological assessment in accordance with BOEM's requirements that will assist in avoiding and mitigating potential adverse effects to significant cultural resources resulting from the Project. Surveys of the OECC to support the marine archaeological assessment were conducted in 2017 and 2018 as part of Vineyard Wind 1/Vineyard Wind Connector 1. Additional surveys of the OECC are planned for 2020, and will focus on areas where the OECC has been widened (i.e., areas that were not previously assessed as part of Vineyard Wind 1/Vineyard Wind Connector 1). The 2017 survey season included approximately 156.5 nautical miles (290 km) of survey along the OECC to support route feasibility. In 2018, a comprehensive survey covered approximately 2,878 nautical miles (5,330 km) of tracklines in the OECC.

Archival and documentary research and field investigations are being conducted as part of the cultural resource examination. Background research includes review of historical documents, previous research reports, shipwreck inventories, secondary sources, and historical map analysis. Much of this research is being conducted utilizing material from the archives of the Massachusetts Board of Underwater Archaeological Resources (MBUAR).

Field investigations conducted in 2017 and 2018 included high-resolution geophysical surveys utilizing magnetometer, side-scan sonar, shallow and medium penetration sub-bottom profilers, and a multibeam echosounder. Geophysical data collected were analyzed for both materials of pre-contact and historical origin that might be affected by Project activities. Geotechnical explorations, bottom grabs, CPTs, bores, and/or vibracores were conducted. The geotechnical surveys provided information on the nature of the Pleistocene/Holocene interface (ravinement surface), geomorphological landscape features, and provided material for sample radiocarbon dating. Geotechnical data also provide general verification of the geophysical interpretations and data throughout the OECC. A similar approach is planned for the 2020 surveys of those areas where the OECC is being widened.

While the marine archaeological assessment is ongoing, no direct evidence of pre-Contact Native American cultural materials has been recovered during investigations to date. However, geoarchaeological analysis of geophysical and geotechnical data indicate there are stream channel, lake, and estuarine landscape features within the Project area that may have the potential to contain archaeological materials. The expanded portion of the OECC will be similarly assessed for either direct evidence of pre-Contact Native American cultural materials or preserved landscape features that may have the potential to contain archaeological materials. Mitigation measures, if necessary, will be developed during the Section 106 process.

4.6.3.6 Avian Resources

Muskeget Channel is an area with high species richness and abundance. Some marine birds may be disturbed by vessels engaged in construction activities, which may lead to temporary displacement during cable installation. However, the duration of cable installation activities is temporary and short-term in any particular location, and most birds are likely habituated to vessel traffic in the Project area and specifically Muskeget Channel. There is a small possibility of collision with lighted vessels during construction in low-visibility conditions. Mitigation measures will reduce any impacts to insignificant levels because most birds, with exception of gulls, are less likely to be attracted to vessels during fair weather conditions. Because of the limited exposure, short-term duration of the proposed activities, and low behavioral vulnerability, population-level impacts are expected to be unlikely for coastal and marine birds. Risks will be further minimized through mitigation measures, which include, when practicable, down-shielding of lighting to limit bird attraction and disorientation.[20]

In addition to the slight potential for bird collisions with vessels, there may be temporary disruption to limited areas where such species forage. These potential impacts will be limited since the OECC avoids and minimizes impacts to sensitive or unique habitats and cable installation activities will be of short duration. The Company does not expect these impacts to be significant.

4.6.3.7 Fish and Fisheries Resources

The Vineyard Wind Connector 2 has been and continues to be designed to avoid and minimize impacts, including impacts to fish and fisheries resources. The alignment of the OECC is intended to minimize impacts to fish and fishing while enabling the delivery of clean renewable energy to the electrical grid. Measures that have been taken to site the Project while minimizing impacts include, but are not limited to:

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20 Poot, H., Ens, B. J., de Vries, H., Donners, M.A.H., Wernand, M.R., & Marquenie, J.M. 2008. Green Light for Nocturnally Migrating Birds. Ecology & Society 13.

- Routing of offshore export cables to avoid sensitive habitats used by fish to the greatest degree possible, including routing of the cable to avoid all eelgrass (see Section 6.4.5 for a discussion of consistency with the Massachusetts OMP);
- Consultation with commercial and recreational fisherman on the location of the cables;
- Prioritization of cable burial to reduce impacts to fishing during Project operations; and
- Implementation of a Fisheries Communications Plan (FCP), including the use of Fisheries Liaisons and multiple Fisheries Representatives, before, during, and after cable installation (see Attachment J for a draft FCP).

Vineyard Wind has been cultivating relationships and consulting with fishermen and the broader fishing community since 2010. The Company has had direct outreach with scores of individual fishermen in the region to understand, as fully as possible, historic, current, and potential fisheries within the affected area. Vineyard Wind has also been actively consulting with the MA Fishery Working Group, NE Fishery Management Council Habitat Committee, various local MA fishing alliances and partnerships, and has hired several fishery representatives, including a representative fisherman on Martha's Vineyard, who serves the fisheries interest and provides communication into the Project from the local fishing community.

Close coordination with fixed-gear fisheries will be necessary prior to construction to ensure fishermen are not placing gear along the cable alignments at the time construction activities begin in a particular section of the route. Although bottom trawl gear typically interacts with the seafloor, target burial depths for the cables will allow for safe deployment of such gear immediately after cable installation. Should the Project not be able to achieve target burial depth in certain areas, cable protection may be required. In such cases, it will be designed to minimize impacts to fishing gear, when possible, and fishermen will be informed of the areas where protection is used.

To further avoid and minimize impacts to commercial fishing activities, Vineyard Wind will implement a comprehensive communications plan with the various port authorities, federal, state, and local authorities, and other key stakeholders, including recreational fishermen and boaters, commercial fishermen, harbormasters, the Northeast Marine Pilots Association, and other port operators.

The DEIR, anticipated to be filed in early fall 2020, will provide additional information on the fish and fisheries resources potentially affected along the OECC.

4.6.3.8 Marine Mammals

Marine mammal species that are likely to occur in the vicinity of the OECC, and are considered common, include the North Atlantic Right Whale (NARW; *Eubalaena glacialis*), Humpback Whale (*Megaptera novaeangliae*), Fin Whale (*Balaenoptera physalus physalus*), Sei Whale (*Balaenoptera borealis*), Minke Whale (*Balaenoptera acutorostrata acutorostrata*), Long-Finned

Pilot Whale, Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*), Short-Beaked Common Dolphin, Bottlenose Dolphin (Western North Atlantic Offshore Stock), Harbor Porpoise (*Phocoena phocoena*), Harbor Seal (*Phoca vitulina concolor*), and Gray Seal. Other marine mammals may also occur near the OECC, but are less common. When in the vicinity of the OECC during construction, these species could be exposed to temporary stressors such as noise, increased vessel traffic, and equipment in the water that may result in short-term, localized disturbance of individuals.

Recognizing the possibility of these temporary impacts, Vineyard Wind will collaborate with BOEM and NOAA to integrate practicable technology choices in equipment, mitigation, and monitoring to meet the necessary standards for permitting and species protection. BMPs to avoid and minimize impacts to marine mammals, as well as any mitigation for unavoidable impacts, will be integrated and applied to construction and installation to meet the required standards of applicable statutes, regulations, and policies in collaboration with implementing agencies. Certain BMPs or mitigation measures that may be individually practicable may not be practicable in concert. Thus, a suite of measures will be developed as part of the permitting processes to ensure efficacy and practicability of the mitigation as an integrated whole.

Vineyard Wind will adhere to legally mandated speed, approach, and other requirements for NARW in the offshore Project area. As safe and practicable, NOAA's vessel strike guidance will also be implemented.[21] Technology used to prevent harm to marine mammals from activities associated with installation and operation the Project may include, but is not limited to, passive acoustic monitoring recorders and thermal cameras.

These measures will be refined throughout the permitting process, and the DEIR will contain a more detailed discussion of measures to avoid and minimize impacts to marine mammals.

4.6.3.9 Conclusion

As described in Sections 4.6.3.1.1 and 5.4.1, the proposed offshore export cable installation methods are well documented as environmentally conscious operations with minimal temporary impacts to the seafloor and water quality. Installation of the export cables will require some displacement of marine sediments to achieve desired cable burial depths, but in most areas the method of installation will result in minimal alteration to seafloor topography. More alteration will be required in high-energy areas where large sand waves are encountered, but these high-energy areas are characterized by constantly changing bathymetry, and any alteration due to the Project is expected to be temporary. None of the affected areas will be altered to the extent that it results in significant impacts to water circulation or sediment grain size distribution.

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21 NOAA (2008). Vessel Strike Avoidance Measures and Reporting for Mariners NOAA Fisheries Service, Southeast Region. Retrieved from http://sero.nmfs.noaa.gov/protected_resources/ section_7/guidance_docs/ documents/copy_of_vessel_strike_avoidance_february_2008.pdf

As discussed in Section 4.6.3.2, sediment mobilized during cable-laying is expected to resettle rapidly (within a number of hours), meaning that sediment mobilized during installation of the first cable will settle well before installation of the second cable. This is based on sediment dispersion modeling performed for Vineyard Wind Connector 1, which is being updated for the Vineyard Wind Connector 2 and will be presented in the DEIR. Consequently, the impacts of offshore cable installation on water turbidity and sediment dispersal will not be additive; instead, similar impacts would be repeated for each of the offshore export cables installed.

The Massachusetts NHESP has mapped all state waters within Nantucket Sound as priority habitat of state-listed rare species for various shorebirds (e.g., piping plover, least tern, roseate tern) (Massachusetts Natural Heritage Atlas, 14th Edition, 2017) (see Section 4.6.3.3). As a result, the OECC will necessarily cross priority habitat within state waters. In accordance with the MESA (321 CMR 10.14), the Company will continue to consult with NHESP to ensure that impacts to rare species from offshore export cable installation in Nantucket Sound are avoided or minimized to greatest extent practicable.

The Massachusetts OMP identifies the following SSU areas for cable projects: (1) core habitat of the North Atlantic right whale, fin, and humpback whales; (2) hard/complex seafloor; (3) eelgrass; and (4) intertidal flats. The OECC has been aligned to avoid North Atlantic Right Whale core habitat, and the landfall site was assessed and selected partially on the basis of avoiding eelgrass. In addition, the alignment of the OECC reflects an effort to minimize the areas of hard and complex bottom that may be affected by cable installation (see Section 4.6.3.4).

As described in Section 4.6.3.5, while the marine archaeological assessment is ongoing, no direct evidence of pre-Contact Native American cultural materials has been recovered during investigations to date. However, geoarchaeological analysis of geophysical and geotechnical data indicate there are stream channel, lake, and estuarine landscape features within the Project Area that may have the potential to contain archaeological materials. The expanded portion of the OECC will be similarly assessed for either direct evidence of pre-Contact Native American cultural materials or preserved landscape features that may have the potential to contain archaeological materials. Other mitigation measures, agreed to by consulting parties during the Section 106 process, may be appropriate.

Muskeget Channel is an avian hotspot with high species richness and abundance (see Section 4.6.3.6). Some marine birds may be disturbed by vessels engaged in construction activities, and there is slight potential for bird collisions with vessels. There may also be temporary disruption to limited areas where such species forage. These potential impacts will be limited since the OECC avoids and minimizes impacts to sensitive or unique habitats and cable installation activities will be of short duration. The Company does not expect these impacts to be significant.

As described in Section 4.6.3.7, Vineyard Wind is not proposing any restrictions on navigation, fishing, or the placement of fixed or mobile fishing gear; however, construction and installation activities may temporarily affect navigation and/or fishing activities in the vicinity of construction and installation vessels. These impacts are temporary in nature and largely limited to the Project's construction and installation period. Given that construction-period impacts will be temporary and spatially constrained, the impacts will not be significant.

Marine mammal species are likely to occur in the vicinity of the OECC, including various species of whales, dolphins, porpoises, and seals (see Section 4.6.3.8). When near the OECC during construction, these species could be exposed to temporary stressors such as noise, increased vessel traffic, and equipment in the water that may result in short-term, localized disturbance of individuals. Recognizing the possibility of these temporary impacts, Vineyard Wind will collaborate with BOEM and NOAA to integrate practicable technology choices in equipment, mitigation, and monitoring to meet the necessary standards for permitting and species protection.

4.7 Cost Analysis

A variety of factors were considered in the cost assessment of these routes, including:

- Route Length: Route length is directly related to cost, since certain fixed costs (e.g., cost of export cable) are determined by length. Lengths of onshore routes as well as the incremental difference in lengths of offshore routes are factored into this analysis.

- Substation Type: The Company has considered both AIS and GIS designs for the proposed substation, the selection of which is largely based on the acreage of available suitable land and cost considerations. A GIS design, which is more compact than AIS, comes with a cost premium related to construction. However, a GIS design can be an efficient use of space and maximizes buffering. Since both the Preferred Route and Noticed Alternative utilize the same substation site, the related costs are the same.

- Land Acquisition or Easement Rights: Since the Project will involve construction of a substation, the Company must acquire suitable land for this infrastructure. In this case, all routing alternatives would utilize the same substation site, and thus related costs are the same. Similarly, use of assessor map parcel #214-001 immediately southeast of the West Barnstable Substation is irrespective of which routing alternative is selected.

- Construction Type: Although the majority of the potential onshore routes are within existing roadway layouts, some stretches are located within utility ROWs, and construction costs differ somewhat between the two.

- Trenchless Crossings: Trenchless crossing techniques such as HDD can be necessary based on physical constraints, environmental concerns, and the need to avoid existing infrastructure (e.g., the offshore-to-onshore transition at the landfall site, Centerville River, Route 6), and these types of construction methods are more costly than simple trenching. However, the same installation methods would be utilized irrespective of which routing alternative is ultimately selected, so the costs of such methodologies are not a distinguishing characteristic of the routing.

- Existing Subsurface Utility Density: The number of existing utilities in the roadway can determine the available lateral and below-grade space to physically accommodate an underground duct bank. Increased utility density can complicate the construction process, resulting in greater costs. For the in-road portions of the proposed Project, the Company mapped existing surface utilities using data from municipal DPWs and field investigations that identified infrastructure such as gas meters. Subsurface utilities present in the Project study area included water, sewer, drainage, and natural gas.

- Street Width: Street width can determine the available lateral and below-grade space available to physically accommodate an underground export cable, as well as constrain the available construction corridor width in order to maintain traffic flow. In general, street widths of less than 22 feet could necessitate road closures or more complex TMPs during construction.

Attachment L provides a cost comparison between the onshore Preferred base routes and variants as well as the Noticed Alternatives for both the transmission routes and grid interconnection routes. The cost estimates account for the length of route and also consider differences in cost between civil duct bank construction within paved roadway layouts as well as unpaved ROWs. Since construction methodology (e.g., crossing methods beneath the Centerville River or Route 6) and property acquisition requirements would be common between all routing alternatives, the cost differences are driven by differences in route length and whether construction is in-road or in-ROW.

For the transmission routes between the landfall site and proposed substation, as shown in Attachment L, the Preferred Route is the lowest-cost option relative to its own variants as well as the Noticed Alternative. This is primarily due to the Preferred Route's shortest, most direct route. The Noticed Alternative itself, while significantly more costly than the Preferred Route, does exhibit a relative cost savings over its Variant 1, while it is relatively more costly than its Variant 2, which includes less construction within pavement.

For the grid interconnection routes between the proposed substation and the interconnection point, the Preferred Route and its variants are all quite similar in costs, largely due to their similar route lengths and characteristics. The Noticed Alternative, with its significantly longer length, exhibits substantially higher costs.

Since a single OECC is proposed for the Project, the cost comparison in Attachment L is focused on onshore routing.

4.8 Reliability Analysis

Onshore, the Company considered whether there was a difference between the Preferred Route and Noticed Alternative with regard to reliability. Increased length of a transmission system, in theory, could introduce additional exposure to potential faults, though in this case route lengths are similar enough that this would not result in any significant difference. Both onshore routes are 100% underground cables, which may be less susceptible to weather-induced outages than overhead lines, so that factor cannot be used to distinguish reliability among routes. Accordingly, physical reliability was not a determining factor when comparing the two base routes. Both base routes are likely slightly superior to Variant 1, however, which would utilize the Covell's Beach Landfall Site and co-locate infrastructure with the Vineyard Wind Connector 1. Geographically separating such infrastructure would increase reliability by decreasing the vulnerability created by having both projects located on the same site.

Reliability is also tied to a proponent's ability to successfully permit and construct a project on a predictable and efficient timeline. For this Project, consultations with the Town of Barnstable have been very productive, and an HCA is already in place. Since all route alternatives are within the Town of Barnstable, no significant reliability differences exist.

With regard to offshore routes, the Company is proposing to utilize the OECC permitted for Vineyard Wind's first project for the Vineyard Wind Connector 2 as well. This means a wealth of marine survey data are already available to the Company's engineers to delineate cable alignments that will ensure reliability.

4.9 Summary and Conclusion

The route selection process undertaken by the Company comprehensively addresses the Siting Board's standards applicable to jurisdictional energy facilities. The Company identified an array of routes as potential alternatives to satisfy the Project need, and the Company's process was designed to ensure that no clearly superior route was overlooked. The Company systematically compared possible routes based upon reasonable criteria to evaluate the environmental impacts, cost, and reliability of the identified route alternatives.

The routing study for the offshore and onshore transmission for a major offshore wind energy project is a challenging undertaking. In contrast to the issues faced by any typical transmission project where the developer begins with two fixed end points and must find viable routes to connect them, an offshore wind project typically has only a fixed starting point. From there, the Project must systematically identify and consider offshore routes, viable landfall sites, onshore routes, and grid interconnection points. Ultimately, all four elements must fit together to form a viable and cost-effective interconnection solution. Other important dimensions include the need to work in both federal and state waters, and the need to interconnect into the power grid at locations controlled by third parties.

Given this challenge, a mix of systematic approaches was used to develop workable interconnection solutions. This approach is described throughout Section 4.0. Sections 4.4 and 4.5 provides the comparative analysis of the onshore underground cable routes using a "conventional" scoring and weighting analysis. This is followed by Section 4.6, which provides a description of the process used to identify, survey, and refine the OECC. This tabular and text-based description considered technical and environmental aspects of the OECC. It is the Company's position that this approach provides an adequate basis for evaluating the onshore and offshore routing without unduly complicating the analysis with a second set of scoring while also recognizing the need for construction flexibility.

The onshore Preferred Routes, T1 (Shootflying Hill Road route) and G1 (ROW #343 to ROW #381), will enable the Company to achieve the best balance between environmental impact, cost, and reliability in accordance with Siting Board precedent. The Preferred Routes are technically feasible for construction and minimize impacts to natural and human environment considerations. The Company has also selected viable Noticed Alternatives, T2 (Oak Street route) and G2 (In-Road), with a good degree of geographic diversity from the Preferred Routes. Finally, the Company has selected a number of variants for inclusion in the public notice issued in connection with review of the Petition. Section 5.0 of this Petition compares the Preferred Routes and Noticed Alternatives in detail.

Regarding the offshore export cables, the Company has identified the OECC utilized for Vineyard Wind Connector 1 as the preferred offshore route for the Vineyard Wind Connector 2. Based on the significant marine survey data and engineering analysis already available for the OECC, the route is considered technically feasible and environmentally favorable.

Section 5.0

Comparison of Routes and Construction

5.0 COMPARISON OF ROUTES AND CONSTRUCTION

5.1 Introduction, Design, Construction Plans

As presented in Section 4, the Company identified Preferred Routes and Noticed Alternatives for the onshore transmission routes connecting the landfall site to proposed substation site and for the grid interconnection routes connecting the proposed substation site to the 345-kV West Barnstable Substation. For the onshore transmission routes, the Company identified Candidate Route T1 (Shootflying Hill Road route) as the Preferred Route based on the best balance of the applied route selection criteria including environmental impacts and cost. A geographically-distinct routing alternative, Candidate Route T2 (Oak Street route), was identified as the Noticed Alternative. For the grid interconnection routes, the Company identified Candidate Route G1 (ROW #343 to ROW #381) as the Preferred Route, and Candidate Route G2 (In-Road) as the Noticed Alternative.

For the onshore transmission routes, as described in Sections 1.5 and 4.0, the Preferred Route travels a total distance of approximately 4.0 miles, entirely within the Town of Barnstable through a mix of residential and commercial land uses. The route lies almost entirely within existing roadway layouts (beneath pavement or within 10 feet of pavement) except for possibly the Centerville River crossing as well as the final approximately 1,000 feet (0.2 miles) within ROW #343 (see Figure 1-2). The Noticed Alternative, which is also entirely within the Town of Barnstable, travels a total length of approximately 6.1 miles through a mix of residential, commercial, and industrial uses; the route, which is largely distinct from the Preferred Route, is located almost entirely within existing roadway layouts except for possibly the Centerville River crossing. Both routes have variants.

For the grid interconnection routes, as described in Sections 1.5 and 4.0, the Preferred Route travels a total distance of approximately 0.7 miles, entirely within the Town of Barnstable and within existing utility ROWs (see Figure 1-3). The Noticed Alternative, which is also entirely within the Town of Barnstable, travels a total length of 1.8 miles and is located entirely within existing roadway layouts. The Preferred Route also has three variants.

This section provides a more detailed analysis and comparison of the potential environmental impacts and mitigation associated with construction and operation of the Preferred and Noticed Alternative routes. Section 4.6.2 contains a description of the proposed OECC, which was identified and selected during an earlier extensive alternatives analysis (also described in Section 4.6). The OECC avoids core habitat mapped for whales and minimizes passage through hard and complex bottom habitats as well as eelgrass.

The balance of this section includes route descriptions, maps, photos, and construction methods for each of the onshore export cable routes (i.e., transmission routes and grid interconnection routes), including the work associated with the proposed substation. Both transmission routes will utilize a new substation site located approximately 0.7 miles east of the West Barnstable Substation, where the Project will interconnect with the electrical grid. Photo arrays of the

Preferred and Noticed Alternative routes for the onshore transmission routes from the landfall site to proposed substation are provided in Attachments A and B, respectively; photo arrays of the Preferred and Noticed Alternative routes for the grid interconnection routes from the proposed substation to the West Barnstable Substation are provided in Attachments C and D, respectively.

Construction methods and the assessment of potential impacts described in Section 5.4 are based on preliminary engineering design. Refinements are expected as the final design effort is undertaken.

5.2 Environmental Considerations

Environmental considerations related to the Preferred and Noticed Alternative routes are discussed below.

5.2.1 Wetland Resources

The Project will result in temporary impacts to coastal wetland resources in the vicinity of the preferred and variant landfall sites, but largely avoids impacts to wetland resource areas located further inland. This section describes the wetland resource areas that occur along each of the identified onshore transmission routes (i.e., routes from the landfall sites to the proposed onshore substation). There are no wetland resource areas located along any of the identified grid interconnection routes (i.e., routes from the proposed onshore substation to the interconnection location), at the proposed substation site, or in the area anticipated to be used for modifications to the 345-kV West Barnstable Substation.

5.2.1.1 Preferred Route (Shootflying Hill Road)

The Preferred Route will temporarily impact coastal wetland resource areas in the vicinity of the Craigville Public Beach Landfall Site (see Figures 4-10 and 5-1). In this area, the Project will pass through approximately 0.4 miles (2,000 linear feet) of Land Subject to Coastal Storm Flowage (LSCSF), but the Project will have no permanent impacts to this resource since the underground duct bank will not alter existing topography or flood storage capacity. The route will also cross approximately 0.1 miles (730 feet) of Riverfront Area (RFA) associated with the Centerville River and approximately 0.2 miles (1,100 linear feet) of a barrier beach system. These temporary impacts will occur almost entirely within the paved surfaces of Craigville Beach Road and the paved parking lot at the landfall site. Only a narrow strip of remnant Coastal Dune located between the paved parking lot and Craigville Beach Road will be temporarily disturbed for the installation of buried duct bank.

A more detailed multi-sheet graphics set illustrating wetlands along the Preferred Route is provided as Figure 5-2.

Landfall Site HDD

As discussed in Section 5.4.2, the transition from offshore to onshore cable will be accomplished by an approximately 1,000- to 1,200-foot-long (300- to 365-m) HDD operation, which will avoid any impacts to the Coastal Beach and other nearshore areas. The drill entry pit will be located in the Town-owned parking lot at the landfall site, which lies within an area mapped as barrier beach but is entirely paved. Regardless, the HDD operation will be staged within the paved parking lot and will avoid impacts to the Coastal Beach. Construction methods for HDD are described in greater detail in Section 5.4.2.

Centerville River Crossing

As described in Section 1.5.1.4, both the Preferred Route and Noticed Alternative will cross the Centerville River approximately a quarter-mile north of the landfall site, where Craigville Beach Road crosses the river with an existing two-lane bridge. Near the existing Craigville Beach Road bridge, the river is approximately 260 feet wide, although it is significantly constricted by rip-rapped approaches on either side of the bridge, which has a clear span of approximately 75 feet. A fringe of salt marsh occurs above the riverbanks on either side of road.

While determining the most appropriate method for crossing the Centerville River in this location, Project engineers assessed the viability of multiple design options, including trenchless techniques (microtunnel, HDD, direct pipe) and replacement of the bridge superstructure. As described in Section 1.5.1.4, based on consultations with the Town of Barnstable and MassDOT as well as engineering considerations, the current preferred option is microtunnel, followed by the other two trenchless crossing options, and finally the bridge superstructure replacement. Wetlands impacts associated with each of these construction methodologies are described below and are summarized in Table 5-1.

Table 5-1 Wetlands impacts (all temporary) for each Centerville River crossing technique (square feet).

Crossing Technique	*Temporary Impacts*				
	Barrier Beach	*Land Under the Ocean*	*Salt Marsh*	*Riverfront Area*	*Coastal Beach*
Microtunnel	10,400	0	0	10,400	0
HDD	3,100	0	0	1,220	0
Direct Pipe	13,800	0	0	0	17,100
Bridge Superstructure Replacement	25,520	450	425	40,100	0

As described in Section 1.5.1.4.2, microtunnel is a pipe jacking operation that utilizes a boring machine pushed into the earth by hydraulic jacks in preparation for insertion of a concrete casing (as opposed to HDD, which drills a curved trajectory through which a conduit is subsequently installed). All activities would be outside the river and riverbanks themselves, but would temporarily affect approximately 10,400 square feet of the 200-foot RFA and barrier beach;

microtunnel would have no permanent impacts to either resource area. The work would also be located within LSCSF and within the regulatory buffer zone of salt marsh and land under the ocean, but again the activity would have no permanent impacts. The microtunnel operation is depicted on Figures 1-15a through 1-15c.

As described in Section 1.5.1.4.3, HDD is a surface-launched trenchless system widely used to install pipelines, often under rivers, roadways, or other surface features. This option for crossing the Centerville River would include two separate approximately 660-foot-long (200-m-long) HDD bores (see Figures 1-16a and 1-16b). The HDD entry pit would be located on the southeast side of the Centerville River, outside the river itself but within the 200-foot RFA. This location will minimize disruption to residents and vehicles traveling on Craigville Beach Road, and to achieve a sufficient depth of cover before crossing under the Centerville River. Use of HDD at the Centerville River crossing would require temporary disturbance of approximately 3,100 square feet of barrier beach and 1,220 square feet of RFA and LSCSF (see Figures 1-16c and 1-16d); the HDD operation would have no permanent impacts to these resource areas.

As described in Section 1.5.1.4.4, a direct pipe trenchless drilling method uses a drill head welded to a pipe casing, and as drilling progresses the pipe casing keeps getting extended. Once the drill path is complete through the receiving end, the head is cut off and the pipe remains in place, becoming the casing for the cables. Most construction activity for the direct pipe option would occur within the paved Craigville Public Beach parking lot (see Figures 1-17a and 1-17b). Direct pipe is generally a faster process than HDD, but it does require a larger unobstructed staging area to weld pipe sections together. This staging area could extend onto the beach itself and also occupy a significant portion of the parking lot. On areas of the beach used for staging, geotextiles and matting would be used to avoid beach compaction or penetration, and the beach would be restored to preexisting conditions following completion of the direct pipe. Construction would also occur in the off-season, when the beach and parking lot would be in minimal use. Use of direct pipe would avoid any direct impacts to the Centerville River, RFA, and salt marsh, but would require temporary disturbance of approximately 13,800 square feet of barrier beach and 17,100 square feet of Coastal Beach for construction laydown (see Figure 1-17c); the direct pipe operation would have no permanent impacts to these resource area.

As described in Section 1.5.1.4.1, a complete superstructure replacement would include foundation modifications to support two conduit bundles between the bridge beams below the roadway (see Figures 1-14a and 1-14b). Replacement of the bridge superstructure would temporarily impact approximately 450 square feet of the Centerville River as well as approximately 40,100 square feet of the RFA and LSCSF (see Figure 1-14c). It would also impact approximately 425 square feet of Salt Marsh and would require temporary disturbance to regulatory buffer zones associated with salt marsh and land under the ocean.[1]

Freshwater Wetlands and Buffer Zones

North of the Centerville River crossing, the onshore duct bank will be installed within existing roadway layouts (beneath pavement or within 10 feet of pavement) where direct impacts to wetland resource areas will be avoided. However, one segment along Shootflying Hill Road will pass within the 100-foot buffer zone of freshwater wetland resource areas associated with Wequaquet Lake. As elsewhere, the duct bank will be installed within the existing roadway layout beneath pavement or within 10 feet of pavement and will have no permanent impacts on the wetland resource areas. As shown on Figures 5-1 and 5-2, the Preferred Route will not directly impact any wetland resource areas outside of paved surfaces.

5.2.1.1.1 Variant 1 – Covell's Beach Landfall Site

Variant 1 of the Preferred Route will pass through the same wetland resource areas as the Preferred Route, but by utilizing Covell's Beach for the landfall site rather than Craigville Public Beach, the variant will travel through an additional 0.3 miles (1,500 linear feet) of the barrier beach system (for a total of 0.5 miles [2,600 linear feet] versus 0.2 miles). However, this entire length will be within the paved surface of Craigville Beach Road (see Figures 5-1 and 5-2).

Similarly, due to the additional length along Craigville Beach Road, the variant will cross approximately 0.8 miles (4,000 linear feet), rather than 0.4 miles, of LSCSF, but will have no associated impacts since the underground duct bank will not alter topography or flood storage capacity.

This variant will also pass within the 100-foot buffer zone to areas of Coastal Dune and Coastal Beach located along Craigville Beach Road, but would avoid any direct impacts to these coastal wetland resources (see Figure 4-10).

5.2.1.1.2 Variant 2 – South Main Street

Variant 2 of the Preferred Route passes through the same wetland resource areas as the Preferred Route and also the 100-foot buffer zones of freshwater wetlands located further inland. As shown on Figures 4-10, 5-1, and 5-2, this variant will pass through an additional approximately 300 feet of LSCSF and 400 linear feet of RFA associated with a culverted stream along South Main Street near the Weaver Road intersection. The duct bank in these areas will be installed within the roadway layout beneath pavement or within 10 feet of pavement, and will not result in any direct

[1] Pursuant to 310 CMR 10.25(2), "land under the ocean" also includes land under estuaries, such as the relevant portion of the Centerville River.

impacts to the resource areas. Variant 2 will also pass through the 100-foot buffer zone of wetlands located on either side of the paved roadway in this same area, but appropriate erosion and sedimentation controls will avoid any impacts to these resources (see Section 5.4.7).

5.2.1.1.3 Variant 3 – Northern Substation Access

Variant 3, which avoids the short off-road segment within utility ROW #343 and instead continues to follow Shootflying Hill Road to the north side of the substation site, will pass through the same wetland resource areas as the Preferred Route described above, and no others (see Figure 5-2).

5.2.1.2 Noticed Alternative Route (Oak Street)

Similar to the Preferred Route, although the alignment of the Noticed Alternative (Oak Street Route) will pass through some mapped coastal wetland resource areas, it will do so within paved parking lots or roadways, or along HDD alignments (sees Figure 5-3 and 5-4).

The Noticed Alternative will pass through approximately 0.4 miles (2,300 linear feet) of LSCSF, but the Project will have no permanent impacts to this resource since the buried duct bank will not alter existing topography or flood storage capacity. No above-ground structures or changes to topography are proposed within LSCSF. HDD staging and subsurface installation of duct bank and splice vaults will have no effect on flood velocities or floodplain storage capacity, and therefore no permanent impact to LSCSF is anticipated.

Similarly, the route will cross approximately 0.4 miles (2,020 feet) of RFA associated with the Centerville River on each side of the river's 80-foot clear span, and three unnamed perennial streams that flow through culverts beneath Old Stage Road and Oak Street; the Project will have no impact to the three unnamed streams (see Figure 5-4). As described in Section 5.2.1.1, various crossing techniques are under consideration for the Centerville River, which would result in varying amounts of temporary impacts to RFA and other wetland resource areas. Lastly, the Noticed Alternative will cross through approximately 0.2 miles (1,100 linear feet) of a barrier beach system, but will do so entirely within the paved surfaces of Craigville Beach Road and the paved parking lot at the Craigville Public Beach Landfall Site, except for a small area of Coastal Dune located between these two paved surfaces.

As with the Preferred Route, cable landfall would be accomplished by HDD, which would be staged in the existing paved parking lot and would thus avoid direct impacts to Coastal Beach.

5.2.1.2.1 Variant 1 – Covell's Beach Landfall Site

Variant 1 of the Noticed Alternative will pass through the same wetland resource areas as the Noticed Alternative itself, but by utilizing Covell's Beach for the landfall site rather than Craigville Public Beach, the variant will travel through an additional 0.3 miles (1,500 linear feet) of the barrier beach system (for a total of 0.5 miles [2,600 linear feet] versus 0.2 miles). However, this entire length will be within the paved surface of Craigville Beach Road (see Figures 5-3 and 5-4).

Similarly, due to the additional length along Craigville Beach Road, the variant will cross approximately 0.8 miles (4,300 linear feet), rather than 0.4 miles, of LSCSF, but will have no associated impacts since it will not alter topography or flood storage capacity.

This variant will also pass within the 100-foot buffer zone to areas of Coastal Dune and Coastal Beach located north and south of Craigville Beach Road, but would avoid any direct impacts to these coastal wetland resources (see Figure 4-10).

5.2.1.2.2 Variant 2 – ROW #345

Variant 2 of the Noticed Alternative will pass through the same wetland resource areas as the Noticed Alternative itself with a couple of exceptions. This variant will cross less RFA than the Noticed Alternative (0.2 miles [1,100 linear feet] vs. 0.4 miles) since it will avoid the three culverted crossings of unnamed perennial streams that flow through culverts beneath Old Stage Road and Oak Street (see Figures 5-3 and 5-4). However, the variant will cross approximately 80 linear feet of Bordering Vegetated Wetlands (BVW) and approximately 60 linear feet of Land Under Water associated with a small unnamed pond located along ROW #345 (see Figure 5-4). Should this variant be utilized, Vineyard Wind would use HDD to avoid impacts to the BVW or pond in this location.

5.2.1.3 Grid Interconnection Routes (Substation Site to Interconnection Location)

None of the identified grid interconnection routes will pass through any mapped wetland resource areas or their buffer zones (see Figure 5-5).

5.2.1.4 Comparison of Impacts/Mitigation Measures

The Preferred and Noticed Alternative routes have been selected to avoid and minimize wetland impacts, but transmission routes will require some work within wetland resource areas, mainly in the vicinity of the landfall site and Centerville River crossing. Table 5-2 summarizes temporary wetlands impacts from the parking lot of the landfall site to the proposed substation.[2]

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[2] All route alternatives will require some temporary alteration to Land Under the Ocean that will result from cable installation activities along the OECC. These impacts are described in Section 4.6.

Table 5-2 Temporary Wetlands Impacts on the Preferred and Noticed Alternative Transmission Routes (linear feet, approximate, excluding Centerville River crossing).[3]

	Wetland Resource Areas Temporarily Impacted					
Candidate Routes	***Land Under Water [a]***	***Coastal Dune [b]***	***Barrier Beach System (all paved) [c]***	***Bordering Vegetated Wetland (BVW)***	***LSCSF***	***RFA [d]***
Preferred Route (Shootflying Hill Road)	0	10	1,100	0	2,000	730
Variant 1 (Covell's Beach Landfall Site)	0	0	2,600	0	4,000	730
Variant 2 (South Main Street)	0	10	1,100	0	2,300	1,130
Variant 3 (Northern Substation Access)	0	10	1,100	0	2,000	730
Noticed Alternative (Oak Street)	0	10	1,100	0	2,300	2,020
Variant 1 (Covell's Beach Landfall Site)	0	0	2,600	0	4,300	2,020
Variant 2 (ROW #345)	60 [e]	10	1,100	80 [e]	2,300	1,100

[a] The Land Under Water affected by the Project's onshore transmission is related to a small unnamed pond that may be crossed by Variant 2 of the Noticed Alternative. The onshore routes will also cross an 80-foot span of the Centerville River, where land beneath the estuary is classified in the WPA as "Land Under the Ocean". The trenchless crossing methodologies for achieving the crossing will have no impacts to land under the ocean (see Table 5-1).

[b] While the Project will have very little impact to Coastal Dune or Coastal Beach, use of either landfall site may result in some temporary disturbance within the 100-foot buffer zones to either resource area while in the paved parking lot and along portions of Craigville Beach Road. In addition, a very narrow strip of Coastal Dune located between the Craigville Beach parking lot and Craigville Beach Road may be temporarily affected.

[c] All impacts to the barrier beach system will be temporary and within paved surfaces (i.e., Craigville Beach Road or the paved parking lot at the Craigville Public Beach Landfall Site).

[d] All temporary impacts to RFA will occur within previously-disturbed areas, paved roads, or underground via HDD.

[e] Variant 2 of the Noticed Alternative, by following a stretch of utility ROW #345, would cross approximately 80 linear feet of BVW and 60 linear feet of Land Under Water associated with a small unnamed pond. However, should this variant become necessary, Vineyard Wind would pursue a trenchless crossing solution that would avoid direct impacts to these resources.

As shown in Table 5-2, all onshore route variations will cross LSCSF, RFA, and the barrier beach system. However, these crossings will be accomplished within a paved road surface without any direct impacts to other associated wetland resource areas. No above-ground structures or changes to topography are proposed within LSCSF or RFA, and the Project will have no effect on flood velocities or floodplain storage capacity, and therefore no permanent impact to LSCSF is anticipated. Any temporary impacts to the barrier beach system will be entirely within paved

[3] Since multiple options are under consideration for crossing the Centerville River, those wetlands impacts are excluded from Table 5-2 and are shown separately in Table 5-1.

surfaces. For the Centerville River crossing, each crossing technique would have temporary impacts to barrier beach, RFA, and LSCSF; only the bridge superstructure replacement would have direct impacts to salt marsh (see Section 5.2.1.1 and Table 5-1).

Of the Preferred Route and its variants, Variant 1 (Covell's Beach Landfall Site) would have the longest stretch through wetland resource areas and their buffer zones. Of the Noticed Alternative and its variants, Variant 1 (Covell's Beach Landfall Site) would similarly have the longest stretch through wetland resource areas and their buffer zones. However, since the Project's impacts will be limited to temporary construction-period disturbance, the Project will have no significant impact on LSCSF, RFA, or the barrier beach system, and because all of the route alternatives would utilize the same crossing of the Centerville River, the difference between routing alternatives on the basis of wetlands impacts is negligible. Similarly, no wetland resource areas are present on or adjacent to the site of the proposed substation.

The only routing alternative that is clearly inferior on the basis of wetlands impacts is Variant 2 of the Noticed Alternative, which by following a stretch of utility ROW #345 would cross approximately 80 linear feet of BVW and 60 linear feet of Land Under Water associated with a small unnamed pond. However, should this variant become necessary, Vineyard Wind would pursue a trenchless crossing solution in an effort to avoid direct impacts to these resources.

Construction-period considerations, including measures that will protect wetlands, are described in Section 5.4.

5.2.1.5 Compliance with Performance Standards under the Massachusetts Wetlands Protection Act (WPA)

Under the Massachusetts WPA Regulations, installation of buried utilities in buffer zones and within paved roadways is a "minor project" (310 CMR 10.02 (b)(2)(b)(i)). Minor projects are exempt from the WPA Regulations and are therefore not subject to the performance standards that would otherwise apply to projects involving work within the buffer zone. As a minor project, the performance standards described in the Regulations apply only to those segments of the onshore duct bank that are within wetland resource areas, but not those segments that are within RFA or the 100-foot buffer zone of wetland resource areas.

For activities proposed along the OECC within Land Under the Ocean, compliance with performance standards of the WPA is described in Section 4.6.3.1.5.

Although Vineyard Wind believes the Project as proposed meets all relevant wetland performance standards, Vineyard Wind may also apply for approvals as a Limited Project. Under the Massachusetts WPA, certain activities are afforded Limited Project status, which allows permitting authorities to approve projects that are inherently unable to meet wetland performance standards that are specified for the various resource areas defined in the Act. The Limited Project provision for work affecting coastal resource areas Regulations at 310 CMR 10.24(7):

10.24 (7) Notwithstanding the provisions of 310 CMR 10.25 through 10.35, the Issuing Authority may issue an Order of Conditions and impose such conditions as will contribute to the interests identified in M.G.L. c. 131, § 40, permitting the limited projects listed in 310 CMR 10.24(7)(a) through (c), although no such project may be permitted which will have any adverse effect on specified habitat sites of Rare Species, as identified by procedures established under 310 CMR 10.37. In determining whether to exercise its discretion to approve the limited projects listed in 310 CMR 10.24(7)(a) through (c), the Issuing Authority shall consider the following factors: the magnitude of the alteration and the significance of the project to the interests identified in M.G.L. c. 131, § 40, the availability of reasonable alternatives to the proposed activity, and the extent to which adverse impacts are minimized and the extent to which mitigation measures including replication or restoration are provided to contribute to the protection of the interests identified in M.G.L. c. 131, § 40. Adverse effects to be minimized include without limitation any adverse impacts on the relevant interests of M.G.L. c. 131, § 40, due to changes in wave action or sediment transport or adjacent coastal banks, coastal beaches, coastal dunes, salt marshes or barrier beaches. The provisions of 310 CMR 10.24(7)(a) through (c) are not intended to prohibit the Issuing Authority from imposing such additional conditions as are necessary to contribute to the interests of M.G.L. c. 131, § 40 where the indicated minimizing measures are not sufficient.

The Limited Project provisions specifically apply to the installation of an electric transmission system beneath Land Under the Ocean, Barrier Beach, and Land Subject to Coastal Storm Flowage:

10.24(7)(b): The construction, reconstruction, operation and maintenance of underground and overhead public utilities, limited to electrical distribution or transmission lines, or communication, sewer, water and natural gas lines, may be permitted as a limited project pursuant to 310 CMR 10.24(7) provided that the project complies with all applicable provisions of 310 CMR 10.24(1) through (6), (9) and (10), and (7)(b)1. through 9.

The Project will comply with all applicable provisions of 310 CMR 10.24(1) through (6), (9) and (10) as well as (7)(b) 1 through 9 and therefore qualifies for Limited Project status.

The Preferred and Noticed Alternative routes for transmission from the landfall site to proposed substation site will have some temporary impacts to LSCSF and RFA. The Project will have no impacts to Coastal Beach, but the Preferred Route may temporarily impact a narrow strip of Coastal Dune that is present between the paved Craigville Beach parking lot and Craigville Beach Road (see Section 5.2.1.5.2). The grid interconnection routes will not affect any mapped wetland resource areas.

There are no performance standards defined for projects located in LSCSF, or for minor projects located in RFA. The performance standards for the other relevant wetland resource areas are discussed below.

5.2.1.5.1 Barrier Beach

Barrier Beaches are relatively narrow, low-lying strips of land that are generally aligned to the trend of the coast and are separated from the mainland by a fresh, brackish, or saltwater body or estuary. Barrier beaches include developed and undeveloped areas of coastal beaches and dunes, and are important because in their exposed position they buffer waves and storm energy, providing a measure of protection to inland resources.

The Centerville Harbor Barrier Beach extends approximately two miles from East Bay in Osterville to a point east of Craigville Beach (but not extending to Covell's Beach), where the landform connects to the mainland (see Figure 4-10). At the proposed Craigville Public Beach Landfall Site in the paved parking lot, the barrier beach is approximately 500 feet wide and has been extensively developed for public recreation and private residences. The barrier beach provides a vertical buffer and a degree of protection to inland resources including the Centerville River estuary and private residences that have been built in low-lying areas adjacent to the estuary on both the barrier beach and mainland. The Project's activities within this barrier beach will be limited to the paved parking lot, paved roadways, and the below-grade path of the HDD from the Craigville Public Beach Landfall Site; the Project will have no permanent impacts to the resource.

Performance standards for projects located on a barrier beach, 310 CMR 10.29 (3) and (4), are discussed below.

> *(3) When a Barrier Beach Is Determined to Be Significant to Storm Damage Prevention, Flood Control, Marine Fisheries or Protection of Wildlife Habitat, 310 CMR 10.27(3) through (6) (coastal beaches) and 10.28(3) through (5) (coastal dunes) shall apply to the coastal beaches and to all coastal dunes which make up a barrier beach.*

Although the Centerville Harbor Barrier Beach includes several areas of Coastal Dune or Coastal Beach, the Project will not result in any permanent or temporary alterations to these resource areas. Proposed construction will be confined to existing paved surfaces, roadway layouts, and the below-grade path of the HDD from the landfall site. Regardless, the Project will preserve the functions of the barrier beach for storm damage prevention and flood control by restoring all grades to pre-construction conditions.

> *(4) Notwithstanding the provisions of 310 CMR 10.29(3), no project may be permitted which will have any adverse effect on specified habitat sites of rare vertebrate or invertebrate species, as identified by procedures established under 310 CMR 10.37.*

As described in Section 4.6.3.3, the Massachusetts NHESP has mapped all state waters within Nantucket Sound as priority habitat of state-listed rare species due to shorebirds (e.g., piping plover, terns) (Massachusetts Natural Heritage Atlas, 14^{th} Edition, 2017). As a result, the OECC will necessarily cross priority habitat within state waters. However, at the landfall site the offshore-to-onshore transition will be completed using HDD, which will avoid any direct impacts to the beach and nearshore areas. As described in Section 5.4.1.5, for the Vineyard Wind

Connector 1, Vineyard Wind and NHESP collaborated on a Piping Plover Protection Plan (PPPP) which stated that HDD activities at the Covell's Beach Landfall Site would begin in advance of April 1, or would not begin until August 31, to avoid and minimize noise impacts to Piping Plover during the breeding season. NHESP approved that PPPP for the Vineyard Wind Connector 1 landfall site at Covell's Beach in May 2019. Based on a meeting with NHESP on April 15, 2020 and as reflected in the Draft PPPP provided in Attachment K, Vineyard Wind is also offering to repeat that same protective measure for the Vineyard Wind Connector 2. In accordance with the MESA (321 CMR 10.14), the Company will continue to consult with NHESP to ensure that impacts to rare species from offshore export cable installation in Nantucket Sound are avoided or minimized to greatest extent practicable.

5.2.1.5.2 Coastal Dune

The Project will cross a small strip of Coastal Dune located between the paved Craigville Beach parking lot and Craigville Beach Road, and will likely pass within the 100-foot buffer zone to Coastal Dune as it exits the paved parking lot at the and proceeds onto Craigville Beach Road (see Figure 4-9). It is not expected that use of the Covell's Beach Landfall Site would result in any direct Coastal Dune impacts, though the duct bank would pass within the 100-foot buffer zone to Coastal Dune. The following performance standards apply to any proposed alteration of a Coastal Dune or within 100 feet of a Coastal Dune (310 CMR 10.28):

> *(3) Any alteration of, or structure on, a coastal dune or within 100 feet of a coastal dune shall not have an adverse effect on the coastal dune by:*
>
> *a) affecting the ability of waves to remove sand from the dune;*
>
> *b) disturbing the vegetative cover so as to destabilize the dune;*
>
> *c) causing any modification of the dune form that would increase the potential for storm or flood damage;*
>
> *d) interfering with the landward or lateral movement of the dune;*
>
> *e) causing removal of sand from the dune artificially; or*
>
> *f) interfering with mapped or otherwise identified bird nesting habitat.*

All infrastructure at the landfall site would be installed below-grade and will not alter existing grade, such that after construction the Project would not provide any barrier to wind, water, or sand transport. The same methods and infrastructure were proposed for the Vineyard Wind Connector 1 at the Covell's Beach Landfall Site, and were approved by the Barnstable Conservation Commission as well as MassDEP.

(4) Notwithstanding the provisions of 310 CMR 10.28(3), when a building already exists upon a coastal dune, a project accessory to the existing building may be permitted, provided that such work, using the best commercially available measures, minimizes the adverse effect on the coastal dune caused by the impacts listed in 310 CMR 10.28(3)(b) through (e). Such an accessory project may include, but is not limited to, a small shed or a small parking area for residences. It shall not include coastal engineering structures.

The Project does not propose any accessory projects to existing buildings on a coastal dune.

(5) The following projects may be permitted, provided that they adhere to the provisions of 310 CMR 10.28(3):

(a) pedestrian walkways, designed to minimize the disturbance to the vegetative cover and traditional bird nesting habitat;

(b) fencing and other devices designed to increase dune development; and

(c) plantings compatible with the natural vegetative cover.

Temporary impacts from Project construction are expected only within a small area of Coastal Dune located between the Craigville Beach parking lot and Craigville Beach Road. At the completion of installation of the buried duct bank beneath this dune, the existing contours will be restored with compatible sand and the area will be replanted with American Beach Grass or other appropriate dune species as deemed appropriate by the Barnstable Conservation Commission.

(6) Notwithstanding the provisions of 310 CMR 10.28(3) through (5), no project may be permitted which will have any adverse effect on specified habitat sites of Rare Species, as identified by procedures established under 310 CMR 10.37.

The Project is located within specified Priority Habitat of rare wetlands wildlife. The Company has started consultations with the NHESP and will comply with all time-of-year restrictions and other conditions deemed necessary by the NHESP for the installation and maintenance of the Vineyard Wind Connector 2. The Company has revised the PPPP created in consultation with NHESP for the Vineyard Wind Connector 1, which would require HDD activities at the landfall site to begin in advance of April 1 or not until August 31, to avoid and minimize noise impacts to Piping Plover during the breeding season (see Attachment K). Consultations with NHESP are ongoing.

The Project would not result in any permanent or temporary impacts that would be detrimental to a dune's stability, its ability to serve as a sediment source for the beach, or any of the recognized functions of coastal dunes. Therefore, the Project meets the performance standards established under the WPA Regulations for this resource area.

5.2.1.5.3 Coastal Beach

Coastal Beach is present seaward of the Craigville Public Beach Landfall Site and the Covell's Beach Landfall Site, although the use of HDD at either landfall site will avoid any impacts to the resource area. Instead, the HDD trajectory will travel below the Coastal Beach, without any surface disturbance. The HDD staging area as well as the transition vaults will be located in the paved parking lot, landward of the Coastal Beach and will similarly not impact the resource area.

As shown on Figure 4-10, the duct bank route associated with use of the Variant 1 Covell's Beach Landfall Site may pass within the 100-foot buffer zone to Coastal Beach, though it would do so within the paved Craigville Beach Road and would not result in any impacts to the resource area.

The following performance standards apply to any proposed alteration to a Coastal Beach (310 CMR 10.27(3)):

> *Any project on a coastal beach, except any project permitted under 310 CMR 10.30(3)(a), shall not have an adverse effect by increasing erosion, decreasing the volume or changing the form of any such coastal beach or an adjacent or downdrift coastal beach.*

Use of HDD for the offshore-to-onshore transition will avoid any impacts to Coastal Beach, as the HDD trajectory will pass well beneath the beach. The same methods and infrastructure were proposed for the Vineyard Wind Connector 1 at the Covell's Beach Landfall Site and were approved by the Barnstable Conservation Commission as well as MassDEP.

Proposed activities will not adversely affect the Coastal Beach by increasing erosion, decreasing the volume or changing the form of the Coastal Beach, or altering an adjacent or downdrift Coastal Beach. Therefore, the proposed activities satisfy the performance standards for coastal beach.

5.2.1.5.4 Riverfront Area

The 200-foot RFA that surrounds the Centerville River is common to all routing alternatives and consists of salt marsh, paved road and road shoulder, and previously developed residential properties. This RFA, which is also coincident with LSCSF, is described in further detail below.

In addition, the transmission route Noticed Alternative and Variant 1 both cross RFA associated with three unnamed perennial streams that flow through culverts beneath Old Stage Road and Oak Street; this RFA only contains paved road and road shoulder. Construction proposed within RFA associated with the three unnamed perennial streams will be confined to the roadway layout and adjacent previously-disturbed areas, and does not require disturbance within any other resource areas. Under Massachusetts WPA Regulations, electric utility installation beneath paved or unpaved public or private roadways within the buffer zone of a resource area other than RFA is considered a "Minor Activity" (310 CMR 10.02(2)(b)(2)(i) and is not subject to the performance standards for RFA. This pertains to the RFA associated with the three unnamed perennial streams.

(b) <u>Activities Within the Buffer Zone</u>. Any activity other than minor activities identified in 310 CMR 10.02(2)(b)2. proposed or undertaken within 100 feet of an area specified in 310 CMR 10.02(1)(a) (hereinafter called the Buffer Zone) which, in the judgment of the issuing authority, will alter an Area Subject to Protection under M.G.L. c. 131, § 40 is subject to regulation under M.G.L. c. 131, § 40 and requires the filing of a Notice of Intent.

(2.) The following minor activities, provided that they comply with 310 CMR 10.02(2)(b)1., are not otherwise subject to regulation under M.G.L. c. 131, § 40: (i.) Installation of underground utilities (e.g., electric, gas, water) within existing paved or unpaved roadways and private roadways/driveways, provided that all work is conducted within the roadway or driveway and that all trenches are closed at the completion of each workday;

In contrast, at the Centerville River crossing, work within RFA is also within LSCSF, and therefore by regulation cannot be considered a “Minor Activity”. However, certain portions of the planned construction at the Centerville River crossing are exempt from the performance standards for construction activities located within RFA pursuant to 310 CMR 10.58(6):

(6) Notwithstanding the Provisions of 310 CMR 10.58(1) through (5), Certain Activities or Areas Are Grandfathered or Exempted from Requirements for the Riverfront Area: (i) Structures and activities subject to a M.G.L. c. 91 waterways license or permit, or authorized prior to 1973 by a special act, are exempt, provided the structure or activity is subject to jurisdiction and obtains a license, permit, or authorization under 310 CMR 9.00: the Massachusetts Waterways Regulations.

Most of the activities associated with the installation of conduits across the Centerville River via microtunnel, HDD, or direct pipe will require a Chapter 91 license for work within filled tidelands, and are therefore exempt from the performance standards required for work within the RFA; only a limited portion of the HDD entry pit on the north side of the river crossing is within RFA but outside of Chapter 91 jurisdiction. Similarly, if the conduits will be added in conjunction with the bridge superstructure replacement option, the existing bridge is a licensed structure and hence the work would either need to be authorized by the existing Chapter 91 license or as part of a new or amended Chapter 91 license; a portion of the bridge superstructure replacement activities would also occur within RFA but outside of Chapter 91 jurisdiction. Since in either event the installation of the conduits would be authorized under Chapter 91, the RFA performance standards do not apply to the specific activities within Chapter 91 jurisdiction.

The limited activities outside of Chapter 91 jurisdiction are subject to RFA performance standards for work within previously developed RFA. These performance standards are excerpted below from 310 CMR 10.58(5):

(5) Redevelopment within Previously Developed Riverfront Areas; Restoration and Mitigation.

Notwithstanding the provisions of 310 CMR 10.58(4)(c) and (d), the issuing authority may allow work to redevelop a previously developed riverfront area, provided the proposed work improves existing conditions. Redevelopment means replacement, rehabilitation or expansion of existing structures, improvement of existing roads, or reuse of degraded or previously developed areas. A previously developed riverfront area contains areas degraded prior to August 7, 1996 by impervious surfaces from existing structures or pavement, absence of topsoil, junkyards, or abandoned dumping grounds. Work to redevelop previously developed riverfront areas shall conform to the following criteria:

(a) At a minimum, proposed work shall result in an improvement over existing conditions of the capacity of the riverfront area to protect the interests identified in M.G.L. c. 131 § 40. When a lot is previously developed but no portion of the riverfront area is degraded, the requirements of 310 CMR 10.58(4) shall be met.

The Project will not degrade RFA. Rather, the proposed trenchless crossing techniques would have some temporary impacts within previously-disturbed portions of the RFA but would have no permanent impacts or effect on the function or values of the RFA. In fact, if the preferred microtunnel option is selected for completing the river crossing, it would likely be necessary for Vineyard Wind to acquire additional property rights south of the bridge that would involve demolishing an existing structures, thus eliminating a structure from the RFA and floodplain. If the bridge superstructure replacement is performed, grading on and around the bridge will optimize travel along Craigville Beach Road and will also optimize stormwater flow and management.

(b) Stormwater management is provided according to standards established by the Department.

The proposed work within RFA would not create any new point source discharges, nor result in any increase in the amount of impervious areas. Therefore, this performance standard does not apply.

(c) Within 200 foot riverfront areas, proposed work shall not be located closer to the river than existing conditions or 100 feet, whichever is less, or not closer than existing conditions within 25 foot riverfront areas, except in accordance with 310 CMR 10.58(5)(f) or (g).

The Project will not require any work that is located closer to the river than the area that was previously disturbed for road and bridge construction. Therefore, this performance standard is satisfied.

(d) Proposed work, including expansion of existing structures, shall be located outside the riverfront area or toward the riverfront area boundary and away from the river, except in accordance with 310 CMR 10.58(5)(f) or (g).

Since the Project must cross the Centerville River, it cannot be located entirely outside of the RFA. However, the proposed activities will not expand the footprint of existing structures within the RFA. Therefore, this performance standard is satisfied.

(e) The area of proposed work shall not exceed the amount of degraded area, provided that the proposed work may alter up to 10% if the degraded area is less than 10% of the riverfront area, except in accordance with 310 CMR 10.58(5)(f) or (g).

The area of the proposed work does not exceed the amount of the degraded area. Therefore, this performance standard is satisfied.

(f) When an applicant proposes restoration on-site of degraded riverfront area, alteration may be allowed notwithstanding the criteria of 310 CMR 10.58(5)(c), (d), and (e) at a ratio in square feet of at least 1:1 of restored area to area of alteration not conforming to the criteria. Areas immediately along the river shall be selected for restoration. Alteration not conforming to the criteria shall begin at the riverfront area boundary. Restoration shall include:

> *1. removal of all debris, but retaining any trees or other mature vegetation;*
>
> *2. grading to a topography which reduces runoff and increases infiltration;*
>
> *3. coverage by topsoil at a depth consistent with natural conditions at the site; and*
>
> *4. seeding and planting with an erosion control seed mixture, followed by plantings of herbaceous and woody species appropriate to the site;*

The proposed activities will have no permanent impacts to RFA, and the Project is not proposing to restore on-site any areas of previously degraded RFA. Therefore, this performance standard does not apply. However, if the preferred microtunnel option is selected for completing the river crossing, it would likely be necessary for Vineyard Wind to acquire additional property rights south of the bridge that would involve demolishing an existing structures, thus eliminating a structure from the RFA and floodplain. The land could then be restored as RFA with native plantings appropriate for the site.

g) When an applicant proposes mitigation either on-site or in the riverfront area within the same general area of the river basin, alteration may be allowed notwithstanding the criteria of 310 CMR 10.58(5)(c), (d), or (e) at a ratio in square feet of at least 2:1 of mitigation area to area of alteration not conforming to the criteria *or an equivalent level of environmental protection where square footage is not a relevant measure. Alteration not conforming to the criteria shall begin at the riverfront area boundary. Mitigation may include off-site restoration of riverfront areas, conservation restrictions under M.G.L. c. 184, §§ 31 through 33 to preserve undisturbed riverfront areas that could be otherwise altered under 310 CMR 10.00, the purchase of development rights within the riverfront area, the restoration of bordering vegetated wetland, projects to remedy an existing adverse impact on the interests identified in M.G.L. c. 131, § 40 for which the applicant is not legally responsible, or similar activities undertaken voluntarily by the applicant which will support a determination by the issuing authority of no significant adverse impact. Preference shall be given to potential mitigation projects, if any, identified in a River Basin Plan approved by the Secretary of the Executive Office of Energy and Environmental Affairs.*

The Project satisfies the performance standards established at 310 CMR 10.58 (5)(c),(d), and therefore is not proposing mitigation for impacts to RFA. Therefore, this performance standard does not apply.

(h) The issuing authority shall include a continuing condition in the Certificate of Compliance for projects under 310 CMR 10.58(5)(f) or (g) prohibiting further alteration within the restoration or mitigation area, except as may be required to maintain the area in its restored or mitigated condition. Prior to requesting the issuance of the Certificate of Compliance, the applicant shall demonstrate the restoration or mitigation has been successfully completed for at least two growing seasons.

The Project is not proposing restoration of degraded RFA. Furthermore, it satisfies the performance standards established at 310 CMR 10.58 (5)(c) and (d), and therefore is not proposing mitigation for impacts to RFA. Therefore, this performance standard does not apply.

5.2.1.5.5 Land Under Water/Bordering Vegetated Wetlands

Variant 2 of the transmission route Noticed Alternative will pass a small pond located along ROW #345. Based on review of published map sources[4], some BVW may occur along segments of pond's shoreline. Should use of this variant become likely, Vineyard Wind would pursue a trenchless crossing solution that would avoid direct impacts to these resources.

[4] Barnstable County Registry of Deeds, Plan Book 77, Pg. 98

The Project will satisfy the performance standards for both Land Under Water and BVW by avoiding these resource areas. The performance standards for Land Under Water require that a project not impair surface or groundwater quality or fish and wildlife habitat. However, they also specifically allow for up to 10% or 5,000 square feet (whichever is less) of alteration to the resource area. The Project will satisfy the performance standards by avoiding any impacts to the pond by utilizing a trenchless crossing technique.

With respect to BVW, the performance standards state that a project may alter up to 5,000 square feet of the resource area provided that a "replacement area" equal to that which is lost is provided within the general area of the altered wetland (310 CMR 10.55 (4)(b)). As with Land Under Water, avoidance of the BVW adjacent to the pond will be accomplished by utilizing a trenchless crossing technique to prevent any alteration to the resource area. Thus, the Project meets the performance standards for both resource areas.[5]

5.2.1.6 Interests Protected under Barnstable Wetlands Protection Bylaw

The Project and associated activities contribute to the protection of wetland functions and values identified in the Town of Barnstable Wetlands Bylaw, Chapter 237. The bylaw specifically addresses fourteen values, as discussed below.

<u>Protection of public and private water supply</u>: Construction activities proposed in or within 100 feet of wetland resource areas will not affect public or private water supplies. Nearly all vehicle fueling and all major equipment maintenance will be performed off-site at commercial service stations or at a contractor's yard. A few pieces of large, less mobile equipment (e.g., excavators, paving equipment) will be refueled as necessary on-site. Any such field refueling will not be performed within 100 feet of wetlands waterways, within 100 feet of known private or community potable wells, or within any Town water supply Zone I area. The only exception may be at the Centerville River crossing, where the crossing methodology has not yet been finalized (see Section 1.5.1.4); should it prove infeasible to refuel immobile equipment more than 100 feet from salt marsh, spill prevention measures will be deployed. Further, the cables and duct bank will not contain any fluids or hazardous materials.

<u>Protection of groundwater supply</u>: The Project will protect groundwater supply through the implementation of a Stormwater Pollution Prevention Plan during construction to properly manage construction activities.

<u>Flood control</u>: The Project will not permanently change existing grades within the floodplain, and therefore will not affect existing flood storage capacity.

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[5] Although Vineyard Wind anticipates the trenchless crossing would entirely avoid the pond/BVW, those impacts are quantified in Table 5-2 to be conservative.

Storm damage prevention: The Project will not affect resources that protect properties from storm damage. Following the temporary disturbance of the narrow strip of Coastal Dune located between the paved Craigville Beach parking lot and Craigville Beach Road, the Company will restore this area of Coastal Dune to pre-construction conditions.

Prevention of pollution: A Stormwater Pollution Prevention Plan will be prepared in accordance with the U.S. EPA's general permit for construction activities and will be implemented during construction to properly manage construction activities. The Company's objective is to minimize the potential for erosion and sedimentation impact during Project construction by managing stormwater and effectively restoring any disturbed areas. The Company will meet these objectives by implementing various erosion and sediment control measures that will:

- Minimize the quantity and duration of soil exposure;
- Protect areas of critical concern during construction by redirecting and reducing the velocity of runoff; and
- Establish vegetation where required as soon as possible following final grading.

Temporary erosion control barriers will be installed prior to initial disturbance of soil and will be inspected on a daily basis in areas of active construction or equipment operation, on a weekly basis in areas with no construction or equipment operation, and within 24 hours of a rain storm event that is 0.5 inches or greater. These temporary erosion control barriers will be maintained as necessary to contain soil and sediment within the permitted work limits.

Any silt fence used as a construction-period control will be installed as directed by the manufacturer and applicable permit conditions. Accumulated sediment will be removed and the fence inspected to ensure it remains embedded in the soil as directed. Sufficient silt fence will be stockpiled on site for emergency use and maintenance. Hay/straw bales used for stormwater management will be anchored in place with at least two wooden stakes and will be replaced if damaged or allowing water to flow underneath; properly placed and staked straw wattles or fiber rolls may be used in lieu of hay bales in certain circumstances.

Protection of land containing shellfish: The Project will cross an area within the Town of Barnstable that is mapped by DMF as a shellfish suitability area, but will not affect any areas that are managed by the Town of Barnstable for the recreational harvest of shellfish.

Protection of shellfish and fisheries: Direct trenching impacts for the two offshore export cables will be limited to two narrow, approximately 3.3-foot (1-meter) wide, strips of seabed. Given the narrow width of disturbance, and since immediately adjacent habitats will remain unaffected, it is anticipated that the affected area will recover quickly, as observed for other cable projects in

Nantucket Sound (e.g., the Martha's Vineyard Hybrid Cable Project between Falmouth and Tisbury in 2015). The Company will continue to consult with the relevant federal and state agencies to refine the Project construction schedule to avoid and minimize impacts to marine species.

Protection of wildlife habitat: The Project will avoid disturbance of the priority habitat associated with Craigville Beach by installing the cables using HDD and by initiating the HDD activities prior to April 1 or after August 31. Furthermore, since the onshore route utilizes existing corridors (e.g., roadway layouts), it will not adversely affect wildlife habitat.

Erosion and sedimentation control: The Project will control erosion through the implementation of a Stormwater Pollution Prevention Plan.

Recreation: The Project will have a minimal impact on recreational activities, and all construction activities at the Craigville Beach parking lot will be completed outside of the busy summer season. In addition, the Company will maintain public access to Craigville Beach parking lot during the construction period. Finally, the Company will repave the parking lot upon completion of construction.

Aesthetics: Within the jurisdiction of the Barnstable Conservation Commission, the Project will have no visual impacts outside of the construction period since the offshore export cables and the onshore duct bank will be entirely underground except for at-grade manhole covers.

Effects on agriculture: The Project will not affect any areas of existing agriculture.

Effects on aquaculture: The Project will not affect any areas of existing aquaculture.

Effects on historic interests: No direct impacts to terrestrial historic resources are anticipated. Avoidance, minimization, and mitigation measures for submarine historical and archaeological resources within the Project area will be determined in consultation with the MHC and MBUAR through the Section 106 process.

5.2.1.7 Offshore Comparison with Respect to Wetlands

As described in Section 4.6.3 in greater detail, a single OECC is proposed for installation of the offshore export cables. The only variation in the OECC pertains to which landfall site, Craigville Public Beach or Covell's Beach, is utilized for the offshore-to-onshore transition. These two landfall sites are approximately 0.4 miles apart and have similar characteristics. In addition, the same construction methodology (HDD) is proposed at both sites and neither approach to the landfall site results in a cable installation path that would affect wetland resources differently from the other approach; for example, the hard bottom and co-located eelgrass around Spindle Rock would be avoided with routes into either landfall site. As such, there is no significant difference in impacts to Land Under the Ocean from utilizing Craigville Public Beach versus Covell's Beach.

5.2.2 Rare Species

Areas mapped as Priority Habitat of Rare Species and/or Estimated Habitat of Rare Wildlife by the NHESP under the MESA and the WPA, respectively (Natural Heritage Atlas, 2008), are described below. The Massachusetts NHESP has mapped all state waters within Nantucket Sound and Muskeget Channel as priority habitat of state-listed rare species, largely for shorebirds (e.g., piping plover, terns) (Massachusetts Natural Heritage Atlas, 14th Edition, 2017). As a result, the portion of the OECC that passes within Barnstable waters will necessarily cross priority habitat. The Company is consulting with the NHESP in accordance with MESA (321 CMR 10.14) to ensure that impacts to offshore rare species are avoided or minimized to greatest extent practicable.

In addition, NHESP has established Priority Habitat along the Centerville Harbor shoreline for Piping Plover that includes the beach and some of the dunes adjacent to the paved parking lots at the Craigville Public Beach Landfall Site and the Covell's Beach Landfall Site (see Figure 5-6). At either location, the Project would utilize HDD to avoid any disturbance to mapped Piping Plover habitat. Nonetheless, due to the proximity of the coastal dune to the paved parking lots where HDD would be staged, the Company has developed a draft PPPP for construction activities at either landfall site very similar to the PPPP that was created in consultations with NHESP during permitting of the Vineyard Wind Connector 1 (see Attachment K); NHESP issued a no take determination for the Vineyard Wind Connector 1 that relied in part on the PPPP on May 14, 2019.[6]

Project construction at either landfall site will remain entirely outside of mapped habitat for any listed species, and the HDD will be performed entirely within existing paved surfaces. Furthermore, since the proposed cable installation by HDD and would extend underneath the beach, there will be no disturbance to any areas of mapped Piping Plover habitat. In discussions with NHESP in the planning stage of Vineyard Wind 1, potential noise disruption to existing nests was raised as a possible concern, and NHESP suggested that if the HDD could begin before April 1 or after August 31, then a pair of birds would be aware of the noise prior to selecting a nesting location. The draft PPPP, provided as Attachment K, adopts this schedule to avoid and minimize noise impacts to Piping Plover during the breeding season. HCA provisions restrict work at the landfall site during the summer months.

Mapped rare species habitats are discussed further below. Areas mapped along the Preferred and Noticed Alternative onshore transmission routes are shown on Figure 5-6. There are no areas mapped as rare species habitats along the Preferred and Noticed Alternative grid interconnection routes (see Figure 5-7).

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6 The PPPP as drafted pertains to the landfall site HDD. Should the direct pipe method for crossing the Centerville River become preferred, the Company anticipates it will be necessary to modify the PPPP in consultation with NHESP to account for temporary staging on the beach.

5.2.2.1 Transmission Routes (Landfall Site to Substation Site)

Rare species habitat along the Preferred and Noticed Alternative onshore transmission routes connecting the landfall site to the proposed substation site are described below.

5.2.2.1.1 Preferred Route (Shootflying Hill Road)

The onshore Preferred Route from the Craigville Public Beach Landfall Site to the proposed substation site will not pass through any mapped rare species habitat, including along ROW #343 (see Figure 5-6). The only location where the onshore Preferred Route will pass adjacent to mapped rare species habitat is at the Craigville Public Beach Landfall Site. While rare species habitat is mapped along the seaward Coastal Beach, the Project's landfall site will be located within the paved Town-owned parking lot, and the use of HDD will avoid any impacts to the Coastal Beach.

The proposed substation site is not located within mapped habitat (see Figure 5-6).

Variant 1 – Covell's Beach Landfall Site

Variant 1 of the Preferred Route does not pass through any areas of mapped rare species habitat. The segment of this variant that utilizes Craigville Beach Road will pass adjacent to rare species habitat mapped along the Coastal Beach, but the duct bank and onshore export cables will be contained entirely within the existing roadway layout (beneath pavement or within 10 feet of pavement). The variant will not pass through any mapped rare species habitat where the route is more than 10 feet from pavement.

The implementing regulations of the MESA (321 CMR 10.00) contain an exemption from review for projects in Priority Habitat for *"installation, repair, replacement, and maintenance of utility lines (gas, water, sewer, phone, electrical) for which all associated work is within ten feet from the edge of existing paved roads"* (321 CMR 10.14(b)(10)). Because the onshore duct bank will be installed beneath or within ten feet of road pavement, construction in those areas is exempt from review under the MESA, and accordingly there is not expected to be any impact to rare species habitats by the duct bank installation.

Variant 2 – South Main Street

Variant 2 of the Preferred Route does not pass through any new or incremental areas of mapped rare species habitat relative to the onshore Preferred Route described above, although it will pass adjacent to mapped rare species habitat associated with Long Pond while on Main Street (see Figure 5-6). The duct bank and onshore export cables will be contained almost entirely within the existing roadway layout (beneath pavement or within 10 feet of pavement) except for possibly the Centerville River crossing as well as the final approximately 0.2 miles within ROW #343, and therefore no impacts to rare species habitat are expected.

Variant 3 – Northern Substation Access

Variant 3 of the Preferred Route does not pass through any new or incremental areas of mapped rare species habitat relative to the route described above.

5.2.2.1.2 Noticed Alternative (Oak Street)

The onshore Noticed Alternative will not pass through any mapped rare species habitat (see Figure 5-6). The only locations where this route will pass adjacent to mapped rare species habitat are at the Craigville Public Beach Landfall Site, where activities will remain within the paved Town-owned parking lot, and a short stretch of Main Street, where duct bank installation will occur within the roadway layout (beneath pavement or within 10 feet of pavement). Therefore, no impacts to rare species habitat are expected along the onshore Noticed Alternative.

Rare species habitat and potential Project-related impacts along the OECC are described in Section 4.6.3.

Variant 1 – Covell's Beach Landfall Site

Variant 1 of the Noticed Alternative does not pass through any new or incremental areas of mapped rare species habitat. However, the segment of this variant that utilizes Craigville Beach Road will pass adjacent to rare species habitat mapped along the Coastal Beach, but the duct bank and onshore export cables will be contained almost entirely within the existing roadway layout (beneath pavement or within 10 feet of pavement) except for possibly the Centerville River crossing as well as the final approximately 0.2 miles within ROW #343.

Variant 2 – ROW #345

Variant 2 of the Noticed Alternative does not pass through any new or incremental areas of mapped rare species habitat. As shown on Figure 5-6, the segments along utility ROW #345 and ROW #343 do not contain any mapped rare species habitat.

5.2.2.2 Grid Interconnection Routes (Substation Site to Interconnection Location)

As shown on Figure 5-7, the grid interconnection routes connecting the proposed substation to the West Barnstable Substation will not pass through or adjacent to any mapped rare species habitat.

5.2.2.3 Comparison of Impacts/Mitigation Measures

The onshore routes are located entirely outside of protected habitats, and therefore are equivalent with regard to associated impacts. As described above, areas where the route passes adjacent to rare species habitat while beneath pavement or within ten feet of pavement are exempt from MESA review, and are not considered to have any impacts on that rare species habitat. The same is true of the variants, which do not have any new or incremental impact to rare species habitat. Similarly, no protected habitats are present on or adjacent to the site of the proposed substation.

Rare species habitat and potential Project-related impacts along the OECC are described in Section 4.6.3.

5.2.3 Water Quality and Water Supply Protection

This section assesses mapped water resource areas along the onshore Preferred and Noticed Alternative routes (transmission routes and grid interconnection routes). Resources identified and evaluated include MassDEP Zone I and II areas and wellhead protection areas determined by hydro-geologic modeling and approved under MassDEP's Drinking Water Program. Freshwater recharge areas identified by the Cape Cod Commission's (CCC's) Regional Policy Plan are also considered, as are the Potential Public Water Supply Areas, mapped by the CCC's Priority Land Acquisition Assessment Project. This CCC project focused on the Upper and Mid-Cape Towns with public water supplies.

As described in Section 1.3, the onshore portion of the Project is essentially a civil construction project predominantly located along roadways and existing ROWs that involves standard inert materials such as concrete, PVC conduit, and solid dielectric cable. The Project will employ proper erosion and sedimentation controls.

Furthermore, the proposed substation will be equipped with an integrated fluid containment system capable of fully capturing fluids from any components containing dielectric fluid (with a generous safety buffer), including all transformers and capacitor banks (see Section 1.3.4.1 for a more detailed discussion of containment at the substation site). Procedures for refueling construction equipment will ensure safety and spill prevention and will be further established during consultations with the CCC.

During the Project's operations phase, vegetation control will be minimal along the duct bank route, primarily due to the route following existing paved roadways and other existing ROWs. It is expected that any duct bank within the Eversource ROW will be maintained consistent with the ROW maintenance program. Any vegetated screening maintained on the substation site will remain natural and will not necessitate application of herbicides.

In addition, the Company is working with the Town of Barnstable to determine whether Project construction can be coordinated with the Town's plans to install sewer infrastructure, which would have wide benefits for water quality in the area. Coordinating construction schedules could reduce inconvenience for the community as well as reduce costs for the Town (see Section 1.6).

As a result, the Project is not expected to result in any significant impacts to water resources; nonetheless, water resources along the onshore routes are discussed below.

5.2.3.1 Transmission Routes (Landfall Site to Substation Site)

Water resource areas along the Preferred and Noticed Alternative onshore transmission routes connecting the landfall site to the proposed substation site are described below.

5.2.3.1.1 Preferred Route (Shootflying Hill Road Route)

Figure 5-8 illustrates water resources along the Preferred Route extending from the Craigville Public Beach Landfall Site to the proposed substation site. The Preferred Route is not located within any Interim Wellhead Protection Areas[7], nor does it cross through any Zone I[8] areas.

While on Shootflying Hill Road, the Preferred Route does pass through an area mapped as a Freshwater Recharge Area by the CCC's Regional Policy Plan. In addition, from a point on Shootflying Hill Road just northwest of Wequaquet Lake to the proposed substation site, the route passes through Zone II areas[9]. The Preferred Route also passes adjacent to a Potential Public Water Supply Area mapped by the CCC west of Wequaquet Lake, although the Project will remain entirely within the roadway layout in this location.

The Preferred Route and each of its variants all pass through approximately 1.1 miles of Zone II protection areas, and none pass within Zone I areas. Coincident with the Zone II area around the northern portion of Wequaquet Lake, the Preferred Route also passes through the Barnstable Groundwater Protection Overlay District. The site for the proposed substation is located within this coincident area mapped for Zone II and the Groundwater Protection Overlay District.

As described above, the transmission route is located along roadways and existing ROWs and involves standard inert materials such as concrete, PVC conduit, and solid dielectric cable. The Project will employ proper erosion and sedimentation controls, and the proposed substation will be equipped with an integrated fluid containment system capable of fully capturing fluids from any components containing dielectric fluid (see Section 1.3.4.1).

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7 As defined in 310 CMR 22.01, "for public water systems using wells or Wellfields that lack a Department-approved Zone II, the Department will apply an Interim Wellhead Protection Area."

8 As defined in 310 CMR 22.02, Zone I "means the protective radius required around a public water supply well or Wellfield…"

9 As defined in 310 CMR 22.02, Zone II "means that area of an aquifer that contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation). The Zone II must include the entire Zone I area…"

5.2.3.1.2 Noticed Alternative (Oak Street)

Figure 5-8 illustrates water resources along the Noticed Alternative transmission route. Similar to the Preferred Route, the Noticed Alternative does not pass through any Zone I areas. Most of the route also avoids Zone II areas, except for the final approximately 0.5 miles to the substation site. Variant 2 (ROW #345) passes through approximately one mile of the Zone II area.

The Noticed Alternative and its variants are not located near any Interim Wellhead Protection Areas or Potential Public Water Supply areas, but roughly the northern half of the route passes through a freshwater recharge area. Approximately 0.5 miles of the final approach to the proposed substation site and the substation site itself are within the Barnstable Groundwater Protection Overlay District.

5.2.3.2 Grid Interconnection Routes (Substation Site to Interconnection Location)

Water resource areas along the Preferred and Noticed Alternative grid interconnection routes connecting the proposed substation site to the interconnection location are described below.

5.2.3.2.1 Preferred Route (ROW #343 to ROW #381)

Figure 5-9 illustrates water resources along the Preferred Route extending from the site of the proposed substation to the West Barnstable Substation. The Preferred Route is not located within any Interim Wellhead Protection Areas, Potential Public Water Supply Areas mapped by the CCC, or Zone I areas.

While on ROW #345 and ROW #381, the route does pass through an area mapped as a Freshwater Recharge Area by the CCC's Regional Policy Plan, and much of the route passes through Zone II areas as well as the Barnstable Groundwater Protection Overlay District.

The Preferred Route passes through approximately 0.6 miles of Zone II protection areas (and no Zone I areas). Variant 1 passes through the same water resources, but only crosses through approximately 0.5 miles of Zone II protection areas. Variants 2 and 3 both avoid the Freshwater Recharge Area and pass through approximately 0.2 miles of Zone II areas. These two variants also pass through a Potential Public Water Supply Area while on ROW #342.

As described above in the context of transmission routes, the Preferred grid interconnection route and its variants are located along roadways and existing ROWs and involve standard inert materials such as concrete, PVC conduit, and solid dielectric cable. The Project will employ proper erosion and sedimentation controls, and no impacts to water resources are anticipated.

5.2.3.2.2 Noticed Alternative (In-Road)

Figure 5-9 illustrates water resources along the Noticed Alternative grid interconnection route extending from the site of the proposed substation to the West Barnstable Substation. The route is not located within any Interim Wellhead Protection Areas, Potential Public Water Supply Areas mapped by the CCC, Zone I areas, or Freshwater Recharge Areas.

While on Shootflying Hill Road and Route 132/Iyannough Road, the Noticed Alternative does pass through approximately 0.5 miles of Zone II protection area that is coincident with the Barnstable Groundwater Protection Overlay District. The route also passes adjacent to, but not within, a Potential Public Water Supply Area mapped by the CCC.

As described above, the route is located along existing paved roadways and involves standard inert materials such as concrete, PVC conduit, and solid dielectric cable. The Project will employ proper erosion and sedimentation controls, and no impacts to water resources are anticipated.

5.2.3.3 Comparison of Impacts/Mitigation Measures

Common to both the Preferred Route and Noticed Alternative, the proposed substation site is located within a Zone II Wellhead Protection Area and the Barnstable Groundwater Protection Overlay District. The proposed substation will be equipped with full containment for any components containing dielectric fluid, including all transformers and capacitor banks (see Section 1.3.4.1 for a more detailed description of substation containment). None of the substation equipment will contain polychlorinated biphenyls (PCBs).

With regard to the onshore transmission routes connecting the landfall site to the proposed substation, the Preferred Route passes through approximately 1.1 miles of Zone II protection areas while the Noticed Alternative passes through approximately 0.5 miles of Zone II protection areas. Neither route passes within Interim Wellhead Protection Areas. Both routes pass through sections of the Barnstable Groundwater Protection Overlay District as well as freshwater recharge areas mapped by the CCC.

With regard to the grid interconnection routes connecting the new substation to the West Barnstable Substation, the Preferred Route passes through approximately 0.6 miles of Zone II protection areas while the Noticed Alterative passes through approximately 0.5 miles of Zone II protection areas. Neither route passes within Interim Wellhead Protection Areas, Potential Public Water Supply Areas, or Zone I protection areas. Both routes pass through the Barnstable Groundwater Protection Overlay District, while the Preferred Route also crosses within a Freshwater Recharge Area.

The operational phase of the Project will have no impact on water quality or water supplies, regardless of which route is constructed. Once the proposed duct bank is installed, backfilled, and repaved, there will be no Project-related sources of erosion or sedimentation, and the export cables will have no capability to generate hazardous waste. No sources of total suspended solids

(TSS) will be created by the Project's onshore duct bank and export cables. As a result, since the Project will have no impact on water quality or water supplies, the onshore export cable routes are equivalent to one another.

Temporary construction-period considerations related to water quality, drainage, and water supply protection, including refueling considerations, are discussed below in Section 5.4.6. Temporary construction-period considerations related to erosion and sediment control are discussed in Section 5.4.7.

5.2.4 Eelgrass

As described in Sections 4.6.3.4 and 6.4.5, the Massachusetts OMP identifies eelgrass as an SSU resource for cable projects. Mapped eelgrass is shown on Figure 4-7. Mapped eelgrass habitat is typically relatively close to shore, and in the general Project area there is no mapped eelgrass more than a few thousand feet offshore. The Company's marine surveys performed in 2018 and 2019 delineated a small area of eelgrass co-located with an area of hard bottom habitat around Spindle Rock approximately 1,000 feet offshore from Covell's Beach. The HDD trajectory for Vineyard Wind 1 will avoid any impacts to this eelgrass, and similarly the HDD for the proposed Vineyard Wind Connector 2 will also avoid impacts to this area. Therefore, the OECC will avoid impacts to eelgrass, and there is no significant difference between use of the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site.

Even though based on the best available information the Project will avoid mapped eelgrass, eelgrass is an ephemeral resource for which the location can change. In the case that mapped or unmapped eelgrass is encountered along the OECC, the Company would develop mitigation in conjunction with regulatory authorities.

Since the Preferred Route and Noticed Alternative would utilize the same landfall site, there is no significant difference between these routes in terms of potential impacts to eelgrass.

5.2.5 Climate Change Resiliency and Sustainability

The Project will reduce GHG emissions in the New England region by offsetting emissions from higher-polluting conventional power generation facilities. Beyond this GHG emissions benefit, the Project has also considered the implications of sea level rise and shoreline change.

Figures 5-1 and 5-3 demonstrate that only the landfall sites and immediately proximate stretches of onshore routing are within existing Federal Emergency Management Agency (FEMA) flood zones. The site of the proposed substation is not within the flood zone.

If properly installed according to industry standards, underground cable systems are not affected by flooding and weather events. Cables and splices are designed to be sealed from water intrusion, and quality control and assurance processes are implemented to assure that construction is completed properly in this regard. Underground systems can be affected by outside influences, some caused by weather and damage leading to water intrusion due to municipal or utility contractors' excavation errors, or from tree roots displacing cables. The proposed placement of conduits within a concrete encasement greatly helps to prevent this type of damage. Nevertheless, to further mitigate for these possibilities, Vineyard Wind design plans will call for proper visual and electronic marking of communication cables and duct banks.

In addition to the precautions and protections noted above, vault design and installation must prevent unnecessary exposure to groundwater and/or surface water which could enter the vaults. Some examples of design criteria to be implemented during construction to prevent water intrusion include the following:

- ♦ Concrete vaults are assembled from pre-cast top and bottom sections. The vault design details will call for the contractor to place black mastic sealant strips (provided from the vault manufacturer) in the groove on the top of the bottom section walls prior to installing the top section, to provide a water-tight installation.
- ♦ It is typical that vaults will be located, if possible, to one side of the road (e.g. in one traffic lane), or in the shoulder of a paved roadway. Either way, it is important to avoid placement of the vault manhole covers within gutter areas; and, if this is unavoidable, a bolted and gasketed cover system should be used to ensure that watertight conditions will exist.
- ♦ In general, vaults should not be placed in wet locations, swale areas, and low points along the route.

Sea level rise is discussed in Section 5.2.5.1, and shoreline change is discussed in Section 5.2.5.2.

5.2.5.1 Sea Level Rise

The Company has evaluated the Project's vulnerability to sea level rise by using data from the CCC's Sea Level Rise Viewer, which covers all of Barnstable County on Cape Cod. This tool depicts sea level rise at one-foot increments between 1 and 6 feet and demonstrates the effects of this bathtub scenario of sea level rise on Cape Cod. The model incorporates overlays from the FEMA Flood Insurance Rate Maps (FIRMs) and the National Weather Service's SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model.

The bathtub model accounts for rising water levels but does *not* take into account natural events like storm surge and does not model the rate of sea level rise. Rather, it evaluates effects from a consistent rise of water (like filling a bathtub). The tool uses mean higher high water (MHHW) as the base sea level elevation; MHHW is the average of the higher high-water height of each tidal day observed over the National Tidal Datum Epoch. Sea level is then raised in one-foot increments to illustrate inundation under various sea level rise scenarios. The analysis for this Project, which has a projected life of up to 30 years, used a conservative sea level rise scenario of 3 feet; a scenario involving 6 feet of sea level rise would be more appropriate for a period spanning 100 years. Modeled scenarios such as these are meant to represent potential flooding to inform planning decisions, but are not suitable for use as actual calculations.

As shown on Figure 5-10, a three-foot rise in sea level would leave the vast majority of the proposed Project infrastructure unaffected, with only the nearshore portion of the onshore duct bank route affected (roughly from the landfall site to the Centerville River crossing). The heavily insulated onshore export cable, which will be buried within an underground concrete duct bank, is designed to withstand wet conditions and would be unaffected by these scenarios.

The SLOSH model is a mathematical and spatial model that estimates and models storm surge heights under different circumstances. The model uses a number of variables to define and compute storm surge potential and provides estimates of surge heights using temporal data for past, present, and theoretical hurricanes. These variables include storm size, wind speed, track, and pressure. Once these variables have been calculated in the model, it is then applied to a specific shoreline of the user's choice, determined using a hydrologically correct digital elevation model to account for rivers, roads, bathymetry, and other features. The output is a spatial grid that represents different surge levels for different scenarios. The National Hurricane Center provides inputs for the SLOSH model.

As shown on Figure 5-11, hurricane storm surge inundation can be expected to occur along southern portions of the Preferred and Noticed Alternative transmission routes. This inundation is constrained to the southern portions of these routes; no hurricane storm surge inundation would be expected at the proposed substation site. The heavily insulated onshore export cable, which will be buried within an underground concrete duct bank, is designed to withstand wet conditions and would be unaffected by these scenarios.

5.2.5.2 Shoreline Change

Trends related to shoreline change are relevant for this Project primarily due to infrastructure proposed at the landfall site where offshore export cables will transition to onshore export cables. A transition vault and manholes will be installed at this location, and it is important to ensure that this infrastructure will neither contribute to nor be vulnerable to erosion and shoreline retreat. As described in Section 5.4.7, the Project is not anticipated to cause long-term erosion or accretion at the landfall site.

To ensure that proposed onshore infrastructure associated with the Project (e.g., manholes and associated electrical infrastructure) will not cause or be vulnerable to shoreline erosion, the Company performed a shoreline change analysis at the landfall sites associated with the Preferred Route and Noticed Alternative. Since both the Preferred Route and Noticed Alternative will utilize the same landfall site (either the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site), there is no difference between the two in this regard. Because Covell's Beach is retained as a variant, results of the shoreline change analysis for the Craigville Public Beach Landfall Site and Covell's Beach Landfall Site are described below.

Craigville Public Beach Landfall Site

Shoreline change at the Craigville Public Beach Landfall Site (the preferred landfall site for both the Preferred and Noticed Alternative transmission routes) is shown on Figure 5-12, which shows that since 1846, the shoreline has accreted approximately 200 feet. As shown on Figure 5-13, the underground transition vaults/joint bays at the landfall site would be located well back from the existing high waterline. Based on this analysis, proposed infrastructure associated with this landfall site would be sufficiently set back from the shoreline to avoid any impacts from shoreline change during the life of the Project.

The landfall site is within the Craigville Beach Zoning District, and the site is in a velocity zone (VE elev. 15 feet), as established by FEMA (see Figures 5-1 and 5-2). An adjacent still-water flood zone (AE elev. 13 feet) lies immediately inland of the velocity zone and extends to a point north of the Centerville River. All Project components at the landfall location and along the onshore transmission route will be buried and designed for submerged conditions.

Covell's Beach Landfall Site

Shoreline change at the Covell's Beach Landfall Site (Variant 1 for both the Preferred and Noticed Alternative transmission routes) is shown on Figure 5-14, which illustrates that since 1846 the shoreline has accreted approximately 150 feet. The HDD pit and transition vault at the Covell's Beach Landfall Site would be located well back from the existing high waterline, as they were permitted for the Vineyard Wind Connector 1. Based on this analysis, proposed infrastructure associated with the Covell's Beach Landfall Site would be sufficiently set back from the shoreline to avoid any impacts from shoreline change during the life of the Project.

Comparison of Landfall Sites

As demonstrated above and illustrated in Figures 5-12 and 5-14, the Craigville Public Beach Landfall Site and Covell's Beach Landfall Site both exhibit accreting shorelines. Therefore, the proposed infrastructure associated with the transition vaults and manholes for the transition from offshore export cables to onshore export cables, which will be located well back from the existing high waterline, will be located sufficiently onshore that they would not be expected to be vulnerable to shoreline change over the life of the Project. Furthermore, as described in Section 5.2.1.5, the Project's buried duct bank and export cables will comply with performance standards of the Massachusetts WPA and construction techniques discussed in Section 5.4 will ensure the Project will not result in any impacts related to erosion at the landfall site.

5.2.6 Tree Clearing

As described in Section 4.4.3.2, only minor trimming activities are expected along in-road sections of the onshore routes, but portions of the routes following utility ROWs may require tree clearing where those ROWs have not been maintained to their full widths. Specifically, Variant 2 of the

Noticed Alternative would likely require some tree clearing on private land within the transmission ROW where the ROW has not been maintained to its full width. Post-construction, Vineyard Wind anticipates that Eversource would still maintain its ROW.

The only significant land clearing will occur on the site of the proposed substation (see Section 1.3.4), parcel #214-001, and possibly at the West Barnstable Substation (see Section 1.3.5), which are common to all routing alternatives. Approximately 3.0 acres of the substation site are currently undeveloped and contain Pitch Pine-Oak forest. Vineyard Wind anticipates the entire site will need to be cleared to accommodate grading and access during construction, but buffers will be revegetated following construction pursuant to final design plans. Given that adjacent forested land that will remain unaffected, however, this clearing is unlikely to have significant impacts on wildlife. As described in Section 1.3.4, some equipment for the proposed substation may be relocated from the parcel on Shootflying Hill Road to assessor map parcel #214-001, located immediately southeast of the West Barnstable Substation (which will also be utilized as the northern terminus of the Route 6 crossing); this would provide greater design flexibility for the proposed substation equipment, and could enhance the visual and noise buffers at the site on Shootflying Hill Road. A possible maximum build-out of assessor map parcel #214-001 is shown on Figure 1-12; under this scenario, all of the 2.8-acre site would be cleared, but it would reduce the motel site substation footprint. Vineyard Wind is planning to perform a Natural Resources Inventory (NRI) on assessor map parcel #214-001 in spring 2020.

As shown on Figure 1-12, it is anticipated that the West Barnstable Substation expansion could occur between the existing 345-kV substation and the Oak Street Substation on the northern part of the same parcel, where it would avoid significant tree clearing.

5.2.6.1 Transmission Routes (Landfall Site to Substation Site)

Tree clearing along the Preferred and Noticed Alternative transmission routes connecting the landfall site to the proposed substation site is described below.

5.2.6.1.1 Preferred Route (Shootflying Hill Road Route)

The Preferred Route, since it is located almost entirely along existing roadway layouts, is only expected to involve minor vegetation clearing and no significant tree clearing. While the final 0.2 miles of the route will follow ROW #343, Vineyard Wind is proposing to locate this section of duct bank within the existing utility ROW access road, which will avoid the need for tree clearing.

5.2.6.1.2 Noticed Alternative (Oak Street Route)

The Noticed Alternative, since it is located almost entirely along existing roadway layouts except for possibly the Centerville River crossing, is only expected to involve minor vegetation clearing and no significant tree clearing.

Variant 2 of the Noticed Alternative follows approximately 1.6 miles of ROW #345 and ROW #343. While the final 0.2 miles of the route, which follows ROW #343, would likely follow the existing ROW access road and hence avoid tree clearing, ROW #345 has not been maintained to its full width. Should this variant be selected, the location of the duct bank within the ROW would be coordinated with Eversource. Depending on the outcome of that consultation, duct bank installation within ROW #345 may require tree clearing.

5.2.6.2 Grid Interconnection Routes (Substation Site to Interconnection Location)

Tree clearing along the Preferred and Noticed Alternative grid interconnection routes connecting the proposed substation site to the interconnection at the West Barnstable Substation is described below.

5.2.6.2.1 Preferred Route (ROW #343 to ROW #381)

Vineyard Wind is proposing to locate this section of duct bank within the cleared portions of existing utility ROWs #343, #345, and #381, which will avoid tree clearing during typical duct bank installation. However, some tree clearing on assessors map parcel #214-001 will be necessary to accommodate the northern terminus of the trenchless crossing beneath Route 6.

Variant 1 will use a similar trenchless crossing to achieve the Route 6 crossing, and therefore the same area of tree clearing would be required.

No tree clearing is anticipated for Variants 2 and 3.

5.2.6.2.2 Noticed Alternative (In-Road)

The Noticed Alternative is located entirely within existing roadway layouts, and no significant tree clearing is anticipated.

5.3 Human/Community Considerations

Human/community considerations for the Preferred and Noticed Alternative routes are discussed below.

5.3.1 Traffic Management

Most of the proposed onshore transmission is located within existing roadway layouts (see Figures 1-2 and 1-3). As a result, the Company has assessed potential traffic-related impacts and has proposed the mitigation measures described below. The traffic analysis relied on MassDOT's road classification system and its most recent traffic counts as a means of evaluating potential traffic impacts. The assessment of Candidate Routes was also informed by communications with local officials and their knowledge of road conditions. As the data and consultations above were considered adequate, the Company did not perform any on-site traffic surveys.

Public transportation is somewhat limited in the Project area, and the busiest transportation facilities, such as the Barnstable Municipal Airport Terminal and Hyannis Transportation Center, are well removed from the onshore routes. In addition, the Project is striving to minimize impacts to public transit by avoiding construction in road and rail corridors during the busiest times of the year. For these reasons, potential impacts to public transit or other transportation corridors was not regarded as an important siting criterion for the Project.

5.3.1.1 Transmission Routes (Landfall Site to Substation Site)

Traffic management along the Preferred and Noticed Alternative onshore transmission routes connecting the landfall site to the proposed substation site are described below.

5.3.1.1.1 Preferred Route (Shootflying Hill Road)

The Preferred Route is located within approximately 3.8 miles of roadway layouts including Craigville Beach Road, Main Street, Old Stage Road, and Shootflying Hill Road. All of these public roads are classified as minor arterials and are regularly traveled by local residents. As minor arterials, these roads provide access to principal arteries such as Route 28 and Route 6, and are expected to carry significant traffic volume even in the off-season.

While the entire route will require thoughtful traffic management, the location with the most potential for traffic impact is the signalized intersection at Route 28 and Old Stage Road (see Figure 1-2), which are both well-traveled local roads.[10] Route 28 in particular is a busy east-west connector used heavily by motorists traveling between the upper Cape towns of Falmouth, Mashpee, and Hyannis. MassDOT has indicated that since the duct bank will be installed via open trench, installation at the Route 28 crossing must occur at night. In addition, depending on the construction methodology ultimately selected to complete the Centerville River crossing (see Section 1.5.1.4), some temporary closure of Craigville Beach Road and detours may be required.

From a traffic management perspective, there are no road segments of the Preferred Route that are considered unique or unusual for this type of construction. The two signalized intersections located along the 0.7-mile stretch of Old Stage Road will require careful planning to maintain traffic flows, but both locations are manageable. In general, the road shoulders are sufficiently wide and unobstructed throughout to allow for safe construction and vehicle passage.

All routes, including the Preferred Route, will cross the Centerville River. As described in Section 1.5.1.4, multiple options for achieving this crossing are under consideration, including trenchless crossing methods as well as a bridge superstructure replacement. The preferred method, microtunnel, would minimize temporary construction-period impacts to traffic, while the other trenchless crossing methods (HDD and direct pipe) would also largely maintain traffic flow. In

[10] For reference, annual average daily trips (ADT) reported by MassDOT are 16,283 and 27,478 for Old Stage Road and Route 28, respectively.

contrast, the bridge superstructure replacement would likely require bridge closure and local detours from approximately Columbus Day to Memorial Day. Vineyard Wind has been discussing options for the river crossing with the Town of Barnstable, and regardless of which option is selected will formulate TMP measures to minimize impacts to traffic flow.

Variant 1 – Covell's Beach Landfall Site

Variant 1 uses an approximately ½-mile section of Craigville Beach Road that extends between the Preferred Craigville Public Beach Landfall Site and the alternative Covell's Beach Landfall Site (see Figure 1-2). Although slightly longer than the Preferred Route, Variant 1 does not present any significant traffic management challenges, and is therefore comparable to the Preferred Route with respect to potential traffic impacts.

Variant 2 – South Main Street

Variant 2 includes two roadway segments, one at Mothers Park Road and the other at the intersection of Old Stage Road and Oak Street, that could present some traffic management challenges due to narrow road widths (see Figure 1-2). In both cases, temporary road closures would likely be required during construction.

In addition, the sharp turn at the intersection of South Main Street and Main Street in the vicinity of the Aaron S. Crowell Park may also require a temporary road closure during construction, and hence also has some potential for traffic impact.

Variant 3 – Northern Substation Access

Variant 3 replaces the segment along ROW #343 with a segment along Shootflying Hill Road, thus adding the intersection of Shootflying Hill Road and Service Road. In this respect, it is considered slightly inferior to the Preferred Route in terms of potential traffic impacts.

5.3.1.1.2 Noticed Alternative (Oak Street)

As shown on Figures 1-2 and 5-3, all 6.1 miles of the Noticed Alternative are located beneath paved public roads including Craigville Beach Road, Main Street, South Main Street, Main Street, Phinneys Lane, Great Marsh Road, Old Stage Road, and Oak Street.[11] All of these public roads are classified as minor arterials and are regularly traveled by local residents, with South Main Street serving as an important east-west connector for motorists traveling between Osterville, Centerville, and Hyannis. As minor arterials, these roads provide access to principal arteries such as Route 28 and Route 6, and are expected to carry significant traffic volume even in the off-season.

[11] MassDOT reports the annual ADT for Phinneys Lane and Old Stage Road as 7,492 and 12,146, respectively. ADT counts are not available for the other roadways.

While the entire Noticed Alternative will require thoughtful traffic management, the location with the most significant potential for traffic impact is the major signalized intersection at Route 28 and Phinneys Lane (see Figure 1-2). Due to traffic concerns, MassDOT has indicated that since the duct bank will be installed via open trench, installation at this intersection must occur at night. In addition, depending on the construction methodology ultimately selected to complete the Centerville River crossing (see Section 1.5.1.4), some temporary closure of Craigville Beach Road and detours may be required.

The Noticed Alternative includes two roadway segments, one at Mothers Park Road and the other at the intersection of Old Stage Road and Oak Street, that could present some traffic management challenges due to narrow road widths. In both cases, temporary road closures are likely. In addition, the sharp turn at the intersection of South Main Street and Main Street in the vicinity of the Aaron S. Crowell Park may also require a temporary road closure during construction, and hence also has some potential for traffic impact.

Other than the locations indicated above, from a traffic management perspective there are no road segments on the Noticed Alternative that are considered unique or unusual for this type of construction. Road shoulders are sufficiently wide and unobstructed throughout to allow for safe construction and vehicle passage. Managing traffic at the signalized intersections will be challenging, but it will be possible to safely accommodate traffic through these areas during construction. In general, the Noticed Alternative is regarded as satisfactory with respect to potential for traffic impacts.

<u>Variant 1 – Covell's Beach Landfall Site</u>

Variant 1 uses an approximately ½-mile section of Craigville Beach Road that extends between the preferred Craigville Public Beach Landfall Site and the variant Covell's Beach Landfall Site (see Figure 1-2). Although slightly longer than the Noticed Alternative, Variant 1 does not present any significant traffic management challenges and is therefore regarded as comparable to the Noticed Alternative with respect to potential traffic impacts.

<u>Variant 2 – ROW #345</u>

Variant 2 avoids construction along approximately 2.5 miles of roadway including portions of Old Stage Road, Oak Street, Service Road, and Shootflying Hill Road by following existing utility ROW #345 and ROW #343 from Oak Street to the proposed substation site. In doing so, Variant 2 avoids several intersections, including the space-constrained intersection of Old Stage Road and Oak Street where a temporary road closure may be warranted. In this respect, Variant 2 is considered superior to the Noticed Alternative in terms of potential traffic impacts.

5.3.1.2 Grid Interconnection Routes

Traffic management along the Preferred and Noticed Alternative grid interconnection routes connecting the landfall site to the proposed substation site are described below.

5.3.1.2.1 Preferred Route (ROW #343 to ROW #381)

The Preferred Route is located entirely within existing utility ROWs, and hence most of the route will not require traffic management. The route will, however, cross Shootflying Hill Road, Service Road, and Route 6 and temporary traffic management measures will therefore be required. A trenchless crossing technique (pipe jacking) will be used to perform the combined Route 6/Service Road crossing, so minimal traffic management measures are anticipated to be necessary. In total, the Preferred Route has very little potential to impact traffic.

Variant 1 – Service Road to ROW #381

Variant 1 is located almost entirely within public roadways, except for the most westerly portion where it crosses Route 6 within ROW #381. Of the two roads affected, Shootflying Hill Road is the more heavily traveled with just under 13,000 average daily trips (ADT) recorded from a 2017 traffic study conducted by MassDOT. By comparison, Service Road had less than 3,200 ADT from a 2018 MassDOT study. A trenchless crossing technique (pipe jacking) will be used to perform the Route 6 crossing, so minimal traffic management measures are anticipated to be necessary. However, construction along Shootflying Hill Road and Service Road will have some temporary traffic impacts and a thoughtful TMP developed in consultation with local public safety agencies will be required.

Variant 2 – ROW #343 to ROW #342

Variant 2 is located entirely within existing utility ROWs, and hence most of the route will not require traffic management. The route will, however, cross Shootflying Hill Road, Service Road, and Route 6 and some temporary traffic management measures will be required at these intersections. A trenchless crossing technique (pipe jacking) will be used to perform the combined Route 6/Service Road crossing, so minimal traffic management measures are anticipated to be necessary. Thus Variant 2 has very little potential to impact traffic.

Variant 3 – Service Road to ROW #342

Variant 3 is located partly within public roadways (Shootflying Hill Road and Service Road), but mostly within ROW #342. Of the two roads affected, Shootflying Hill Road is the more heavily traveled with just under 13,000 ADT recorded from a 2017 traffic study conducted by MassDOT. By comparison, Service Road had less than 3,200 ADT from a 2018 MassDOT study. A trenchless crossing technique (pipe jacking) will be used to perform the Route 6 crossing, so minimal traffic management measures are anticipated to be necessary. However, construction along Shootflying Hill Road and Service Road will have some temporary traffic impacts and a thoughtful TMP developed in consultation with local public safety agencies will be required.

5.3.1.2.2 Noticed Alternative (In-Road)

The Noticed Alternative is located entirely in roads including Shootflying Hill Road, Route 132/Iyannough Road, and Oak Street. From a traffic perspective, the heavily traveled Route 132 segment is the most challenging. Primary concerns include maintaining traffic flows on and off Route 6 and maintaining access to several public facilities located nearby including a commuter parking lot and visitors' center at the Route 6 interchange, Cape Cod Chamber of Commerce Headquarters and Visitors Center, Cape Cod Community College, a YMCA recreation center and housing complex, and the Cape Cod Conservatory. The Route 132/Oak Street intersection presents another challenge as it could affect traffic entering either road from Route 6A. For these reasons, the Noticed Alternative is regarded as significantly more impactful with respect to traffic management.

5.3.1.3 Summary and Comparison of Impacts/Mitigation Measures

In terms of the potential for traffic congestion along the onshore transmission routes, the Preferred Route is considered superior to the Noticed Alternative. As described above, the Noticed Alternative follows some roadways that are expected to carry significant traffic volume even in the off-season, and will also have temporary impacts at intersections with South Main Street and Route 28. Although the Noticed Alternative avoids Main Street in the village of Centerville, it would shift traffic impacts to South Main Street, an important east-west connector for motorists traveling between Osterville/Centerville and Hyannis. The Noticed Alternative also requires crossing Route 28 at Phinneys Lane, which is considered less favorable due to the oblique roadway configuration at that intersection.

Along the grid interconnection routes, the Preferred Route has very little potential for traffic congestion given that it follows utility ROWs. Some traffic mitigation at intersections with Shootflying Hill Road will be required, but trenchless construction at the combined Route 6/Service Road crossing is expected to obviate the need for traffic management in that location. The Noticed Alternative has significantly greater potential for impacts to traffic given that it follows approximately 0.9 miles of Route 132/Iyannough Road and could impact traffic to and from Hyannis as well as traffic attempting to access various high-volume facilities located in the vicinity of the highway interchange.

Regardless of the route selected, signage, lane restrictions, police details, and other appropriate traffic management measures will be used to maintain traffic flow, and traffic management will always be coordinated with Town officials. The Company will utilize various methods of public outreach prior to and during the construction phase to keep residents, business owners, and officials updated on the Project construction schedules, vehicular access, lane closures, detours, and other traffic management information, local parking availability, emergency vehicle access, construction crew movement and parking, laydown areas, staging, and equipment delivery, nighttime or weekend construction, and road repaving. The Company will work with the local police and emergency service departments prior to commencement of any work and will formulate a comprehensive traffic plan for each phase of the upland works.

Prior to construction, the Company will work closely with the Town of Barnstable to develop a TMP for construction. The TMP will be submitted for review and approval by appropriate municipal authorities (typically DPW/Town Engineer and Police). The TMP will be a living document such that any unanticipated change in construction location, timing, or method previously identified will result in revision of the TMP and approval by the appropriate authorities before any construction changes are implemented.

The Company will continue to work closely with the Barnstable DPW and MassDOT District 5 traffic engineers to develop a series of temporary TMPs that include the following mitigation measures:

- Use of Advanced Warning Signs and Changeable Message Boards to alert motorists of "Road Work Ahead" and Alternate Routes.
- Use of Construction Signage to alert motorists of construction activities in the "Work Zone".
- Use of One Lane Road (Bi-directional) traffic control with police details in the "Work Zone".
- Use of Detour plans around the "Work Zone" for short-duration road closures during daylight construction activities.
- Use of Traffic Control Devices such as traffic cones, reflectorized drums, barricades and temporary pavement markings for delineation of travel ways and walkways.
- Use of defined hours of operation.
- Reasonable limits on the length of trench the contractor may have open at any given time.
- Use of Road Plates to cover trench work in progress to restore two-way traffic during non-working hours or to allow access to local streets and driveways.
- Use of Designated Staging and Laydown Areas to minimize impacts to pedestrian and vehicular traffic.
- Use of public communications media to inform the public of current and future construction activities and how they may affect local traffic conditions.

The traffic mitigation measures will be in accordance with the *Manual of Uniform Traffic Control Devices* (2009 Edition) and the MassDOT *Work Zone Safety Guidelines*. These manuals and guidance documents provide detailed specifications for all aspects of the temporary roadway modifications that the Company will implement in the Project construction zone, including necessary lane widths, lane tapers, size, type and color of warning signs, dates and times of permitted work activities, and similar provisions that ensure safe travel through the construction zone. For additional detail on the TMP, please refer to sheets 20 and 21 of the engineering plans provided in Attachment F.

Table 5-3 below describes how the generic TMP mitigation measures defined above may be applied to construction of the underground duct bank on the Preferred Route.

Table 5-3 TMP Mitigation Measures for the Preferred Routes (transmission and grid interconnection routes)

TMP ID	Street or Route	From	To	Construction Activity	TMP Action Plan	Estimated Traffic Impacts[1]
Preferred Transmission Route						
1	Craigville Beach Rd	Craigville Public Beach Landfall Site	Centerville River Bridge	10' wide trenching Utility work Splice vault [#1]	Local traffic only. One-lane road Local detour 1: Southbound traffic Strawberry Hill Rd to Craigville Beach Rd; and maintain access to at least 1 end of Short Beach Rd. 2 Police detail	Work during off-peak hours Approximate 16-day construction duration Number of homes or businesses impacted: 18
2	Craigville Beach Rd	Centerville River Bridge Crossing		Bridge Reconstruction and Utility Crossing	Maximum impact scenario is for bridge superstructure replacement (trenchless crossings would avoid full bridge closure). Local detour 1: Southbound traffic Strawberry Hill Rd to Craigville Beach Rd; and maintain access to at least 1 end of Short Beach Rd.	Bridge Closed from Columbus Day to Memorial Day. Approximate 150-day construction duration
3	Craigville Beach Rd	Centerville River Bridge	S Main St	10' wide trenching Utility work Splice vaults [#2]	Local traffic only. One-lane road Local detour 1: Southbound traffic Strawberry Hill Rd to Craigville Beach Rd; and maintain access to at least 1 end of Short Beach Rd. 2 Police detail	Work during off-peak hours Approximate 25-day construction duration Number of homes or businesses impacted: 13
4	Main St	S Main St	Church Hill Rd / Bacon Ln	10' wide trenching Utility work Spice vaults at S. Main St [#3]	Local traffic only. One-lane road Local detour 1: Church Hill Rd to S Main St 2 police detail	Work during off-peak hours Approximate 14-day construction duration Number of homes or businesses impacted: 7
5	Main St	Church Hill Rd / Bacon Ln	Park Ave / Old Stage Rd	10' wide trenching Utility work	Local traffic only. One-lane road Local detour 1: Park Ave to Bacon Ln 2 police detail	Work during off-peak hours Approximate 17-day construction duration Number of homes or businesses impacted: 27

Table 5-3 TMP Mitigation Measures for the Preferred Routes (transmission and grid interconnection routes) (Continued)

TMP ID	Street or Route	From	To	Construction Activity	TMP Action Plan	Estimated Traffic Impacts[1]
Preferred Transmission Route						
6	Old Stage Rd	Park Ave / Main St	Fuller Rd / Old Post Rd	10' wide trenching Splice vaults at Pine Tree Ln [#4] Utility work	Local traffic only. One-lane road Local detour 1: Phinneys Ln to Main St Local detour 2: Fuller Rd to Bumps River Rd 2 police detail	Work during off-peak hours Approximate 24-day construction duration Number of homes or businesses impacted: 24
7	Old Stage Rd	Fuller Rd / Old Post Rd	100 ft south of Falmouth Rd (Rte. 28)	10' wide trenching Utility work	Local traffic only. One-lane road Local detour 1: Phinneys Ln to Main St Local detour 2: Silver Leaf to Lewis Rd to Rte 28 2 police detail	Work during off-peak hours Approximate 7-day construction duration Number of homes or businesses impacted: 2
8	Old Stage Rd	At Falmouth Rd (Rte. 28)		10' wide trenching Utility work	Half-roadway closure eastbound Two-way traffic Local detour 1: 5 Corners Rd to Bumps River Rd to Park Ave to Main St to Phinneys Ln 2-3 police detail	Night Work[2] Approximate 2-day construction duration Number of homes or businesses impacted: 1
9	Old Stage Rd	At Falmouth Rd (Rte. 28)		10' wide trenching Utility work	Half-roadway closure westbound Local detour 1: Phinneys Ln to Main St to Park Ave to Bumps River Rd to 5 Corners Rd 2-3 Police detail	Night Work[2] Approximate 2-day construction duration Number of homes or businesses impacted: 1
10	Old Stage Rd	100 ft north of Falmouth Rd (Rte. 28)	Shootflying Hill Rd	10' wide trenching Splice vaults north of Rt-28 [#5] Utility work	Local traffic only. One-lane road Local detour 1: Great Marsh Rd to Richardson Rd or Phinneys Ln 2 Police detail	Work during off-peak hours Approximate 19-day construction duration Number of homes or businesses impacted: 8

Table 5-3 TMP Mitigation Measures for the Preferred Routes (transmission and grid interconnection routes) (Continued)

TMP ID	Street or Route	From	To	Construction Activity	TMP Action Plan	Estimated Traffic Impacts[1]
Preferred Transmission Route						
11	Shootflying Hill Rd	Old Stage Rd	Great Marsh Rd	10' wide trenching Utility work	Local traffic only. One-lane road 2 police detail	Work during off-peak hours Approximate 5-day construction duration Number of homes or businesses impacted: 7
12	Shootflying Hill Rd	Great Marsh Rd	Carleton Ln	10' wide trenching Utility work	Local traffic only. One-lane road Local Detour 1: Carleton Ln to Old Stage Rd Local Detour 2: Service Rd to Oak St to Old Stage Rd 2 police detail	Work during off-peak hours Approximate 8-day construction duration Number of homes or businesses impacted: 6
13	Shootflying Hill Rd	Carleton Ln	Knotty Pine Ln	10' wide trenching Splice vaults [#6] Utility work	Local traffic only. One-lane road Local Detour 1: Knotty Pine Ln to Maddaket Ln to Carleton Ln 2 police detail	Work during off-peak hours Approximate 11-day construction duration Number of homes or businesses impacted: 6
14	Shootflying Hill Rd	Knotty Pine Rd	Moon Penny Ln	10' wide trenching Utility work	Local traffic only. One-lane road Local detour 1: Moonpenny Ln to Gleneagle Dr to Old Stage Rd Local Detour 2: Service Rd to Oak St to Old Stage Rd 2 police detail	Work during off-peak hours Approximate 20-day construction duration Number of homes or businesses impacted: 15
15	Shootflying Hill Rd	Moon Penny Ln	Lakeview Dr	10' wide trenching Splice vaults [#7] at Annable Rd, and [#8] past Hillside Dr. Utility work	Local traffic only. One-lane road Local Detour 1: Service Rd to Oak St to Old Stage Rd 2 Police Details	Work during off-peak hours Approximate 65-day construction duration Number of homes or businesses impacted: 48

Table 5-3 TMP Mitigation Measures for the Preferred Routes (transmission and grid interconnection routes) (Continued)

TMP ID	Street or Route	From	To	Construction Activity	TMP Action Plan	Estimated Traffic Impacts[1]
Preferred Transmission Route						
16	Shootflying Hill Rd	Lakeview Dr	Pleasant Pines Ave	10' wide trenching Splice vaults [#9] past Lakeview Dr, and [#10]. Utility work	Local traffic only. One-lane road Local Detour 1: Pleasant Pines Ave to Lakeview Dr Local Detour 2: Service Rd to Oak St to Old Stage Rd 2 Police Details	Work during off-peak hours Approximate 35-day construction duration Number of homes or businesses impacted: 14
17	Shootflying Hill Rd	Pleasant Pine Ave	Utility ROW #343	10' wide trenching Utility work	Local traffic only. One-lane road Local Detour 1: Service Rd to Oak St to Old Stage Rd 2 police detail	Work during off-peak hours Approximate 2-day construction duration in Shootflying Hill Rd Number of homes or businesses impacted: 1
18	Utility ROW #343	Shootflying Hill Rd (East)	Vineyard Wind Substation	(2) sets of 10' wide trenching 90-degrees to road Pulling Vaults [#11 & #12]. Utility work	Local traffic only. One-lane road Local Detour 1: Service Rd to Oak St to Old Stage Rd 1 police detail	Work during off-peak hours Approximate 15-day construction duration Number of homes or businesses impacted: 0
Preferred Grid Interconnection Route						
19	Utility ROW #343	Vineyard Wind Substation	Shootflying Hill Road (East)	(2) sets of 10' wide trenching 90-degrees to road Pulling Vaults [#11 & #12]. Utility work	Local traffic only. One-lane road Local Detour 1: Service Rd to Oak St to Old Stage Rd 1 police detail	Work during off-peak hours Approximate 15-day construction duration Number of homes or businesses impacted: 0

Table 5-3 TMP Mitigation Measures for the Preferred Routes (transmission and grid interconnection routes) (Continued)

TMP ID	*Street or Route*	*From*	*To*	*Construction Activity*	*TMP Action Plan*	*Estimated Traffic Impacts[1]*
Preferred Transmission Route						
20	Utility ROW #345	Shootflying Hill Rd (West)	Utility ROW #381	10' wide trenching 90-degrees to road Splice Vaults [#13]. Utility work	Local traffic only. One-lane road Local Detour 1: Service Rd to Oak St to Old Stage Rd 1 police detail	Approximately 2 days to cross Shootflying Hill Rd, and 25 days construction duration within utility ROW. Number of homes or businesses impacted: 0
21	Utility Right-of-Way #381	Service Road south of Route 6	Assessor map parcel #214-001, Barnstable	Trenchless Crossing State Route 6 via Jack & Bore or Micro-tunneling	Special warning signals and State Police details to enable temporary construction access to the median between Rt-6 eastbound and westbound lanes	Occasional/temporary slowing of traffic speeds, and lane closures on one or both directions of Rt-6 Work during off-peak hours Approximate 120-day construction duration. Number of homes/businesses impacted: 0

1 – Estimated durations are in work days.

2 – Work at the Route 28 intersection to be performed at night or other time period to allow least disruption and public delays.

Because the Project will maintain access to businesses and duct bank installation will proceed at a rate of approximately 80 to 200 feet per day, the Company does not expect significant impact on businesses. Furthermore, any in-road construction will occur outside the busy summer season. Vineyard Wind believes the most effective approach to mitigation will be to communicate directly with each business that might be affected by the Project to determine if there are specific timing concerns such as hours of operation, deliveries, high-traffic periods, or other constraints. The Company will work with businesses located along the selected route to minimize any impacts to these businesses.

In terms of parking accommodations for construction workers, for similar types of construction past practice has been to utilize off-site commercial locations such as large existing parking lots or contractors' yards for satellite parking. Employees are then "shuttled" to the project site in company-supplied passenger vans. The Company will coordinate any required parking with the local police and town departments as necessary. There are several areas near the Preferred and Noticed Alternative routes where off-site parking could potentially be utilized and employees shuttled to the work sites. The Company has committed to only working during the off-peak seasons in public roadways which should alleviate any potential parking conflicts.

5.3.2 Historic and Archaeological Resources

The Project is subject to review by the Massachusetts Historic Commission (MHC) in compliance with M.G.L. Chapter 9, Sections 26-27C as amended by Chapter 254 of the Acts of 1988 (950 C.M.R. 71.00) known as "State Register Review", and Section 106 of the National Historic Preservation Act. The Project undertook surveys to identify historic resources, including above-ground historic resources and recorded archaeological sites, within and near the onshore routing alternatives. The term Historic Resources as used herein includes properties listed or eligible for listing on the National Register of Historic Places, properties on the Massachusetts State Register of Historic Places, and properties included in the Inventory of Historic and Archaeological Assets of the Commonwealth (Inventory). To be considered significant and eligible for listing on the State or National Registers of Historic Places, a resource must exhibit physical integrity and contribute to American history, architecture, archaeology, technology, or culture. Historic architectural resources located along the Preferred and Noticed Alternative transmission routes and grid interconnection routes are shown on Figures 5-15 and 5-16, respectively. Locations of recorded archaeological sites have been included in the scoring analysis presented in Section 4, but the locations themselves are considered confidential by MHC and applicable federal agencies to protect the resources' integrity.

The Project will largely be constructed in previously disturbed areas (i.e., within public roadways or other rights of way). All public roadway areas have been modified by construction of the road itself as well as above- and below-grade utilities, and it is unlikely that natural/undisturbed soils or potentially significant unrecorded intact archaeological deposits would be located below or immediately adjacent to them. Based on a preliminary assessment performed by the Proponent's archaeology consultant, Public Archaeology Laboratory Inc. (PAL), the general area surrounding the Project routes has been assigned moderate to high sensitivity for unrecorded archaeological resources. In general, it would be expected that unrecorded archaeological resources would not be found in previously disturbed roadway layouts where the duct banks will be placed; however. Further archaeological assessments of the routes will be conducted by PAL in 2020.

No impacts are anticipated to above-ground historic resources, as the proposed export cables will be underground, and the substation site is too far distant from historic properties to create a visual effect. No tree trimming in the viewshed of historic properties is anticipated as part of the Project, and no destabilization of foundations of historic resources is anticipated. Excavation for the proposed onshore duct bank will comply will all pertinent codes and regulations for such work to ensure no damage occurs to adjacent properties. As the Project involves construction of an underground duct bank in existing roadways and/or right of ways, temporary construction activities will temporarily affect the appearance of existing roads near historic properties. However, the effect will be limited to excavation and resurfacing of existing roads. No adverse impacts to above-ground historic properties are anticipated.

Review by the MHC has already commenced through the filing of a Project Notification Form (PNF) and supporting information in March 2020. A reconnaissance-level archaeological survey is anticipated to be conducted in 2020, with the report anticipated to be filed with the MHC after it is complete. After review by MHC, it is expected that an intensive archaeological survey may be completed later in 2020, with report submission to MHC to follow.

Additional filings will be made associated with the federal Section 106 process, in which MHC will be a consulting party, related to offshore visual impacts and marine archaeological impacts in state waters.

Marine archaeological resources and considerations along the OECC are described in Section 4.6.3.5.

5.3.2.1 Transmission Routes (Landfall Site to Substation Site)

Historic buildings, structures, and recorded archaeological resources along the Preferred and Noticed Alternative transmission routes connecting the landfall site to the proposed substation site are described below and are shown on Figure 5-15.

5.3.2.1.1 Preferred Route (Transmission Route) – Shootflying Hill Road

Other than the substation site itself and the Centerville River crossing, the Preferred Route is located almost entirely within existing roadway layouts except for the final approximately 0.2 miles within ROW #343, with the proposed duct bank to be installed under pavement or within 10 feet of pavement. The Preferred Route passes by or through one National Register District (the Centerville Historic District), one National Register property (Captain Hinkley House), and 32 Inventory properties including one archaeological site (Figure 5-15 shows 34 historic properties but does not identify the archaeological site since its location must remain confidential). As shown on Figure 5-15, the Inventory properties are clustered at the southern half of the Preferred

Route. Since the export cables will be underground, they will have no visual impacts to historic buildings or structures. In addition, the proposed substation will be too far distant from historic properties through intervening trees and structures to create any adverse visual effects. The presence or absence of potential archaeological sites within the Project's construction footprint will be assessed as part of Project permitting.

Variant 1 Covell's Beach Landfall Site

Variant 1 of the Preferred Route would pass by seven additional Inventory properties including two archaeological sites as compared to the Preferred Route (see Figure 5-15).

Variant 2 South Main Street

Variant 2 of the Preferred Route, which would avoid much of the village center of Centerville, would pass by one additional National Register property and three fewer Inventory properties than the Preferred Route (see Figure 5-15).

Variant 3 Northern Substation Access

Variant 3 of the Preferred Route would not result in any changes in the number of historic properties along the route as compared to the Preferred Route.

5.3.2.1.2 Noticed Alternative (Transmission Route) – Oak Street

Other than the substation site itself and the Centerville River crossing, the Noticed Alternative is entirely within existing roadway layout, with the proposed duct bank and transmission lines to be installed under pavement or within 10 feet of pavement. The Noticed Alternative passes by or through one National Register District, two National Register properties, and 35 Inventory properties, including three archaeological sites (see Figure 5-15). Since the export cables will be underground, they will have no visual impacts to historic buildings or structures. In addition, the proposed substation modifications will be too far distant from historic buildings and structures through intervening trees and structures to create any adverse visual effects.

Variant 1 – Covell's Beach Landfall Site

Variant 1 of the Noticed Alternative would pass by seven additional Inventory properties as compared to the Noticed Alternative, including two archaeological sites (see Figure 5-15).

Variant 2 – ROW #345

Variant 2 of the Noticed Alternative, which would utilize two existing utility ROWs, would pass by four fewer Inventory properties (which are not archaeological sites) than the Noticed Alternative (see Figure 5-15).

5.3.2.2 Grid Interconnection Routes (Substation Site to Interconnection Location)

Historic resources along the Preferred and Noticed Alternative grid interconnection routes connecting the proposed substation site to the interconnection location are described below and shown on Figure 5-16.

<u>*5.3.2.2.1 Preferred Route (Grid Interconnection Route) – ROW #343 to ROW #381*</u>

The Preferred Route connecting the proposed substation to the interconnection at West Barnstable Substation passes by or through one State Register District (Old King's Highway) and two Inventory properties, including one archaeological site (see Figure 5-16). Since the export cables will be underground, they will have no visual impacts to historic buildings or structures.

<u>Variant 1 – Service Road to ROW #381</u>

Variant 1 of the Preferred Route would pass one additional Inventory property, an archaeological site, as compared to the Preferred Route.

<u>Variant 2 – ROW #343 to ROW #342</u>

Variant 2 would not result in any changes to the number of historic properties along the route when compared to the Preferred Route.

<u>Variant 3 – Service Road to ROW #342</u>

Variant 3 would not result in any changes to the number of historic properties along the route when compared to the Preferred Route.

<u>*5.3.2.2.2 Noticed Alternative (Grid Interconnection Route) – In-Road*</u>

The Noticed Alternative will pass by or through one State Register District, one National Register District, and six Inventory or State Register properties including one archaeological site. Since the export cables will be underground, they will have no visual impacts to historic buildings or structures.

5.3.2.3 Comparison of Impacts/Mitigation Measures

For the onshore transmission routes, construction and operation of the Project will not affect any historic buildings or structures on either the Preferred Route or the Noticed Alternative. The Preferred Route is superior to the Noticed Alternative on the basis of the number of historic resources alone because it contains fewer known historic and archaeological sites, recognizing that none of the identified buildings or structures will be altered by proposed underground export cables or construction along either route.

Both routes have similar archaeological sensitivities based on the number and locations of nearby recorded archaeological sites. A more detailed archaeological sensitivity assessment of the routes is planned. The Company will coordinate directly with the MHC regarding the need for additional field surveys. The Company will also consult with the Tribal Historic Preservation Officers (THPOs) of involved federally recognized tribes to avoid, minimize, and mitigate impacts to significant Native American archaeological resources, if identified in the Project's area of physical effect (i.e., construction footprint). Potential effects, if any, to archaeological resources will be addressed with the MHC and the THPO(s) through the federal Section 106 and the State Register Review processes.

For the onshore grid interconnection routes, the Preferred Route is superior to its variants as well as the Noticed Alternative because it contains fewer known historic and recorded archaeological sites, recognizing that none of the identified buildings or structures will be altered by proposed underground export cables or construction along either route.

The site of the proposed substation does not contain any historic buildings, structures, or recorded archaeological sites. The Project footprint will be further assessed for potential archaeological resources prior to construction.

Marine archaeological resources and considerations along the OECC are described in Section 4.6.3.5.

5.3.3 Open Space, Conservation, and Recreational Lands

By routing largely along existing paved roadway layouts, the Project's onshore duct bank will generally avoid crossing protected open spaces, with only a few instances along the various off-road segments where crossing these resources will be necessary. These areas are described below.

5.3.3.1 Transmission Routes (Landfall Site to Substation Site)

Figure 5-17 illustrates protected open spaces along the Preferred and Noticed Alternative transmission routes. The figure includes lands shown on MassGIS maps as subject to Article 97 jurisdiction, which are lands acquired for conservation, recreation, or open space purposes and protected under Article 97 of the Amendments to the Massachusetts Constitution. It also includes other parcels shown in the MassGIS system that are owned or and managed through town or county entities for open space conservation and recreational purposes but are not subject to Article 97 jurisdiction.

5.3.3.1.1 Preferred Route (Shootflying Hill Road)

As shown on Figure 5-17, the Preferred Route does not require crossing any protected open space, conservation, or recreational lands except for the beach and paved parking lot at the Craigville Public Beach Landfall Site. The parking lot and the beach are both subject to Article 97 jurisdiction.[12] The HDD trajectory offshore to the parking lot will pass well beneath the beach; the HDD will have no temporary or permanent impacts to the beach itself. HDD activities and installation of the transition vaults and duct bank in the parking lot will have only temporary off-season construction-related impacts. Because all infrastructure will be buried except for ground-level manhole covers, the Project will have no permanent impact on use of the parking lot after construction is complete.

While not shown on MassGIS as an Article 97-jurisdictional protected open space, there is one other mapped recreational parcel located near but not on the Preferred Route at 460 Shootflying Hill Road, where the Town of Barnstable owns and maintains a public beach and boat ramp on Wequaquet Lake. In addition to providing public recreational access to the lake, this area also serves as the base of operations for the Cape Cod Rowing Club, which offers training and teaching for adult rowers. Although the Preferred Route will not cross this parcel, construction could require temporarily closing the boat ramp, which is accessed directly from Shootflying Hill Road; the Company will work with the Town of Barnstable to limit any necessary closure, which would be unlikely to last more than two to three days. Because work in roadway layouts will avoid peak summer season, any temporary closures would be off-peak.

Variant 1 – Covell's Beach Landfall Site

Variant 1 does not require crossing any protected open space, conservation, or recreational lands except for the beach and paved parking lot at the Covell's Beach Landfall Site. The parking lot and beach, similar to the Craigville Public Beach Landfall Site, are both subject to Article 97 jurisdiction.[13] The HDD trajectory offshore to the parking lot will pass well beneath the beach, and will have no temporary or permanent impacts to the beach itself. HDD activities and installation of the transition vaults and duct bank in the parking lot will have only temporary off-season construction-related impacts. Because all infrastructure will be buried except for ground-level manhole covers, the Project will have no permanent impact on use of the parking lot after construction is complete. Chapter 44 of the Acts of 2019 authorizes the use of Covell's Beach by Vineyard Wind for the proposed onshore duct bank.

Like the Preferred Route, Variant 1 will also pass the Town of Barnstable's public beach and boat ramp at 460 Shootflying Hill Road.

Variant 2 – South Main Street

Variant 2 of the Preferred Route will not require any new or incremental crossings of protected open space, conservation, or recreational lands, but the variant will pass adjacent to Aaron S. Crosby Park, a ¼-acre greenspace at the intersection of South Main Street and Pine Street in Centerville that is maintained by the Town of Barnstable. This parcel is shown on MassGIS as

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[12] The Craigville Public Beach Landfall Site is located on Parcel 206 013, owned by the Town of Barnstable.

[13] The Covell's Beach Landfall Site is located on Parcel 225 006, owned by the Town of Barnstable.

subject to Article 97 jurisdiction. Under the current route design, Aaron S. Crosby Park will not be crossed by the proposed duct bank, although access to a portion of the park may be temporarily restricted due to narrow road widths and configurations. It is possible, however, that it may become necessary for the route to cross Aaron S. Crosby Park to eliminate what would otherwise be a very sharp bend in the route between South Main Street and Main Street; this would avoid an otherwise complicated layout of splice vaults and duct banks that could otherwise require the temporary closure of the wider intersection consisting of Main Street, Dunakin Road, South Main Street, and one entrance to Stanley Way.

Because work in roadway layouts will avoid the peak summer season, any temporary closures would occur off-season.

Variant 3 – Northern Substation Access

Variant 3 of the Preferred Route will not require any new or incremental crossings of protected open space, conservation, or recreational lands beyond those associated with the Preferred Route.

5.3.3.1.2 Noticed Alternative (Oak Street)

As with the Preferred Route, the Noticed Alternative utilizes the Craigville Public Beach Landfall Site, which is subject to Article 97 jurisdiction. As described in Section 5.3.3.1.1, the use of HDD and installation of below-grade infrastructure (with the exception of ground-level manhole covers) will avoid any permanent impact on use of the parking lot after construction is complete, and there will be no temporary or permanent impacts to the beach itself.

In addition, the Noticed Alternative route also passes adjacent to Aaron S. Crosby Park, which is shown on MassGIS as subject to Article 97 jurisdiction and is described above in the context of Variant 2. As described for Variant 2 of the Preferred Route, under the current route design the park will not be crossed by the proposed duct bank, although access may be temporarily restricted due to narrow road widths and configurations. It is possible, however, that it may become necessary for the route to cross Aaron S. Crosby Park to eliminate what would otherwise be a very sharp bend in the route between South Main Street and Main Street; this would avoid an otherwise complicated layout of splice vaults and duct banks that could otherwise require the temporary closure of the wider intersection consisting of Main Street, Dunakin Road, South Main Street, and one entrance to Stanley Way.

Because work in roadway layouts will avoid the peak summer season, any temporary closures would occur off-season.

Variant 1 – Covell's Beach Landfall Site

Variant 1 does not require crossings of protected open space, conservation, or recreational lands except for use of the paved parking lot at the Covell's Beach Landfall Site. As described above under Variant 1 of the Preferred Route, Covell's Beach is subject to Article 97 jurisdiction, although the Project will have no permanent impact on use of the parking lot after construction is complete, and no temporary or permanent impacts on the beach itself. Existing Article 97 legislation authorizes use of the Covell's Beach Landfall Site for the onshore duct bank. This variant will also pass Aaron Crosby Park described for the Noticed Alternative.

Variant 2 – ROW #345

Variant 2 of the Noticed Alternative will require crossing a protected open space parcel potentially subject to Article 97 jurisdiction located at 2081 Service Road owned by the Town of Barnstable (Centerville-Osterville-Marstons Mills [COMM] Fire District).[14] The 12.5-acre parcel is used primarily for water supply, and a 3.3-million-gallon steel water tank occupies the high ground in the northwest corner of the site. Based on MassGIS data, it appears this parcel may have Article 97 protection. Variant 2 would traverse the COMM parcel along the north side of utility ROW #345 for a distance of approximately 930 feet (see Figure 5-17).

While the parcel may be subject to Article 97 protection, Variant 2 would be constructed within an existing utility easement currently developed with overhead high voltage electric transmission lines. Vineyard Wind believes the proposed transmission use within the utility ROW does not require Article 97 approval.

Construction of the underground duct bank would temporarily restrict access to a portion of this site during installation, but the Project does not involve any above-ground infrastructure and would have no permanent impacts on use of the property.

5.3.3.2 Grid Interconnection Routes (Substation Site to Interconnection Location)

Figure 5-18 illustrates protected open spaces along the Preferred Route and Noticed Alternative grid interconnection routes. The figure includes lands shown on MassGIS maps as subject to Article 97 jurisdiction. It also includes other parcels shown in the MassGIS system that are owned or and managed through town or county entities for open space conservation and recreational purposes but are not shown as subject to Article 97 jurisdiction.

5.3.3.2.1 Preferred Route (ROW #343 to ROW #381)

As shown on Figure 5-18, while in ROW #345 the Preferred grid interconnection route will cross a parcel shown on MassGIS as possibly subject to Article 97 jurisdiction. This parcel, located at 2081 Service Road, is the same parcel described above under Variant 2 of the Noticed Alternative transmission route. It encompasses the full width of ROW #345 and extends north of the ROW to include some forested land as well as cleared area with a water tower. Construction of the

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[14] Parcel 214 011 is owned by the Town of Barnstable.

underground duct bank would temporarily restrict access to a portion of this site during installation, but the Project does not involve any above-ground infrastructure and would have no permanent impacts on use of the property.

While the parcel may be subject to Article 97 protection, the route would be constructed within an existing utility easement currently developed with overhead high voltage electric transmission lines. Vineyard Wind believes the proposed transmission use within the utility ROW does not require Article 97 approval.

Variant 1 – Service Road to ROW #381

Variant 1 does not require crossings of protected open space, conservation, or recreational lands, including parcels shown on MassGIS as subject to Article 97 jurisdiction.

Variant 2 – ROW #343 to ROW #342

Variant 2 will cross three parcels of land shown on MassGIS as possibly subject to Article 97 jurisdiction that are distinct from the protected parcel described for the Preferred Route (see Figure 5-18).[15] One of these parcels is located along the stretch of ROW #342 between Shootflying Hill road and Service Road. The other two are abutting parcels located along ROW #342 north of Route 6 that include a 32-acre property owned by the Commonwealth of Massachusetts and a 10-acre parcel owned by the Town of Barnstable. Construction of the underground duct bank would temporarily restrict access to a portion of this site during installation, but the Project does not involve any above-ground infrastructure and would have no permanent impacts on use of the property.

While the parcels may be subject to Article 97 protection, Variant 2 would be constructed within an existing utility easement currently developed with overhead high voltage electric transmission lines. Vineyard Wind believes the proposed transmission use within the utility ROW does not require Article 97 approval.

Variant 3 – Service Road to ROW #342

Variant 3 will cross the two parcels shown on MassGIS as possibly subject to Article 97 jurisdiction north of Route 6 that are described above in the context of Variant 2 (see Figure 5-18).[16] Both parcels are located along ROW #342 east of the West Barnstable Substation. Construction of the

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15 Parcels 215 025 and 215 018 are both owned by the Town of Barnstable; parcel 215 019 is owned by the Massachusetts Department of Conservation and Recreation.

16 Parcel 215 019 is owned by the Massachusetts Department of Conservation and Recreation; Parcel 215 018 is owned by the Town of Barnstable.

underground duct bank would temporarily restrict access to a portion of this site during installation, but the Project does not involve any above-ground infrastructure and would have no permanent impacts on use of the property.

While the parcels may be subject to Article 97 protection, the route would be constructed within an existing utility easement currently developed with overhead high voltage electric transmission lines. Vineyard Wind believes the proposed transmission use within the utility ROW does not require Article 97 approval.

5.3.3.2.2 Noticed Alternative (In-Road)

As shown on Figure 5-18, the Noticed Alternative does not require crossings of protected open space, conservation, or recreational lands, including parcels shown on MassGIS as subject to Article 97 jurisdiction.

5.3.3.3 Comparison of Impacts/Mitigation Measures

For the transmission routes from the landfall site to the proposed substation, other than use of the paved parking lot at the landfall site and the HDD trajectory which will pass beneath the beach, areas that are subject to Article 97 jurisdiction, the Preferred and Noticed Alternative onshore transmission routes do not require crossing any protected open spaces. Variant 2 of the Noticed Alternative is the only route variant that crosses an additional Article 97-jurisdictional parcel, and that is via an existing utility ROW. Should it become necessary to cross Aaron S. Crosby Park to eliminate a sharp bend, then Variant 2 of the Preferred Route as well as the Noticed Alternative would cross this additional parcel subject to Article 97 jurisdiction (see Figure 5-17).

For the grid interconnection routes from the proposed substation to the interconnection location, Variant 2 of the Preferred Route as well as the Noticed Alternative are the only two routes that do not cross Article 97-jurisdictional parcels. The Preferred Route crosses one parcel that may be Article 97-jurisdictional while Variants 2 and 3 cross three and two of these parcels, respectively. However, in each case, the crossing would be via a utility ROW that should not require legislative approval.

Since the proposed onshore export cables will be installed within a buried concrete duct bank, the Project will have no permanent impact on appearance or use of any Article 97-jurisdictional parcels except for ground-level manhole covers installed to access buried splice vaults.

5.3.4 Sensitive Land Uses

Impacts to sensitive land uses from the Project will be limited to the period of active construction. Following construction, the operational phase of the Project will have no impacts to sensitive receptors. The discussion of sensitive receptors below is focused on construction-related issues of maintaining access and minimizing disturbance to uses such as hospitals, schools, police and fire stations, elder care facilities, cemeteries, daycares, district courts, and religious facilities.

If the route passed adjacent to a sensitive receptor, that receptor was counted regardless of whether or how many entrances to the receptors could be affected by construction. However, the number of entrances to a sensitive receptor was and continues to be considered in terms of formulating TMPs that will ensure ongoing access to these facilities during construction.

5.3.4.1 Transmission Routes (Landfall Site to Substation Site)

Sensitive receptors along the Preferred and Noticed Alternative transmission routes connecting the landfall site to the proposed substation site are described below.

5.3.4.1.1 Preferred Route (Shootflying Hill Road)

Sensitive receptors along the Preferred Route and its variants from the Craigville Public Beach Landfall Site to the proposed substation site are shown on Figure 5-19. The Preferred Route passes parcels associated with a total of four sensitive receptors: the South Congregational Church, Beechwood Cemetery, Plumer Family Childcare, and D'Angelo Family Childcare. The church is located on Main Street, the cemetery on Old Stage Road, and both family childcares are located on Shootflying Hill Road.

Variants 1 and 3 both pass the same four sensitive receptors.

Variant 2 of the Preferred Route (South Main Street) passes six sensitive receptors, two more than the Preferred Route. If Variant 2 is utilized, the South Congregational Church and Beechwood Cemetery will no longer be abutting the route; however, in addition to the two childcare facilities on Shootflying Hill Road, Variant 2 would pass Our Lady of Victory Parish and the Cape Regency Rehab and Health Care Center (both on South Main Street), Ancient Cemetery (Phinneys Lane), and Cordeiro Family Childcare (Great Marsh Road).

5.3.4.1.2 Noticed Alternative (Oak Street)

The Noticed Alternative and its two variants all pass the same four sensitive receptors: Our Lady of Victory Parish and the Cape Regency Rehab and Health Care Center (both on South Main Street), Ancient Cemetery (Phinneys Lane), and Cordeiro Family Childcare (Great Marsh Road). Sensitive receptors along the Noticed Alternative and its variants are shown on Figure 5-19.

5.3.4.2 Grid Interconnection Routes (Substation Site to Interconnection Location

Sensitive receptors along the Preferred and Noticed Alternative grid interconnection routes connecting the proposed substation site to the interconnection location are described below and shown on Figure 5-20.

5.3.4.2.1 Preferred Route (ROW #343 to ROW #381)

Neither the Preferred Route nor Variant 1 pass any sensitive receptors (see Figure 5-20). Variants 2 and 3 each pass a single sensitive receptor, the Cape Cod Conservatory, while within ROW #342. Although these two routes will pass adjacent to the Cape Cod Conservatory parcel, neither will impact access to the property.

5.3.4.2.2 Noticed Alternative (In-Road)

Sensitive receptors along the Noticed Alternative are shown on Figure 5-20. The Noticed Alternative passes adjacent to a total of four sensitive receptors: Cape Cod Conservatory, Cape Cod Community College, Cape Cod YMCA Daycare, and the Presbyterian Church of Cape Cod. All four sensitive receptors are located on Route 132/Iyannough Road. Although the Cape Cod Conservatory parcel is not actually a direct abutter to the route, it has been counted because the route will cross its access drive.

5.3.4.3 Comparison of Impacts/Mitigation Measures

In summary, both the Preferred and Noticed Alternative transmission routes pass four sensitive receptors; Variant 2 of the Noticed Alternative passes the most (six) sensitive receptors.

As for the grid interconnection routes, the Preferred Route and variant 1 avoid sensitive receptors entirely. Variants 2 and 3 each pass a single sensitive receptor, the Cape Cod Conservatory, but will not affect access to the property.

None of the sensitive receptors are located adjacent to the proposed substation, and the Project will have no post-construction impacts to any sensitive receptors. Impacts will be limited to the construction period, when trenching and installation of the duct bank will have the potential to affect traffic flow in the vicinity of these receptors for a relatively brief period of time. Construction-period traffic issues will be addressed in the TMP and access will be maintained, and therefore the practical difference between the routes is small.

As described in Section 5.3.1.3, police details and other appropriate traffic management measures will be used to maintain traffic flow, and traffic management will always be coordinated with Town officials. Prior to construction, the Company will work closely with the municipalities to develop a TMP to avoid and minimize impacts.

5.3.5 Visual Impact

The routing alternatives all utilize the same proposed substation site, such that the substation will have the same potential visual effect regardless of the route selected. The Project's proposed location for the onshore substation is an approximately 6.7-acre parcel of privately-owned land at 8 Shootflying Hill Road. The site is just southwest of the intersection between Route 6 and

Route 132/Iyannough Road[17] and is less than a mile from the existing West Barnstable Substation. The site, which currently houses a motel, is in a residentially zoned area. An existing electric transmission corridor (ROW #343) is located immediately south of the site (see Figure 1-9). As shown on Figure 1-10, Vineyard Wind plans to plant vegetated screening on the western and northern boundaries of the substation site. Abutting land to the east is undeveloped woodland owned by MassDOT. The vegetated screening along the western edge will provide visual screening for a few existing residences, while the northern vegetation will provide visual screening from Shootflying Hill Road (see Figure 1-9). Since the southern property line extends into ROW #343, no vegetated screening will be possible in that location. Visual simulations of the proposed substation will be provided in the DEIR anticipated to be filed in fall 2020, which will also be filed with the Siting Board.

Other than the proposed substation, all proposed infrastructure for the transmission routes from the landfall site to the substation site and for the grid interconnection routes from the substation site to the West Barnstable Substation will be entirely underground. The only at-grade features will be manhole covers. The offshore export cables and onshore export cables will have no permanent visual impacts. Accordingly, there will be no difference in visual effects between the routing alternatives.

5.3.6 Substation Noise

The proposed substation will include two transformers as part of a GIS layout. GIS transformers typically produce sound predominantly in the 125 to 500 Hertz (Hz) octave bands. As the substation design progresses, the total broadband and octave band sound power levels of the substation will be obtained from the manufacturer or calculated. The megavolt-ampere rating and techniques in the Electric Power Plant Environmental Noise Guide (Edison Electric Institute) may be used to calculate these sound power levels for acoustic modeling purposes. Potential community sound impacts will be evaluated using these data and other substation design aspects.

In January 2020, an ambient sound level survey was conducted to characterize the acoustical environment in proximity to the proposed substation site. The survey was conducted under defoliated conditions. Existing noise sources included vehicular traffic along local roads including Route 6 and Route 132, aircraft flyovers from the nearby Barnstable Municipal Airport, some residential sources, birds, and rustling vegetation.

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[17] Route 6, the Mid Cape Highway, is a four-lane divided, limited access highway. Route 132, south of Route 6, is a four-lane commercial arterial providing access to commercial areas in Hyannis/Barnstable as well as the Barnstable County Airport.

A total of six sound level measurement locations were selected to represent sound levels at the nearest noise-sensitive receptors to the Project, including residences to the west, south, and southeast of the proposed substation site. Figure 5-21 identifies the substation site boundary, nearby roads, and sound measurement locations. The sound measurement locations include:

- **Location LT-1 – Northwestern Property Line**

  Continuous 1/3 octave-band and broadband sound level data were collected at this location along the northwestern edge of the proposed substation site, at a similar setback distance from Route 6 as the adjacent residence.

- **Location LT-2 – Southwestern Property Line**

  Continuous 1/3 octave-band and broadband sound level data were collected at this location near the southwest corner of the proposed substation site north of the existing utility ROW to represent residences west and south of the site (although it is located much closer to the location of proposed substation equipment than it is to the residences to the south).

- **Location LT-3 – Chamber of Commerce**

  Continuous 1/3 octave-band and broadband sound level data were collected at this location on the Chamber of Commerce property located east of the substation site to represent the Chamber of Commerce building northeast of the Project.

- **Location ST-1 – Service Road**

  Short-term 1/3 octave-band and broadband sound level data were collected at this location along Shootflying Hill Road to represent residences along Service Road west of the site due to their setback distance from Route 6.

- **Location ST-2 – Summerwind Lane**

  Short-term 1/3 octave-band and broadband sound level data were collected at this location at the end of Summerwind Lane to represent residences south of the site.

- **Location ST-3 – Cranberry Lane**

  Short-term 1/3 octave-band and broadband sound level data were collected at this location on Cranberry Lane to represent residences southeast of the proposed substation site that are farthest from Route 6.

The program consisted of three long-term monitors at Locations LT-1, LT-2, and LT-3 and one set of supplemental daytime/nighttime short-term measurements at Locations ST-1, ST-2, and ST-3. Approximately nine days of continuous ambient sound level data were collected from Tuesday, January 14, 2020 to Thursday, January 23, 2020. Short-term (i.e., 20-minute) spot measurements were made at Locations ST-1, ST-2, and ST-3 during the daytime on Wednesday, January 15, 2020 (10:30 AM to 12:30 PM) and during nighttime hours on Wednesday, January 22, 2020 (12:30 AM to 2:30 AM).

All measurements were made at publicly accessible locations or with landowner permission. Meteorological data from the closest National Weather Service (NWS) station in Hyannis, MA (Barnstable Municipal Airport) provided by the National Centers for Environmental Information (NCEI) were archived for the duration of the continuous monitoring period and used to determine hourly measurement periods when precipitation was present and when ground level wind speeds exceeded the appropriate threshold for sound level measurements.

One-hour A-weighted sound pressure level data from continuous ambient monitors at locations LT-1, LT-2, and LT-3 are presented in Figure 5-22 along with periods of precipitation and ground level wind speeds recorded by the NWS. The measured long-term ambient sound level data were processed to establish ambient sound levels at each location for evaluation. A-weighted broadband L_{90} (dBA) values presented in Table 5-4 represent the average of the daily nighttime average L_{90} (dBA) sound pressure levels observed between 12:00 AM and 4:00 AM (i.e., four hours of each night). The octave-band L_{90} levels (dB) correspond to a representative time period when the broadband L_{90} value was the same as or comparable to the averaged broadband level at that location. Nights with periods of precipitation noted and wind speeds above 5 m/s (11 mph) were excluded from the calculations. In addition, although no precipitation was recorded at the NWS station on the night of January 15, 2020, precipitation was observed by Epsilon personnel on this night during observations, so this night was also excluded from the calculation. Established A-weighted broadband (dBA) and unweighted octave-band (dB) ambient sound levels are presented in Table 5-4.

Table 5-4 Long-Term Ambient Sound Level Measurement Summary

Location ID	L_{90}	L_{90} Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz	16k Hz
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
LT-1	33	39	36	29	28	29	30	23	18	19	23
LT-2	31	40	37	29	29	28	27	18	17	18	22
LT-3	33	41	38	34	32	28	29	19	15	16	21

Short-term broadband and octave-band sound level data collected at locations ST-1, ST-2, and ST-3 are presented in Table 5-5.

Table 5-5 Short-Term (20-min) Ambient Sound Level Measurement Summary

Loc. ID	Period	Start Date/ Time	Broad-band L_{90}	L_{90} Sound Pressure Level by Octave-Band Center Frequency (Hz)									
				31.5	63	125	250	500	1000	2000	4000	8000	16000
			dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
ST-1	Day	1/15/2020 11:49 AM	54	58	57	50	45	48	52	45	30	18	21
ST-2	Day	1/15/2020 11:23 AM	50	54	51	46	42	46	48	39	22	18	21
ST-3	Day	1/15/2020 10:54 AM	46	51	49	45	39	41	44	34	19	17	21
ST-1	Night	1/22/2020 12:47 AM	28	41	39	37	29	25	21	16	17	18	24
ST-2	Night	1/22/2020 1:17 AM	25	40	42	30	23	23	20	16	17	18	23
ST-3	Night	1/22/2020 1:49 AM	25	38	37	31	24	22	20	16	17	18	23

Sound level impacts will be determined though modeling when the substation design progresses and sound power level data become available. This information will likely be presented in the Draft EIR.

There will be no differences in sound level impacts between the routing alternatives, since the substation itself would be the same.

5.4 Construction Considerations and Methodologies

This section describes construction methodologies as well as the sequence of activities and addresses construction-related topics such as schedule, construction work hours, environmental compliance, monitoring, and mitigation.

The Company will assemble a Construction Management Plan (CMP) that will be used by Vineyard Wind and its contractors during Project construction. Vineyard Wind highly values effective construction management, and will select contractors in significant measure based on their performance on prior contracts, including consideration of their careful management of environmental issues. The CMP will be developed to guide contractors during construction, and the document will be an integral part of Vineyard Wind's effort to ensure that environmental protection and sound construction practices are implemented throughout construction. The CMP will reflect permitting updates and include relevant commitments made during environmental reviews and permitting processes as well as a verbatim listing of formal permit conditions.

The Company has selected cable installation techniques to maximize efficiency while minimizing potential impacts. Installation methods are summarized below. The progression of installation will begin with the onshore substation civil works, followed by installation of substation equipment coincident with HDD proposed at the landfall site as well as installation of the onshore underground cables. Installation of the offshore export cables will follow.

5.4.1 Offshore Cable Installation

The entirety of the two offshore export cables will have a target burial depth of 5 to 8 feet (1.5 to 2.5 meters) below stable seabed, which Project engineers have determined is more than twice the burial depth that is required to protect the cables from potential anchor strikes or fishing activities. Several possible techniques may be used during cable installation to achieve the target depth (see description below). Generally, jetting methods are better suited to sands or soft clays, whereas a mechanical plow or mechanical trenching tool is better suited to stiffer soil conditions, but is also effective in a wider range of soil conditions. While the actual offshore export cable installation method(s) will be determined by the cable installer based on site-specific environmental conditions and the goal of selecting the most appropriate tool for achieving adequate burial depth, the Company will prioritize the least environmentally impactful cable installation alternative(s) that is/are practicable for each segment of cable installation

The majority of the export cables are expected to be installed using simultaneous lay-and-bury via jetting techniques (e.g., jet-plow or jet trenching) or mechanical plow. However, the various installation methods identified below are retained as options to maximize the likelihood of achieving sufficient burial depth while minimizing the need for possible cable protection measures and accommodating varying weather conditions. The two most common methods are described below under "Typical Techniques." Additional techniques that may be used more rarely are described below under "Additional Possible Specialty Techniques." These specialty methods may be needed in areas of coarser or more consolidated sediment, rocky bottom, or other difficult conditions to ensure adequate burial depth is achieved (though it is worth noting that the OECC alignment avoids and minimizes passage through areas of hard bottom to the extent feasible).

Typical Techniques

- Jetting techniques (e.g., jet-plow or jet-trencher): Based around a seabed tractor, a sled, or directly suspended from a vessel, the tool typically has one or two arms that extend into the seabed (or alternatively a plow share that runs through the seabed) equipped with nozzles which direct pressurized seawater into the seafloor. As the tool moves along the installation route, the pressurized seawater fluidizes the sediment allows the cable to sink under its own weight to the appropriate depth or be lowered to depth by the tool. Once the arm or share moves on, fluidized sediment will naturally settle out of suspension, backfilling the narrow trench. Depending on the actual jet-plow equipment used, the width of the fluidized trench could vary between 1.3 and 3.3 feet (0.4 – 1 m). While jet-plowing will fluidize a narrow swath of sediment, it is not expected to result in significant sidecast of materials from the trench. Offshore cable installation will result in some temporary elevated turbidity, but this is expected to remain relatively close to the installation activities (see Section 4.6.3.2.1 for a discussion of sediment dispersion modeling).

- Mechanical plowing: A mechanical plow is pulled by a vessel or barge and uses a cutting edge(s) and moldboard, possibly with water jet assistance, to penetrate the seabed while feeding the cable into the trench created by the plow. While the plow share itself would likely be only approximately 1.6 feet (0.5 m) wide, a 3.3-foot (1-m) wide disturbance area is also conservatively assumed for this tool. The narrow trench will infill behind the tool, either by slumping of the trench walls or by natural infill, usually over a relatively short period of time.

Other Possible Specialty Techniques

- Mechanical trenching: Typically used only in more resistant sediments, a rotating chain or wheel with cutting teeth or blades cuts a trench into the seabed. The cable is laid behind the trencher and the trench collapses and backfills naturally over a period of time.

- Shallow-water cable installation vehicle: While any of the above typical techniques could be used in shallow water, the Project envelope also includes specialty shallow-water tools if needed. This system would use either of the Typical Techniques described above but is deployed from a vehicle that operates in shallow water where larger cable-laying vessels cannot efficiently operate. The cable is first laid on the seabed, and then a vehicle passes over or alongside the cable while operating an appropriate burial tool to complete installation. The vehicle is controlled and powered from a shallower-draft vessel that holds equipment and operators above the waterline.

- Pre-pass jetting: Prior to cable installation, a pre-pass jetting run using a jet-plow or jet trencher may be conducted along targeted sections of the cable route with stiff or hard sediments. A pre-pass jetting run is an initial pass along the cable route by the cable installation tool that loosens the sediments without installing the cable. The pre-pass jetting run maximizes the likelihood of achieving sufficient burial during the subsequent pass by the cable installation tool when the cable is installed. Impacts from the pre-pass jetting run are largely equivalent to cable installation impacts from jetting described under "Typical Techniques" above.

- Pre-trenching: A trench is excavated by a plow or other device, and the sediment is placed next to the trench. The cable is then laid in the trench. Separately or simultaneous to laying the cable, the sediment is returned to the trench to cover the cable. It is unlikely that Vineyard Wind will use a pre-trench method, as site conditions are not suitable since sand would simply fall back into the trench before the cable-laying could be completed. Pre-trenching is typically used in areas of very stiff clays, where a displacement plow is used to create a wide trench within the seabed into which the cable is laid.

- Pre-lay plow: In limited areas of resistant sediments or high concentrations of boulders, a larger tool may be necessary to achieve cable burial. One option is a robust mechanical plow that would push boulders aside while cutting a trench into the seabed for subsequent cable burial and trench backfill. Similar to pre-trenching, if this tool is needed it would only be used in limited areas to achieve sufficient cable burial.

- Boulder relocation: Any boulders identified along the cable alignments will need to be relocated prior to cable installation, facilitating installation without any obstructions to the burial tool and better ensuring sufficient burial. Boulder relocation is accomplished either by means of a grab tool suspended from a crane onboard a vessel that lifts individual boulders clear of the route, or by using a plow-like tool which is towed along the route to push boulders aside. Boulders will be shifted perpendicular to the cable route; no boulders will be removed from the area.

- Precision installation: In situations where a large tool is not able to operate, or where another specialized installation tool cannot complete installation, a diver or Remotely Operated Vehicle (ROV) may be used to complete installation. The diver or ROV may use small jets and other small tools to complete installation.

- Jetting by controlled flow excavation: Jetting by controlled flow excavation uses a pressurized stream of water to push sediments to the side. The controlled flow excavation tool draws in seawater from the sides and then jets this water out from a vertical down pipe at a specified pressure and volume. The down pipe is positioned over the cable alignment, enabling the stream of water to fluidize the sediment around the cable, which allows the cable to settle into the trench. This process causes the top layer of sediments to be sidecast to either side of the trench. This method will not be used as the conventional burial method for the offshore export cables, but may be used in limited locations, such as to bury splice joints or to bury the cable deeper and minimize the need for cable protection where initial burial of a section of cable does not achieve sufficient depth. Typically, a number of passes are required to lower the cable to the minimum sufficient burial depth, resulting in a wider disturbance than use of a jet-plow or mechanical plow. Jetting is not to be confused with a jet-plow or jet trencher used for typical cable installation described above. Jetting can also be used for dredging small sand waves.

Potential impacts from offshore export cable installation are described and quantified in Section 4.6.3.1 (see Table 4-10). The impact calculations shown in Table 4-10 are based on a 3.3-foot (1-m) wide direct trench disturbance. In addition, as described above, cable installation equipment may ride on a set of skids or tracks on either side of the vehicle; these are each assumed to be approximately 5 feet (1.5 m) wide, which is slightly wider than that assumed for the Vineyard Wind Connector 1 (which assumed 3.3-foot [1-m] wide skids/tracks). This conservatism ensures that larger installation equipment remains an option for the Project, providing the greatest chance of achieving target burial depth.

Cable burial will temporarily displace marine sediments, but in normal operations these displaced sediments return to the ocean floor in the wake of the cable installation vehicle generally within a few meters of the furrow created by the cable installation. Particle sediment monitoring studies recently completed for the Block Island Wind Farm's offshore cable installation found that displaced sediments were an average of 12.5 feet (3.8 meters) from the trench with a thickness of 2.8 inches (7 cm).[18] Given the limited spatial extent of impacts from the offshore cable installation, no impacts in state waters are expected from cable installation activities in federal waters.

For any of the offshore export cable installation methodologies described above, the trench would be expected to backfill naturally after passage of the tool since surveys have identified only granular material (not clays) along the OECC. Where cobbles are present on the seafloor, they are mixed with granular material (e.g., sand), and therefore even though cobbles may be present, the sediment is expected to behave as a frictional material, resulting in natural backfilling of the trench. Given the high-energy marine environment along the OECC, this trench backfilling is likely to occur in a short period of time; this process was most recently evidenced in the Martha's Vineyard Hybrid Cable Project installed from Falmouth to Tisbury (on Martha's Vineyard) in 2015.

In accordance with normal industry practice, a pre-lay "grapnel run" will be made in all instances to locate and clear obstructions such as abandoned fishing gear and other marine debris. Operations for the pre-lay grapnel run will consist of a vessel towing equipment that will hook and recover obstructions such as fishing gear, ropes, and other debris from the seafloor. The Company estimates this activity will begin any time up to two months prior to cable installation. Any abandoned fishing gear recovered will be disposed of or returned to its owner in accordance with requirements of DMF and other relevant Massachusetts regulations.

The proposed offshore cables will be deployed from a turntable mechanism aboard a cable ship or cable barge and installed along a surveyed track. This track will be within the surveyed OECC to enable the avoidance or minimization of impacts. Impacts will be avoided and minimized by allowing the contractor to micro-site the cable inside the installation corridor such that localized areas of hard bottom or boulders, for example, may be avoided. This installation corridor, rather than a specific cable alignment, allows for optimal routing of the cables.

Cable burial tools (e.g., jet-plow, mechanical plow) can be mounted on a sled pulled by the cable-laying vessel or can also be mounted on a self-propelled underwater tracked vehicle. The tracked vehicle would run along the seafloor using a power feed from the cable-laying vessel. This type of vehicle is routinely used for wind energy cable projects in Europe and has proven effective in dynamic marine environments similar to the proposed Project route. Typical cable installation speeds are expected to range from 100 to 200 meters per hour, and it is expected that installation

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18 James Elliott, K. Smith, D.R. Gallien, and A. Khan. 2017. Observing Cable Laying and Particle Settlement During the Construction of the Block Island Wind Farm. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-027. 225 pp.

activities for the offshore export cables will occur 24 hours per day. It is anticipated that installation activities for the offshore export cables will require continuous construction once begun. During installation, the cable will be deployed from a turntable on the installation vessel or barge and buried beneath the seafloor. For the integrity of the cable, this activity is ideally performed as a continuous action along the entire cable alignment up to splice joints.

Although the Company is considering the use of dynamic positioning (DP) vessels, due to shallow water depths along the northern portion of the OECC, DP cable-laying vessels could not operate and anchoring would be necessary. Therefore, anchoring is expected to be used along the entire OECC (see Section 4.6.3.1.2).

The Company's preferred installation approach is to install the offshore export cables sequentially. Given that installation of both cables at the same time would require two separate vessel spreads, at considerable expense and with additional logistical challenges, it is unlikely that both cables would be installed at the same time. Spacing between individual cables will be approximately 165 feet (50 m), though this could be modified further pending ongoing routing evaluation. Spacing will be adequate to minimize the risk of damaging previously-installed cable (e.g., the first cable of the pair) while providing sufficient space for future maintenance and repair activities, should they be necessary. Vineyard Wind will maintain a minimum distance of approximately 330 feet (100 m) between cable pairs (i.e., between the cables for Vineyard Wind Connector 1 and the cables for this proposed Project); spacing between cable pairs could be even greater in deeper waters.

5.4.1.1 Splices

Due to the length of the OECC, each offshore export cable will likely require two or three splices (i.e., joints), at least one of which is expected to be located in state waters. One cable will be installed (i.e., buried within the seabed) to a point where a splice is required to continue. When the splicing vessel reaches the splice location, the end of the installed cable will be retrieved from the seafloor and brought up to the surface and inside the cable-laying vessel or other specialized vessel (e.g., jack-up vessel). Inside a controlled environment (i.e., a jointing room) aboard the vessel, the two ends of the cable will be spliced together. Once cable splicing is completed, the offshore export cable will be lowered to the seafloor and buried (likely via controlled flow excavation). Depending on the design of the cable and joint, the splicing process may take several days, in part because the jointing process must be performed during good weather. Prior to retrieving the cable ends from the seabed for cable splicing, cable protection may be temporarily placed over the cable ends to protect them.

If a jack-up vessel is used for cable splicing operations, the vessel would impact approximately 0.15 acres (600 m^2) of seafloor each time the vessel jacks up.

5.4.1.2 Sand Waves and Potential Dredging

As described in Section 4.6.2, some areas of Vineyard Sound have active sand waves that can exceed 12 feet in height. Marine surveys over multiple seasons have allowed the Company to assess these areas, which may require some pre-cable-laying dredging to ensure that the necessary burial depth can be achieved. As described in Section 4.6.3.1.5, a TSHD is the anticipated methodology for dredging given the heights of sand waves in the Project area, although jetting by controlled flow excavation could be used in smaller sand waves. Where a TSHD is used, it is anticipated that the TSHD would dredge along the cable alignment until the hopper is filled to an appropriate capacity, then the TSHD would sail several hundred meters away and deposit the dredged material within an area of the surveyed corridor that also contains sand waves. Such depositing of dredged material would be prohibited within areas identified as hard bottom (see Figure 4-9). Dredging will be limited to only the extent required to achieve adequate cable burial depth during cable installation. If sufficient burial cannot be achieved, some bottom areas may require cable protection in the form of rock placement, gabion rock bags, concrete mattresses, or half-shell protection (see Section 4.6.3.1.3).

5.4.1.3 Cable Crossings

Although no cable crossings are planned for the Vineyard Wind Connector 2, given the development of other offshore wind projects in the vicinity, a cable crossing could occur. If required, a cable crossing would likely include the following steps:

1. Perform a full desktop study of any as-built and post-construction survey data for the previously installed cable.

2. Upon identification of a suitable crossing point that is agreed to by the cable owner, perform a full survey and inspection of the proposed crossing location and the existing cable using an ROV, diver-held instrument, or similar.

3. Carefully remove any existing debris surrounding the crossing point.

4. Depending on the depth of the existing cable and cable owner's requirements, there may be a cable protection placed between the existing cable and Vineyard Wind's proposed cable. This cable protection could be in the form of rock placement, gabion rock bags, or concrete mattresses similar to the standard methods of cable protection described in Section 4.6.3.1.3 (though if concrete mattresses are used at a cable crossing, they may need to be up to 30 feet [9m] wide). Half-shell pipes could also be used, which are products made from composite materials and/or cast iron with corrosion protection that are fixed around the cable to provide mechanical protection. Alternately, if there is sufficient vertical distance between the existing cable and Vineyard Wind's proposed cable, there may be no manmade physical barrier between the cables.

5. During installation of an offshore export cable on approach to the crossing location, the cable will be graded out of burial with the cable installation tool. At this point, some form of cable protection (e.g., half-shell pipes or similar) will likely be applied to the cable when it is surface-laid on the seabed across the cable crossing. Once Vineyard Wind's cable has been laid over the existing cable and clears the crossing location, no further protection will be applied to the cable and cable burial methods will resume using the cable installation tool.

6. Soon after installing the cable at the crossing, the surface-laid section of Vineyard Wind's cable would be protected with either additional concrete mattresses, controlled rock placement, or a similar physical barrier. Remedial post-lay burial of Vineyard Wind's cable on either side of the crossing may be performed to lower the cable into the seabed to ensure its protection.

7. If necessary, additional cable protection will be carefully placed on and around the crossing.

8. A final as-built survey of the completed crossing will be undertaken to confirm the exact location of Vineyard Wind's surface-laid cable and the cable protection laid over the crossing. As-built positions for the cable crossing will be shared with the existing cable's owner and provided to NOAA for charting purposes.

Cable protection used for cable crossings may be wider than typical cable protection, but the total impacts from cable protection will be within the estimates provided in Section 4.6.3. Cable protection measures will be designed to protect the offshore export cables against mechanical impact from above and respect the vertical distance and physical barrier (if any) to the existing cable. The cable crossing will also be designed to minimize the risk of fouling or snagging of fishing equipment. The design of the crossing structure, as well as any survey at the crossing, will be defined, planned, executed, evaluated, and documented in agreement with the cable's owner.

5.4.1.4 Navigation and Vessel Traffic

This section describes the maritime navigation and vessel traffic characteristics of Project-related activities as they may impact navigation and vessels operating to and from ports along the south coast of Massachusetts, Cape Cod, and the Islands. Vineyard Wind is not proposing any restrictions on navigation, fishing, or the placement of fixed or mobile fishing gear; however, construction and installation activities may temporarily affect navigation and/or fishing activities in the vicinity of construction and installation vessels. These impacts are temporary in nature and largely limited to the Project's construction and installation period. Safety zones will be determined by the USCG and are anticipated to be activity-specific. Regarding cable installation, safety zones will be around the cable installation as it proceeds and will not preclude activity along the entire routes for the duration of construction. Vineyard Wind, through its fisheries liaison, will coordinate with fishermen while these discussions with the USCG are underway.

The target burial depth of the cables is sufficient to allow continued use of mobile fishing gear, and anchors from vessels operating at the water depths in the cable area would not penetrate to the planned burial depth even in storm situations.

Vineyard Wind is developing a detailed Navigational Risk Assessment for the Project that will conform to the USCG guidance for Offshore Renewable Energy Installations contained in Navigation Vessel Inspection Circular 02-07.

During construction and installation, Vineyard Wind will employ a Marine Coordinator to manage all construction vessel logistics and act as a liaison with the USCG, port authorities, state and local law enforcement, marine patrol, and port operators. The Marine Coordinator will keep informed of all planned vessel deployments and will manage the Project's marine logistics and vessel traffic coordination between the staging ports and the SWDA in federal waters. Vineyard Wind has also engaged with the Northeast Marine Pilots Association to coordinate construction and installation vessel approaches to the Project region, as required by state and federal law, and to minimize impacts to commercial vessel traffic and navigation.

Vineyard Wind has been actively engaged with fisheries stakeholders for the past several years and has developed a Fisheries Communication Plan, which will continue to be refined throughout the Project. As described in the Fisheries Communication Plan, both a Fisheries Liaison and Fisheries Representative will be employed by Vineyard Wind to ensure effective communication and coordination between the Project and the fishermen. The Fisheries Communications Plan is provided in Attachment J.

There will be a maximum of approximately six vessels used during installation of the offshore export cables on any given day, and construction will proceed in a single phase. On average, there will be approximately four vessels associated with installation of the offshore export cables. During cable construction, vessels will be used for route clearance (e.g. dredging sand waves, removing boulders, pre-construction surveys, and grapnel runs), cable-laying and burial, and installation of remedial protection. Approximately four vessels will be used for route clearance, one or two vessels will be used for cable laying and burial, and one vessel will be used for the installation of remedial protection. In addition, at any given time during cable construction, a guard vessel may be used to monitor vessel activity around the construction area and a crew transfer vessel may be used to transport crew and supplies between shore and the installation vessels.

Vineyard Wind has been and will continue to distribute Notices to Mariners to notify recreational and commercial vessels of their intended operations related to both the offshore SWDA in federal waters as well as the OECC. Local port communities and media will be notified and kept informed as the construction and installation process progresses. Vineyard Wind is currently providing and will continue to provide portable digital media with electronic charts depicting locations of Project-related work to provide fishermen with accurate and precise information on work within the offshore Project area. The Project's website will be updated regularly to provide information on the construction zone, scheduled activities, and specific Project information.

5.4.1.5 Time-of-Year Restrictions

The Company will consult with state and federal agencies to address the timing of export cable installation. Agencies involved in these discussions will likely include BOEM, NMFS, Massachusetts CZM, DMF, MassDEP, and NHESP.

Vineyard Wind is continuing to consult with the NHESP regarding possible TOY restrictions for HDD activities at the Craigville Public Beach Landfall Site or Covell's Beach Landfall Site. For the Vineyard Wind Connector 1, Vineyard Wind and NHESP collaborated on a PPPP which stated that HDD activities at the Covell's Beach Landfall Site would begin in advance of April 1, or would not begin until August 31, to avoid and minimize noise impacts to Piping Plover during the breeding season. Based on a meeting with NHESP on April 15, 2020 and as reflected in the Draft PPPP provided in Attachment K, Vineyard Wind is also offering that it may make sense to repeat that same protective measure for the Vineyard Wind Connector 2. These consultations are ongoing.

5.4.1.6 Schedule for Offshore Export Cable Installation

There are a number of components to the cable-laying process that will involve marine operations. These can be categorized as Route Clearance, Cable Lay and Splicing, and Remedial Protection:

- Route Clearance: this activity is required to prepare the cable alignment for the subsequent installation, and it involves dredging sand waves, relocating boulders, grapnel runs for debris, and disproval survey. The extent of the need for route clearance activities will be further refined as Project design advances and when a contractor is selected. The Company expects approximately 4-8 weeks of vessel activity to clear both offshore export cable alignments. An exclusion zone to be set by the U.S. Coast Guard (USCG) will be established around major cable installation vessels.

- Cable Laying: The cable-laying itself is expected to proceed at a rate of approximately 100-200 m/h. During the lay process, an exclusion zone to be defined by the USCG will be established around cable-laying vessels.

- Cable Splicing: Given the length of the OECC, each offshore export cable could require up to three splices (at least one of which is anticipated to be located in state waters). Depending on the design of the cable and joint, the splicing process may take several days, in part because the jointing process must be performed during good weather.

- Remedial Protection: Any area of the cable that cannot be buried to adequate depth will be protected by the placement of rock or concrete materials. This activity will only occur where required and is anticipated to affect only a small portion of the total cable route. During the remedial protection process, an exclusion zone to be set by the USCG will be established around cable-laying vessels.

5.4.1.7 Post-Installation Surveys

Vineyard Wind is assembling a Benthic Habitat Monitoring Plan intended to document habitat and benthic community disturbance and recovery as a result of construction and installation. Offshore and nearshore geophysical surveys will also be conducted post-construction during the operations and maintenance phase of the Project to inspect cable depth of burial and conduct as-built cable surveys. In addition, it is anticipated that short ad-hoc, supplemental geophysical or geotechnical surveys may be required during construction to provide final verification of site conditions. Geotechnical work would only be conducted in areas already cleared for archaeological resources. Any unanticipated discoveries of cultural resources will be reported and avoided during further onsite work, with review and recommendations by the qualified marine archaeologist and as agreed during the Section 106 consultation.

All surveys will use BMPs and industry-standard equipment that has been approved for use previously for offshore renewable energy work. Most of the surveys will entail use of geophysical systems 200 kHz or higher in frequency that do not require any special mitigation (e.g., multi-beam echosounder, side scan sonar, and magnetometer) to avoid impacts to marine mammals. Standard operating conditions (e.g., vessel strike avoidance, separation distances from protected species, necessary notifications, marine trash and debris prevention) for work will be observed.

For surveys using sonar equipment less than 200 kHz in frequency (sub-bottom profilers) and any bottom-disturbing investigations that have been previously cleared, in addition to the standard operating procedures identified above, the following mitigation measures will be employed to maintain a level of consistency with offshore project activities:

- Notifications when appropriate: national security and military organizations, USCG communication, tribal correspondence.
- Vessel strike avoidance measures, including speed restrictions in Dynamic Management Areas and from November 1 through July 31.
- Protected Species Observer (PSO) monitoring: PSOs will accompany survey vessels and follow standard monitoring protocols, actively observing an established exclusion zone around each vessel.
- Shut down and soft start procedures.

5.4.2 Transition from Offshore to Onshore

HDD is the primary means of eliminating Project-related impacts to the beach, intertidal zone, and nearshore areas, as well as ensuring that the cables remain sufficiently buried and permanently out of the human environment at the shoreline. HDD is a “trenchless” installation technique that will avoid disturbance to the shoreline by negating the need to open-excavate existing coastal wetland resource areas; it will also avoid disturbing recreational use of the beach. At the Craigville Public Beach Landfall Site as well as the variant Covell’s Beach Landfall Site, the proposed HDD would be approximately 1,000 to 1,200 feet (300-365 meters) in length and would be angled offshore to avoid an area of hard bottom and co-located eelgrass (see Figure 4-7). Although the HDD trajectory is still undergoing engineering refinement, it is estimated that the trajectory will result in the HDD passing at a depth of approximately 30 feet below the ground surface at MHW.

HDD would be performed in the off-season using a staging area in the paved Town-owned parking lot. A significant portion of the parking lot would remain available during construction. The Company will work with the Town of Barnstable to ensure that acceptable access is available to the beach during construction.

An HDD construction layout for the Craigville Public Beach Landfall Site is shown in Figure 5-13.

Once the offshore export cables make landfall, they will transition to the onshore export cables within two parallel below-grade transition vaults/joint bays (exterior dimensions approximately 20 feet wide by 60 feet long by 3.5 feet high). Figure 5-13 illustrates the transition vaults/joint bays at the Craigville Public Beach Landfall Site.

5.4.2.1 HDD Construction Sequence

The construction sequence for installation via HDD will consist of the following methods:

- Approach Pit: Land-based HDD rigs are typically staged behind an approach pit, which for this Project will measure approximately 10 by 20 feet for each drill path entry point. The approach pit will provide the contractor with access to the proper trajectory for drilling and will also serve as a reservoir for drilling fluids (i.e., a slurry consisting predominantly of water and bentonite, a naturally-occurring, inert and non-toxic clay) used to extract material from the drill head.

- Pilot Hole: A small pilot hole (typically one to three inches in diameter) will be drilled from the approach pit to the pre-determined location offshore where typical offshore cable installation will terminate. The pilot hole will be drilled at an angle of typically 8 to 18 degrees such that it arcs down beneath the nearshore coastal resources and extends to a depth of approximately 25 to 35 feet beneath the surface of the seafloor. The path of the pilot hole will then arc back up towards the desired point on the seafloor that will be the transition point between typical offshore cable installation and the seaward end of the HDD. Drilling fluid (a bentonite slurry), will cool and lubricate the drill bit, stem, and other equipment, and will also serve to seal the sides of the bore.

- Surfacing of HDD Pilot Hole: At the HDD exit point, a shallow 10-foot by 10-foot “pit” will be excavated to expose the conduit end. Given the coarse-grained nature of sediments at the HDD exit hole location and the small diameter of the pilot hole, little to no turbidity is expected as the drill head reaches the seafloor surface. Although not anticipated, a small amount of bentonite clay could be released at the exit point of the HDD operation, and the contractor may install silt curtains at the exit point; alternatively, where the pilot hole exits the seafloor, the contractor may lower a gravity cell that would capture any incidental bentonite drilling fluid released from the end of the HDD drill. Bentonite clay is an inert, naturally-occurring substance and is appropriate for use in sensitive environments because it poses minimal environmental risks; for this reason, bentonite is commonly used for the HDD process. Nevertheless, the contractor will minimize the amount of bentonite near the exit hole and will have controls near the exit hole to minimize and contain any bentonite. The temporary receiving pit will be filled back in with the same material once the offshore export cable has been brought to land, thereby restoring the ocean bottom to pre-installation conditions.

- Reaming and HDPE Conduit Insertion: After the pilot hole has been established, divers will replace the cutter head on the end of the drill shaft with a reaming head and swivel connection. Upsizing of the bore hole can be achieved by forward or reverse reaming of the pilot hole. The reaming head will enlarge the pilot hole to the necessary diameter ahead of the pull-back of the HDPE conduit into the underground bore. The HDPE pipe lengths can be thermally fused and staged onshore or offshore depending on the pulling direction being determined for pull-in. Cuttings from the reaming/pull-back effort will be pumped from the HDD drill pit back to HDD settling tanks, then passed to a reclaim/cuttings separation tank. Filtered water will be released if it meets water quality requirements, and waste cuttings solids will be properly and legally disposed of as solid waste or landfill material.

- Cable Insertion and Transition: Upon conclusion of the reaming and conduit pullback, the end of the conduit will remain exposed on the seafloor. The conduit will likely have a messenger wire passing through it with a cap on each end until the cable is installed. Divers will insert the offshore cable into the installed conduit, and it will be pulled through the conduit to the land connection. The seaward end of the conduit would then be reburied beneath the seafloor, likely using divers will with hand-jets (i.e., a narrow, high-pressure stream of water). Based on core samples (yet to be obtained), if softer sediments are present that could create turbidity when disturbed, silt curtains will be employed in and around the area of proposed hand-jet excavations to contain turbidity that may develop when completing connections in this transition area, approximately 1,000 feet offshore.

- Disposal of drill cuttings and drill fluids: The HDD installation method will produce a slurry of two co-mingled byproducts: drill cuttings and excess drill fluids (water and bentonite clay). During drilling, this slurry will be collected from the reservoir pit and will be processed through a filter/recycling system where drill cuttings (solids) will be separated from reusable drill fluids. Non-reusable material consisting of drill cuttings and excess drill fluids will be trucked to an appropriate disposal site. This material is typically classified as clean fill, and it is anticipated that will be the case for this Project. The material may have an elevated water content, which could require transport to occur in sealed trucks. Typical disposal sites for this type of clean fill include gravel pits or farm fields/pastures.

- Landward Manholes and Infrastructure: Each offshore cable will be pulled back through the conduit installed via HDD, from which it will enter one of two proposed transition vaults or bays, where it will transition to onshore cabling.

- Site Restoration: The contractor will restore the location of the approach pit to match existing conditions. Any paved areas that have been disturbed will be properly repaved, per the Company's HCA with the Town of Barnstable.

Throughout HDD operations, the Company will ensure shore-side site security, and traffic control which will be coordinated with Town officials.

As described in Section 5.4.1.5, the Company has included a draft PPPP that proposes the same HDD schedule as will be utilized for the Vineyard Wind Connector 1. This schedule, which was formulated in consultation with NHESP to avoid and minimize noise impacts to Piping Plover during the breeding season, will begin HDD activities before April 1 or after August 31.

Work would be done in the off-season (i.e., not during the busy summer months). Given the nature of HDD activities, the operation works best if pursued in 12-hour shifts. A summary of the estimated time requirements for drilling 1,000 to 1,200 feet is presented in Table 5-6.

Table 5-6 HDD Installation of Landfall Site Conduits

	Time (in weeks)
Weeks **per Drill Path** (assumes 12-hours per shift, 6 shifts per week)	6
Expected Number of Drill Paths	2
Total Weeks, on Site Drilling Activity	**12**
Mobilization/Demobilization/Staging (weeks)	3
Total Estimated Time at HDD Site (weeks)	**15**

In summary, the duration of two drill paths of approximately 1,000 to 1,200 feet (300 to 365 m) at either landfall site, including set-up, staging, drilling, and shut-down & demobilization, would be approximately 15 weeks, depending on the drilling conditions and weather encountered. Estimated time requirements could be more, or less, depending upon geotechnical inputs, final engineering design, and associated drilling and construction requirements.

5.4.2.2 Management of Drilling Fluids

HDD is a well-known and commonly utilized installation technique in this type of project, and with proper construction management the risk of drilling fluid release is very low. As described above, it is important to note that the Project will use a drilling fluid composed of bentonite clay or mud. This benign, naturally-occurring material will pose little to no threat to water quality or ecological resources in the rare instance of seepage around the HDD operations.

As described in Section 5.4.2, the HDD installation method will produce a slurry of two co-mingled byproducts: drill cuttings and excess drill fluids (bentonite clay or mud). During drilling, this slurry will be collected from the reservoir pit and will be processed through a recycling system where drill cuttings (solids) will be separated from reusable drill fluids. Once the drilling fluid cannot be recycled any further, the non-reusable material consisting of drill cuttings and excess drill fluids will be trucked to an appropriate disposal site. This material is typically classified as clean fill, and it is anticipated that will be the case for this Project. The material may have an elevated water content, which could require transport to occur in sealed trucks. Typical disposal sites for this type of material include gravel pits or land farmed as upland field or pasture.

Effective construction management contingency plan procedures during HDD operations will minimize construction-period disturbances for nearby land uses and will also minimize the already-remote potential for seafloor disturbance through drilling fluid seepage (i.e., frac-out). Drilling fluid seepage can be caused by pressurization of the drill hole beyond the containment capacity of the overburden soil material. Providing adequate depth of cover for the HDD installation can substantially reduce this potential impact and, as described above, the Project will use a drilling fluid composed of bentonite clay or mud that will pose little to no threat to water quality or ecological resources should seepage occur. Nonetheless, the Company will adhere to operational standards to minimize the chances of drilling fluid seepage.

The trajectory of the HDD installation has been a primary consideration for contingency planning and prevention of drilling fluid seepage. The HDD drill hole will descend from the HDD pit location to a depth of 30 to 35 feet below the seafloor before rising toward the exit hole on the seafloor where installation will transition to cable burial. The geometry of the drill hole profile can also affect the potential for drilling fluid seepage. In a profile that makes compound or tight-radii turns, down-hole pressures can build, thus increasing the potential for drilling fluid seepage. The proposed drilling profile, with its smooth and gradual vertical curves, will avoid this potential effect. In addition, horizontal curvature of the HDD route has been avoided to minimize the potential for pressure buildup caused by drill hole geometry.

The drilling crew will be responsible for executing the HDD operation, including actions for detecting and controlling drilling fluid seepage. The process and actions of the drilling crew will be closely supervised. HDD is a technically-advanced process, and proper training and supervision of the drilling crew will be critical for minimizing the potential for drilling fluid seepage and for promptly and competently responding to seepage should it occur. Each drilling situation is unique, in that the behavior of subsurface material is highly variable and can be difficult to predict. No in-hole monitoring equipment can detect drilling fluid seepage, only pressure and monitoring of actual drilling fluid volume returns, and therefore a combination of factors must be properly interpreted to assess conditions that have the potential to cause seepage.

A seep occurs when the path of least resistance for the pressurized drilling fluid to flow into the subsurface materials immediately surrounding the down-hole tooling is less than the path along the borehole. This situation is most common during pilot hole drilling, when the annulus between the borehole and the drill pipe is the smallest. The most obvious sign of a drilling fluid seepage is the loss of drilling fluid circulation at the drilling pit. One of the functions of drilling fluid is to seal the hole to maintain down-hole pressure. The loss of returning drilling fluid is a sign that pressure is not being maintained in the drill hole and seepage is possibly occurring. If there is a reduction in the quantity of drilling fluid returning to the drill site (i.e., loss of circulation), this could be a warning sign. However, some reduction in the volume of returning drilling fluid is also normal during the drilling process, when a loose sand or gravel layer may be encountered that would require additional drilling fluids to fill voids in the substrate. Consequently, drilling fluid loss in and of itself is not an indication of a potential seepage, but rather the loss of drilling fluid in combination with other factors may indicate a potential seepage. For example, if there is a loss of drilling fluid and the return cuttings do not show a large quantity of gravel, this could indicate a loss of containment pressure within the borehole.

Detecting a potential seep prior to it actually occurring is dependent upon the skill and experience of the drilling crew. For this reason, the Project will utilize a specially assigned drill crew. The drilling crew will monitor certain aspects of the drilling operation to detect fluid loss, including but not necessarily limited to the following:

- Drilling pit returns, where a sudden loss of drilling fluid would indicate that fluid may be lost to geological materials or a release at the seafloor surface;
- Down-hole pressure, which will be compared to the calculated confining pressure during pilot hole drilling;
- Returning drilling fluid volumes and rates, which will be compared to the volumes and rates of drilling fluid pumped down-hole; and
- Pump pressures and flow rates.

The drill crew will be responsible for immediately notifying the Project Manager if seepage occurs. The Project Manager will immediately assess the situation and estimate the quantity of drilling fluid lost and the square footage of area potentially affected. If drilling fluid seepage is detected, the drilling crew will take immediate corrective action and implement the project mitigation plan as appropriate. The primary factor causing seepage would be pressure from the drilling fluid pumps, so the most direct corrective action will be to stop the rig pumps. By stopping the pumps, pressure in the drill hole will quickly dissipate, and with no pressure in the hole seepage will cease. Pumps will be stopped as soon as seepage is suspected or detected. In the event of seepage, the Company will notify MassDEP.

Corrective actions for conditioning the drill hole should seepage occur differ with specific issues encountered during a particular HDD operation. Common corrective actions include, but are not limited to:

- Transitioning the down-hole tooling in a drill hole closer to the entry or exit location to reestablish drilling fluid returns, and “swabbing” out the drill hole;

- Modifying drilling pressures and/or pumping rates to account for an unanticipated or changing soil formation;
- Pumping drilling fluid admixtures into the drill hole at the location of seepage to solidify or gel the soil; and
- Suspending drilling operations for a period of time to allow the drill hole to set up.

5.4.3 Onshore Trenching and Duct Bank Installation

Installation of the onshore export cables will occur in two stages: the first stage will consist of installing the concrete duct bank and splice vaults that will house the onshore export cables and associated infrastructure; the second stage will consist of pulling/installing the export cables through the duct bank conduits and completing splices and terminations. Construction of the onshore cable duct bank system will be performed via open trenching with equipment such as excavators and backhoes. All work will be performed in accordance with local, state, and federal safety standards, as well as any Project-specific local requirements.

The duct bank will contain six single-core cables consisting of a copper or aluminum conductor covered by solid XLPE insulation and separate fiber optic cables. The cables will not contain any fluids. Each onshore export cable will have its own 8 to 10-inch-diameter PVC or HDPE conduit within the concrete duct bank. This duct bank, shown in typical cross-section in Figure 1-8, will be an array of PVC or HDPE pipes or sleeves encased in concrete. Up to eight conduits spaced approximately 12 inches apart will be installed within the duct bank to accommodate onshore conductors and spare conduits, with additional smaller conduits for fiber optic communications cables; grounding will be accommodated within the duct bank trench.

This duct bank will be designed to accommodate the entire Project, approximately 800 MW of transmission. The layout of conduits within the duct bank, and hence the duct bank dimensions, will vary somewhat along the onshore export cable route, and the final layout and configuration is subject to final design and survey, including survey of existing utilities. As described in Section 1.3.3 and shown in Table 5-7, for a majority of the onshore route, the duct bank is expected to be arrayed four conduits wide by two conduits deep, with the total duct bank measuring five feet wide and 2.5 feet feet deep. To accommodate this 4x2 duct bank array, the top of the trench will be approximately 9 to 11 feet wide. A more upright duct bank arrangement, arrayed two conduits wide by four conduits deep, is also possible in certain locations where a narrower footprint is necessary.

The open trench will be supported by temporary trench boxes or other shoring as appropriate. Installation of duct bank within the utility ROW will require clearing and grading within a corridor wide enough to accommodate excavation and stockpiling of soils, and to provide space for construction equipment access along the work zone. The work, however, will be confined to as narrow a corridor as possible and will not impact adjacent wildlife habitat located outside of that corridor elsewhere within the utility ROW.

The target depth of cover in all cases will be at least three feet, although if required in some instances (e.g., at certain utility crossings), the minimum cover will be 2.5 feet.

Table 5-7 Duct Bank and Trench Dimensions (feet)

Duct Bank			*Trench*			
Conduit Layout	**Width**	**Depth**	**Depth**	**Width at Bottom**	**Width at Top (0.3 side slope)**	**Width at Top (0.5 side slope)**
4x2 (flat)	5	2.5	5.5	5.5	8.8	11
2x4 (upright)	2.5	5	8	3	7.8	11

In locations where splicing is necessary, the excavated area will be larger, approximately 20 feet wide by 50 feet long, to accommodate a splice vault which is typically 8 feet wide by 34 feet long and up to 9 feet deep (outer dimensions). Splice vaults will be installed as two-piece preformed concrete chambers, and will be located approximately every 1,500 to 2,500 feet along the Onshore Export Cable Route. Where the onshore route is particularly straight, the distance between splice vaults may be as great as 3,000 feet (the approximate length of export cable that can be effectively transported by truck and pulled through conduit within the manufacturer's tension specifications). These splice vaults will accommodate cable splicing and cross-bonding of cable metallic sheaths.

Onshore construction is expected to proceed at an average rate of approximately 80 to 200 feet per day depending on a number of factors including existing utility density. Over this period, the construction sequence includes survey/marking underground utilities, installation of erosion controls and traffic management signage/controls, pavement marking, saw cutting of pavement, pavement excavation/removal, trench excavation and removal of excess excavate, trench shoring, placement of ducts and spacers, placement of concrete around the ducts, backfill, temporary repaving, and cleanup. Open-trench work areas will be kept to a minimum, and any open trench will be covered with heavy steel plates at the end of each day. At a rate of 80 to 200 feet per day, a typical 0.5-mile segment of duct bank could be installed in 13 to 33 work days. Assuming a normal 5-days-per-week construction effort, this would be approximately 3 to 6 weeks. This estimate includes installation of splice vaults at intervals of 1,500 to 2,500 feet. In time-sensitive areas where there is potential impact on access to businesses or road crossings, a modified work schedule could be implemented for those specific cases.

Proposed trenching will occur primarily within existing roadway layouts, where excavation will occur within paved areas or within 10 feet of pavement. A small portion of the Preferred Route and certain route variants also utilize existing utility ROWs, in which case excavation and installation of the duct bank would be followed by restoration to match existing conditions.

The trench will be backfilled with a combination of Flowable Thermal Backfill (FTB), native material (typically sand and gravel), or road base under roadway areas to original grade. FTB, a thermally-approved concrete mix, will be placed above the thermal concrete-encased duct bank if final cable engineering determines it necessary; FTB is an inert mix of stone, sand, and cement that is designed to dissipate heat generated by underground electric transmission cables. Compared with the thermal concrete used to encase the duct bank, FTB is a lower-strength material; as such, FTB is "excavatable," whereas the thermal concrete around the ducts is more solid. During installation, FTB will flow to fill trench voids and bond with the trench side-walls. Once hardened, FTB will support loads from vehicular traffic above, and eliminate possibility of future settlement. The final backfill in roadway areas will be town- and/or state-required road sub-base graded material upon which base course and finish course pavements will be placed. In landscaped areas, the final backfill above the FTB will typically be a sandy loam, which can be seeded.

During construction, traffic will be managed in accordance with TMPs developed in consultation with Town of Barnstable officials.

5.4.3.1 Duct Bank Sequence and Timing

The typical duct bank construction sequence will include the following steps:

- Survey and mark splice vault and duct bank locations.
- Set up erosion and siltation controls, including silt sacks or similar protection for existing storm drains.
- Set up traffic management measures in coordination with local police and public works officials.
- Pipe will be delivered on flatbed trucks, stockpiled in a local staging area or along the road if space is available, and advanced ahead of the trench.
- Trench excavation should advance at a rate of 80 to 200 feet per day.
- Excavated material will be hauled away in trucks daily and recycled or disposed of in accordance with state regulations.
- At the landfall site, fusing or joining of continuous PVC or HDPE pipe is planned to be completed in advance of the trench excavation, and will be waiting for assembly into a duct bank array (above ground).
- Duct pipe is proposed to be assembled into the duct bank array in advance, with required spacers (above ground) then lowered into the trench with slings via heavy equipment.
- After the duct bank array is secure, concrete trucks will backfill the array in place.

- Trench areas that are not backfilled by day's end will be secured with steel plates set in place to cover and protect the trench overnight. Openings in the shoulder will be protected and barricaded to ensure traffic and pedestrian safety.

- While new trench excavation advances, backfill will be placed above new concrete-encased sections from the prior day's work. Backfill will be brought to required grade, and the trench will be secured with steel plates again overnight.

- Subject to local permit conditions, temporary pavement will be placed at completed trench sections as soon as there is enough work to occupy a paving crew for a full day's work. Final restoration will be performed in accordance with requirements of the HCA.

- Clean up work area and remove erosion controls.

All work will conform to MassDOT and Town specifications for new road construction. Roadways will be restored to "like new" condition or an alternative mutually agreed upon with the Town and consistent with Town policies and procedures.

This cycle of trench work will proceed up to any given vault, and vaults will have been installed prior to duct bank trench work, in most cases staggered to minimize roadway impacts. For vault installations, a separate but similar sequence or work will be performed by a separate crew while trench work advances:

- Vault locations will be excavated to required grade, and a base of leveling stone will be set in place.

- The vault (pre-delivered sections) waiting nearby will be set in place by a crane and fully assembled, including required manway risers.

- Conduit connections to the vault will then be made from trench ducts in place on each side of the vault.

- When all exterior connections are complete, the vault area will be fully backfilled and compacted to grade.

- Temporary pavement will be placed when vault work is complete, as described in step 10, above.

- If dewatering is required for vault installation, then procedures as described in Section 5.4.1.6 will be employed.

5.4.3.2 Trenchless Crossing Techniques

Trenchless crossing techniques (e.g., HDD, microtunnel, direct pipe, pipe jacking) are typically used where either: (1) open trenching is not feasible from a construction perspective due to subsurface infrastructure, bridges, culverts, or railroad tracks; or (2) open trench construction is not practical due to traffic conditions. For crossings of busy roads, nighttime work may allow for open trench construction. Trenchless techniques proposed to be employed for Project construction are described briefly below.

As described in Section 5.4.2, HDD is proposed for the offshore-to-onshore transition at the landfall site. This methodology is typically used for comparatively deep and long crossings such as those under interstate highways, water bodies, and railroads. This method commonly involves drilling a hole under a conflicting object from one side to the other, then pulling either a large HDPE casing or several smaller HDPE pipes (in a bundle) back through the bore hole. Once the pullback process begins, it cannot be stopped until the pipes are in place.

As described in Section 1.5.1.4, a number of trenchless crossing techniques (microtunnel, HDD, and direct pipe) are under consideration for the Centerville River crossing. Microtunnel is defined as a pipe jacking operation that utilizes an MTBM pushed into the earth by hydraulic jacks mounted and aligned in a jacking shaft (see Section 1.5.1.4.3). A concrete casing pipe is lowered into the shaft and inserted between the jacking frame and the MTBM or previously jacked pipe. Slurry lines and power and control cable connections are made, and the pipe and MTBM are advanced along the planned alignment. This process is repeated until the MTBM reaches the reception shaft. Upon completion of the tunnel, the equipment is removed, the carrier pipeline/conduits are pulled through the concrete casing pipe utilizing rollers or an alternative method, and the annular space is grouted. As described in Section 1.5.1.4, this is the preferred method for accomplishing the Centerville River crossing.

Direct pipe is a similar process that uses a drill head welded to a pipe casing, and as drilling progresses the pipe casing keeps getting extended (see Section 1.5.1.4.4). Once the drill path is complete through the receiving end, the head is cut off and the pipe remains in place, becoming the casing for the cables.

As described in Section 1.5.2.1.4, pipe jacking is proposed at the Route 6 crossing. Pipe jacking uses powerful hydraulic jacks to thrust a specially designed casing pipe through the ground, led by a guidance system, to excavate a tunnel from a jacking shaft to a receiving shaft. The bore is advanced behind a shield at the leading edge or face of the tunnel providing instant support of the soil as excavation is taking place at the face of the tunnel within the shield. Pipe jacking methodologies include microtunnel, earth pressure balance machines, conventional non-pressurized tunnel boring machines, and open shield machines. The open shield method is preferred for the Route 6 crossing as it allows for the removal of large boulders and is most appropriate for the expected low groundwater application and the relative depth of cover under Route 6. The ability for boulder removal is key to this method where pneumatic jack hammers can be used to breakup boulders. The open shield pipe arrangement is equipped with a hoe, cutter boom, muck cars, or conveyor belt to remove excavated material. The open shield pipe jacking method provides a flexible, structural, watertight, finished pipeline once the tunnel is completed.

5.4.3.3 Restoration

Where the trench location requires cutting of pavement, pavement restoration will be carried out in compliance with Section 9.0 of the DPU Street Restoration Standards (from Docket #DTE 98-22). Generally, all pavement excavations will be repaired with same-day permanent patches unless specifically agreed to by the town. Typically, temporary patches are only permitted for work between December 1 and March 31, when bituminous concrete is not available, or if the excavation must be reopened within five working days (e.g., to continue work after a weekend). In general, the length of new excavation completed each day will equal the length of duct bank installed, backfilled, and compacted. The Company expects to install approximately 80 to 200 feet of duct bank per day.

If, at the end of the day, construction is not complete along an active section, any street openings will be covered with steel plates and marked with drums and yellow flashers until pavement patching is accomplished. Openings in the shoulder will be protected and barricaded to ensure traffic and pedestrian safety.

As described above, the final backfill in roadway areas will be town- and/or state-required road sub-base graded material upon which base course and finish course pavements are placed. All affected public roads will be repaved to as-new condition after construction is complete. In cross-country areas or landscaped areas, the final backfill above the FTB will typically be a sandy loam which can be seeded. The shoulder will be graded to its pre-existing contours, with slight mounding to allow for settlement. Any disturbed vegetated areas will be loamed and seeded to match pre-existing vegetation. Any lawn-edge that has been affected by replacement main installation, including equipment passage, will be hand-dressed, seeded, and mulched.

Substation construction will involve clearing some forested land, and duct bank installation within existing utility ROWs may also require some clearing where those ROWs have not been maintained to their full widths. However, no significant tree trimming is anticipated outside existing utility ROWs where the routes follow existing roadway layouts. As described above, for construction within the utility ROW, any disturbed vegetated areas will be loamed and seeded to match pre-existing vegetation.

5.4.4 Onshore Cable Installation and Testing

Prior to cable installation, each conduit within the installed duct bank will be tested and cleaned by pulling a mandrel (a close-fitting cylinder designed to confirm a conduit's shape and size) and swab through each of the conduits. When the swab and mandrel have been pulled successfully, the conduit is ready for cable installation.

Six conductors and two fiber optic cables will be installed between two adjacent manholes. To install each cable section, a cable reel will be set up at the "pull-in" manhole and a cable puller will be set up at the "pull-out" manhole. Following the initial pulling of the mandrel and pulling line through each conduit, a hydraulic cable-pulling winch and tensioner will be used to individually pull cable from the pull-in to the pull-out manhole. This process will be repeated until all cables have been installed.

Once adjacent cable sections are installed, they will be spliced together inside the manholes. Splices will be performed for straight joints, whereby two cable ends will be joined and then encapsulated with a heat-shrinking material to protect the splice. Cable sheath grounding will be either single or cross bonded. The splicing operation requires a splicing van and a generator. The splicing van contains all of the equipment and material needed to make a complete splice. At times, an air conditioning unit may be used to control the moisture content in the manhole. A portable generator will provide the electrical power for the splicing van and air conditioning unit, and the generator will be muffled to minimize noise. Typically, the splicing van will be located at one manhole access cover, the air conditioner will be located near the second manhole access cover, and the generator will be located in a convenient area that does not restrict traffic movement around the work zone.

Once the complete cable system is installed, it will be field-tested from the substation. At the completion of successful testing, the line will be energized.

During Project operation, the Company will conduct routine maintenance per a preventative maintenance schedule based on the cable manufacturer's recommended maintenance schedules and best industry management practice. This will include visual inspection of the manhole and associated cabling, splice joints, grounding cable connections, and link boxes. The fiber optic splice boxes will also be visually inspected for signs of moisture and corrosion. Inspection of and access to manholes within roadways will be scheduled with Town departments for permission and implementation of any required traffic management mitigation. Entering a manhole will be in full compliance with the Project's safety management system and work permit practices.

5.4.5 Substation Civil Works and Construction

The Project's onshore substation is planned for an approximately 6.7-acre parcel located approximately 0.7 miles east of the West Barnstable Substation. The parcel has frontage on Shootflying Hill Road and direct access to utility ROW #345. As described in Section 1.3.4, the Project is planning to construct a substation that will be enclosed with wire mesh fence and/or concrete masonry unit (CMU) wall and will house two 220/345-kV or 275/345-kV "step-up" transformers, gas-insulated switchgear and a control room inside two metal enclosures, and other necessary equipment likely including shunt reactors, STATCOMs, and harmonic filters along with associated bus work and support structures, overhead and underground wiring and conduits, protective systems, electrical service equipment, grounding protection, and lightning protection masts. A general arrangement for the new substation is provided as Figure 1-9, and the substation layout is shown on Figure 1-10.

Most of the major equipment and bus work is not expected to exceed 30 feet in height, although the shunt reactors will be on the order of 40 feet tall. The station will also be equipped with three slender lightning protection masts that will be approximately 80 feet in height.

As shown on Figure 1-10, the Company plans to plant vegetated screening on the western and northern boundaries of the site; since the southern property line extends into ROW #343, no vegetated screening will be possible in that location. The eastern side of the site is bordered by woodland owned by MassDOT. As described in Section 1.3.4, some of the equipment for the proposed substation may be relocated from the motel site to a parcel located immediately southeast of the West Barnstable Substation (shown as assessor map parcel #214-001 on Figure 1-11). Should that occur, it would provide flexibility with regard to the substation equipment itself and would also provide greater flexibility for providing visual and noise buffers for residences near the motel site.

The substation yard area will be finished in crushed stone, and perimeter security fencing will be installed. Access to the new substation site will be via a paved driveway off of Shootflying Hill road. The substation design also includes an all-weather internal access road. The proposed substation will be equipped with an integrated fluid containment system described in Section 1.3.4.1 and as determined and agreed to with the Town of Barnstable.

Construction of the substation will include the following steps:

- Install perimeter construction fencing and security gate, install initial erosion controls;
- Prepare the site for construction, which entails clearing and grading the site (providing erosion controls where needed), installing retaining walls (if needed), and excavating areas required drainage swales and basins required for site drainage;
- Excavate areas required for major component foundations and full volume containment sumps;
- Form and pour major foundations/containment sumps;
- Excavate areas required for spread footings, form and pour footings;
- Deliver and place major equipment (e.g., transformers, reactors) using appropriate heavy load vehicles and equipment (transformers are filled with dielectric fluid later in the construction sequence);
- Trench areas for underground cabling, install duct bank, and backfill;
- Install ground grid and place crushed stone in yard area;
- Deliver and set prefabricated control equipment enclosure;

- Deliver and place other equipment (e.g., breakers), and begin to erect buswork;
- Complete buswork, begin cabling, including bringing 220-kV or 275-kV transmission into the site and 345-kV cabling to the West Barnstable Substation;
- Complete cabling, control wiring, and installation of protection systems;
- Test and commission;
- Install permanent perimeter security fencing and screening;
- Restore and landscape periphery of site; and
- Remove construction stage erosion controls.

Construction and commissioning of the substation is scheduled to occur over a period of approximately 18 to 24 months.

As described in Section 1.3.5, modifications at the West Barnstable Substation will also be required to accommodate the Project's proposed interconnection. The design and schedule of this work will be determined by the results of the ISO-NE System Impact Study and coordinated with Eversource.

5.4.6 Dewatering

Dewatering of the duct bank trench may be necessary in areas where groundwater is encountered, where soils are saturated, or at times when the trench is affected by stormwater. Dewatering will likely be necessary in areas where the onshore export cable route is adjacent to wetlands, streams, or other bodies of water. Standard erosion control practices will be employed to minimize erosion during trenching operations and construction activities in general. Areas where groundwater may be encountered will be identified as part of the pre-construction environmental investigation of soils.

Trench dewatering is the process of removing excess runoff and groundwater that has accumulated and is occupying the trench line to allow for the installation of the duct bank and dry backfilling of the trench. Trench dewatering management will be accomplished using a combination of best management practices (BMPs) that will be tailored to the site-specific conditions for each dewatering operation. Water found in all excavations must be assessed for obvious signs of contamination (e.g., discoloration, odor, signs of oil) prior to discharge. Water exhibiting signs of contamination cannot be pumped to the ground, catch basin, storm drains, sewer system, or surface water; such water will typically need to be pumped by a waste management contractor for proper off-site disposal. If the assessment shows no evidence of contamination, BMPs must be followed to avoid pumping sediment-laden water from the excavation.

Although high groundwater conditions are not expected, if they are encountered then groundwater would be pumped from a series of sumps within the trench or vault excavation. Each sump would have a submersible pump surrounded by clean crushed stone, and would discharge groundwater to a collector line that would discharge to a dewatering fractionization tank (frac tank). After any water-born sediment has settled within the frac tank, the water would be released to duplex filter bags for further filtration prior to release. Water released from the filter bags would flow through a series of floc-log check dams to an appropriate nearby Town catch basin or drainage way.

5.4.7 Laydown and Staging

The contractor will identify laydown/staging areas necessary to complete construction. These locations will be located more than 100 feet from any wetland resource areas, more than 200 feet from perennial waterways, and outside the Zone I area of any public water supply wells.

5.4.8 Construction Equipment and Refueling

Procedures for refueling construction equipment will be finalized during consultations with the CCC to ensure safety and spill prevention. Nearly all vehicle fueling and all major equipment maintenance will be performed off-site at commercial service stations or a contractor's yard. A few pieces of large, less mobile equipment (e.g., excavators, paving equipment) will be refueled as necessary on-site. Any such field refueling will not be performed within 100 feet of wetlands or waterways, or within 100 feet of known private or community potable wells, or within any Town water supply Zone I area. The fuel transfer operation will be conducted by a competent person knowledgeable about the equipment, the location, and with the use of the work zone spill kit. Proper spill containment gear and absorption materials will be maintained for immediate use in the event of any inadvertent spills or leaks. All operators will be trained in the use and deployment of such spill prevention equipment. During construction, equipment will be inspected for incidental leaks (e.g., hydraulic fluid, diesel fuel, gasoline, anti-freeze) prior to site access and on a daily basis at the commencement of each work shift. The Company will require its contractor to document the daily inspections as part of the approved means and methods. Small pieces of powered equipment such as generators and pavement saws will be placed in containment bins or on absorbent blankets or pads to contain any accidental fuel spills or leaks. In addition, under no circumstances shall fuel or oils of any kind be stored or brought into any duct bank vault, nor shall there be any re-fueling of equipment either inside a vault or within 100 feet of any vault.

Further, the contractor will ensure that all refueling is performed consistent with the requirements described above, and that impact minimization measures and equipment will be sufficient to prevent discharged fluids from leaving the construction zone or reaching wetlands or waterbodies, and be readily available for use. Minimization measures and equipment will include some combination of the following:

(a) dikes, berms or retaining walls sufficiently impervious to contain spilled oil;

(b) sorbent and barrier materials in quantities determined by the contractor to be sufficient to capture the largest reasonably foreseeable spill;

(c) drums or containers suitable for holding and transporting contaminated materials;

(d) curbing;

(e) culverts, gutters, or other drainage systems;

(f) weirs, booms, or other barriers;

(g) spill diversion or retention ponds;

(h) sumps and collection systems;

(i) secondary containment of non-mobile pumps;

(j) The contractor will prepare a list of the type, quantity, and storage location of containment and clean up equipment to be used during construction, and Vineyard Wind will review this list prior to construction;

(k) All spills will be cleaned up immediately. Containment equipment will not be used for storing contaminated material; and

(l) Date and location of refueling activities will be documented and maintained by the contractor and made available to Vineyard Wind for review.

The Company will prohibit its contractors from refueling machinery or storing oil and/or hazardous materials within Zone I areas, and will require its contractors to regularly inspect construction equipment for leaks. Construction equipment not in use will not be stored within Zone I areas. Spill containment equipment will be immediately available throughout construction in the unlikely event of a leak. In addition, under no circumstances will fuel or oils of any kind be stored or brought into in any duct bank vault, nor will there be any re-fueling of equipment either inside a vault or within 100 feet of any vault.

During operations and maintenance, there will be no on-site refueling of vehicles within Zone I areas or within 100 feet of vaults.

5.4.9 Construction Hours and Schedule

For the installation of the onshore duct bank and cables, construction is anticipated to occur during typical work hours (7:00 AM to 6:00 PM) on Monday through Friday, though in specific instances at some locations, or at the request of the Barnstable DPW, the Company may seek municipal approval to work at night or on weekends. Nighttime work will be minimized and performed only on an as-needed basis, such as when crossing a busy road, and will be coordinated with the Town.

For work at the landfall site, the Company's proposed HDD construction schedule is from 7:00 AM to 7:00 PM on Monday through Saturday, though during conduit pull-in the contractor will likely need to work around the clock since once that process is started it cannot be stopped. Should the Company need to extend construction work beyond those hours and/or days (i.e., on Sunday), with the exception of emergency circumstances on a given day that necessitate extended hours, the Company will seek prior permission from the Town of Barnstable.

The Company will be adhering to the general summer limitations on construction activities on Cape Cod, which the Company has reflected in the Project schedule for construction at the landfall site and along the onshore transmission route where the route follows public roadway layouts. Activities at the landfall site where transmission will transition from offshore to onshore are not expected to be performed during the months of June through September unless authorized by Barnstable. Activities along the onshore transmission route (particularly where the route follows public roadway layouts) will also likely be subject to significant construction limitations from Memorial Day through Labor Day unless authorized by Barnstable, but could extend through June 15 subject to consent from the DPW. The Company will consult with the Town of Barnstable regarding the construction schedule.

5.4.10 Soil Management

The proposed trench will be excavated using a "clean trench" technique, where soil will be loaded directly into a dump truck for temporary off-site stockpiling or hauling to an off-site facility for recycling, re-use, or disposal should it not be required for backfilling the trench. The soil will not be stockpiled along the edge of the roadway, thus reducing the size of the required work area and reducing the potential for sedimentation and nuisance dust.

The Company's objective is to minimize the potential for erosion and sedimentation impacts during construction, and to effectively restore any disturbed areas. Vineyard Wind will meet these objectives by implementing the erosion and sediment control measures described in Section 5.4.7.

Potential locations of contaminated soils along the proposed duct bank route will be researched and identified in advance of construction through review of the MassDEP database known as the "*Waste Site & Reportable Releases*" list. When considering the transmission routes from the landfall site to the proposed substation, a single Chapter 21E Tier 1D site and a single site with an Activity Use Limitation (AUL) are located on Main Street and Shootflying Hill road, respectively (see Figure 5-23 and Table 5-8). No sites identified by the BWSC are located within 300 feet of the Noticed Alternative. No hazardous waste sites are located in proximity to the grid interconnection routes, with the nearest Chapter 21E Tier-Classified Site located over one mile to the south and the nearest site with an AUL located over two miles to the south (see Figure 5-24).

Table 5-8 Sites Identified by the MassDEP BWSC with a Documented Release Located within 300 feet of Project routes.

RTN #	Chapter 21E Compliance Status	Date Listed at Current Compliance Status	Release/Event
4-0020277	Tier 1D	1/28/2008	#2 fuel oil, 160 gallons (residential above-ground storage tank)
4-0011672	Response Action Outcome (RAO Class A3), Phase II, AUL	9/22/2003	#2 fuel oil, underground storage tank

Classifying of existing soils at such locations (or at any location that may later be discovered as a potential contaminated zone) will be administered by a third-party Licensed Site Professional (LSP). This process will begin with test-pitting sites in advance of duct bank construction. During actual duct bank installation, any questionable soil or materials encountered will continue to be examined by the LSP for the presence of contamination, suitability as backfill and or to determine classification for proper disposal. Given the nature of development along the routes (primarily residential, light commercial open space), the relative absence of reported MassDEP BWSC waste sites near the routes, and the publicly available information about those reported BWSC sites referenced in Table 5-8, the Project does not expect to find significant areas with contaminated soils. As construction begins, excavated soils will be observed for visible signs of contamination. If suspected contamination is encountered, construction will proceed under the provisions of a Utility-Related Abatement Measure (URAM).

Off-site stockpile locations have not yet been identified. It is anticipated that two or more locations may be required for temporary storage of soils. Appropriate locations will be determined based on final design documents and will comply with all local, and state ordinances. To avoid unnecessary stockpiling and/or transport of soils, efforts will be made to re-use soil as trench backfill, if deemed appropriate by the LSP based on testing results and based on the requirements of the Massachusetts Contingency Plan (310 CMR 40.000).

5.4.11 Environmental Inspections

The Company will require the contractor to have a qualified environmental compliance manager who will manage an environmental inspection program to ensure that construction activities will comply with requirements of applicable federal, state, and local environmental permits and approvals. The environmental compliance manager will have immediate access to a Company contact and will have “stop work” authority relative to environmental non-compliance.

5.4.12 Air Quality

During Project construction, temporary and minor impacts on ambient air quality from onshore construction vehicles will be limited to areas adjacent to active construction. Temporary and minor impacts on ambient air quality from commercial marine vessels used to install offshore export cables will be limited to offshore areas along the OECC. Project impacts associated with construction include construction vehicle emissions, vessel emissions, construction equipment emissions, and possibly the generation of fugitive dust during construction.

5.4.12.1 Onshore Construction

The Company shall require all construction to be performed in accordance with applicable sections of the MassDEP Air Pollution Control Regulations at 310 CMR 7.00. Specific air quality mitigation measures expected to be required include:

- For on-ROW construction, use of appropriately designed track out pads to prevent off-site migration of soils;
- Mechanical street sweeping of construction areas and surrounding streets and sidewalks as necessary;
- Removal of construction waste in covered or enclosed trailers;
- Wetting of exposed soils and stockpiles to prevent dust generation;
- Minimizing stockpiling of materials on site;
- Turning off construction equipment when not in use and minimizing idling times;
- Minimizing the storage of construction waste on site;
- Minimizing the duration that soils are left exposed; and
- Use of marine vessels that will be certified by the manufacturer to comply with applicable marine engine emission standards.

Although fugitive dust may be generated during construction activities, the relatively short duration of construction at any single location for this Project makes it unlikely that the migration of dust will cause off-site impacts. Furthermore, soil excavation does not typically generate dust due to the natural moisture content of subsurface soils. Nonetheless, the contractor will implement dust control measures as needed during active construction that will primarily consist of street sweeping and using wetting agents to control and suppress dust. Pavement will be cut with a pavement saw, which cuts a trench line in the pavement and across driveways and any intersecting roadways. Pavement will then be removed, trucked away, and disposed of in accordance with applicable regulations. No pavement crushing will occur on-site.

The Company will require contractors to use ultra-low sulfur diesel (ULSD) in off-road diesel vehicles, and the Proponent will comply with requirements of the MassDEP Diesel Retrofit Program. The Diesel Retrofit Program, formerly called the Clear Air Construction Initiative of the Clean Construction Equipment Initiative, originated as an air quality mitigation measure for the

Central Artery/Tunnel Project. The program encourages users of diesel construction equipment to install exhaust emission controls such as oxidation catalysts or particulate filters on their diesel engines. While MassDEP requires participation in the Diesel Retrofit Program by municipalities applying for funding under the State Revolving Fund for water and wastewater projects, there is no MassDEP requirement for participation by other project proponents.

All onshore diesel-powered non-road construction equipment with engine horsepower ratings of 50 and above to be used for 30 or more days over the course of Project construction will either be EPA Tier 4–compliant or will have EPA-verified (or equivalent) emissions control devices such as oxidation catalysts or other comparable technologies (to the extent that they are commercially available) installed on the exhaust system side of the diesel combustion engine.

In addition, vehicle idling will be minimized in accordance with Massachusetts' anti-idling law, G.L. c. 90, § 16A, c. 111, §§ 142A–142M, and 310 C.M.R. 7.11. The Company will require the use of ULSD in diesel-powered construction equipment and will limit idling time to five minutes except when engine power is necessary for the delivery of materials or to operate accessories to the vehicle such as power lifts. The Company will require its contractors to follow these procedures.

5.4.12.2 Offshore Construction

Offshore Project-related emissions are primarily from internal combustion engines, including marine diesel engines, diesel engines on construction equipment, and diesel generators. While the specifics vary by engine type, emissions are generally minimized by ensuring complete combustion to avoid formation of carbon monoxide (CO), particulate matter (PM), and volatile organic compounds (VOC) and by controlling mixing of fuel and oxygen in the combustion process to avoid "hot spots" that generate nitrogen oxides (NOx). Engine manufacturers will optimize the combustion process to avoid incomplete combustion and avoid "hot-spots." These optimization steps will differ from engine to engine and can include changes to "fuel injection timing, pressure, and rate (rate shaping), fuel nozzle flow area, exhaust valve timing, and cylinder compression volume." Controls can also include the use of water injection and exhaust gas recirculation to cool the combustion temperature.

The Project will minimize SO_2 and PM emissions through the use of clean, low-sulfur fuels in compliance with the air pollution requirements detailed in this section. Annex VI of the International Maritime Organization's (IMO's) MARPOL treaty is the main international treaty that addresses air pollution from marine vessels. In the U.S., MARPOL Annex VI is implemented through the *Act to Prevent Pollution from Ships* (33 U.S.C. §§ 1901-1905) and Control of NO_x, SO_x, and PM Emissions from Marine Engines and Vessels Subject to the MARPOL Protocol (40 C.F.R. Part 1043). Under MARPOL Annex VI and EPA's corresponding regulations, any foreign and domestic vessel used during the Project will comply with the fuel oil sulfur content limit of 1,000 ppm. All non-road engines (e.g., generators used offshore) will comply with the non-road diesel fuel sulfur limit of 15 ppm under Regulations of Fuels and Fuel Additives (40 C.F.R Part 80).

The marine engines and generators used during this Project will be certified by the manufacturer to meet or emit less than the applicable marine engine emission standards for NOx, CO, VOCs (as hydrocarbons [HC]), and PM, which include:

- **MARPOL Annex VI:** Annex VI of the MARPOL treaty establishes global limits on the sulfur content of fuel oil used aboard any foreign or domestic vessel and NOx emissions limits from foreign vessels built after 2000 with engine sizes greater than 130 kW (~174 horsepower).

- **40 C.F.R. Part 89, Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines:** 40 C.F.R. § 89 sets emission standards and certification requirements for domestic Tier 1 and 2 domestic marine diesel engines below 37 kW (~50 horsepower).

- **40 C.F.R. Part 94, Control of Emissions from Marine Compression-Ignition Engines:** 40 C.F.R. § 94 sets emission standards and certification requirements for Tier 1 and 2 domestic marine diesel engines at or above 37 kW and manufactured on or after January 1, 2004.

- **40 C.F.R. Part 1042, Control of Emissions from New and In-Use Marine Compression-Ignition Engines and Vessels:** 40 C.F.R. § 1042 sets emission standards and certification requirements for Tier 3 and 4 domestic marine diesel engines.

EPA's emission standards for marine compression-ignition engines contained in the above regulations are structured as a tiered progression, with each tier of emission standards becoming increasingly stringent. These standards are primarily a function of the size, engine displacement, and age of the marine diesel engine. Each tier phased in over several years (by categories of engine size).

At this time, the specific vessels (and hence, engines) that will be used for the Project are unknown; vessel data are highly speculative at this stage of the Project. While vessel details are anticipated to be further refined in the Fabrication and Installation Report (FIR) submitted to BOEM, due to variable availability and limitations associated with the Jones Act, vessels may even be changed out just prior to or during construction. Vineyard Wind will not be able to maintain the Project's construction schedule without the flexibility to draw vessels from the existing fleet of construction vessels as needed to meet Project construction demands. Furthermore, manufacturers have strict restrictions on installing upgrades to avoid violating warranties and emission standard certifications. Thus, it is not technically feasible for Vineyard Wind to propose process modifications for individual marine diesel engines, either by retrofitting or replacing specific marine engines.

The Project's emissions on the Outer Continental Shelf (OCS) (i.e., federal waters) are regulated through the EPA's OCS Air Permit process under the Outer Continental Shelf Air Regulations (40 C.F.R. Part 55). The OCS Air Regulations, which implement Section 328(a)(1) of the Clean Air Act (CAA), establish federal air pollution control requirements for OCS Sources located beyond a state's seaward boundaries. Under 40 C.F.R Part 55, OCS Sources located within 25 miles beyond a state's seaward boundary are also required to comply with the air quality requirements of the corresponding onshore area (COA). Vineyard Wind expects Massachusetts to be designated as the COA, in which case the Project's OCS Sources will be required to comply with the applicable Massachusetts air quality regulations including Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) under 310 CMR § 7.00. To satisfy BACT and LAER, Vineyard Wind's OCS Air Permit will contain, at a minimum, emission limitations, monitoring, testing, and reporting requirements for OCS Sources. Based on the draft OCS Air Permit issued for Vineyard Wind 1 on June 28, 2018, Vineyard Wind expects that Project vessels that become OCS Sources will be required to have engines meeting EPA's or IMO's highest applicable marine emission standards, where available. Additionally, through the OCS Air Permit Process, the Project will offset applicable NO_x and VOC emissions by acquiring emissions offsets in compliance with the Nonattainment New Source Review program, if required.

5.4.13 Noise

Potential construction-period noise impacts and proposed mitigation measures are described below.

5.4.13.1 Sound Level Considerations – Duct Bank and Cable Installation

Civil construction activities related to the Project will consist generally of the following five principal noise-producing phases:

- Trench excavation;
- Duct bank installation;
- Manhole installation;
- Backfill and Compaction; and
- Final pavement restoration.

Each of these phases will be conducted in sequence at each location; it is possible that several phases of construction will be ongoing simultaneously along various sections of the onshore export cable route.

The potential for noise impacts from Project construction is a function of the specific receptors along the route as well as the equipment used and proposed hours of operation. Construction is anticipated to occur during typical work hours (7:00 AM to 6:00 PM), though in specific instances at some locations, or at the request of the DPW of any given municipality, the Project may seek municipal approval to work at night. Nighttime work will be minimized and performed only on an as-needed basis, such as when crossing a busy road, and will be coordinated with the Town.

Onshore cable installation will generate noise levels that are periodically audible along the Project route, conductor-pulling sites, and staging and maintenance areas. Proposed construction equipment will be similar to that used during typical public works projects (e.g., road resurfacing, storm sewer installation, transmission line installation).

In general, sound levels from construction activities will be dominated by the loudest piece of equipment operating at the time. Therefore, at any given point along the work area, the loudest piece of equipment will be the most representative of the expected sound levels in that area. Maximum sound levels from typical equipment proposed during construction are listed in Table 5-9 at a reference distance of 50 feet.

Table 5-9 Reference Sound Levels of Construction Equipment at 50 feet

Equipment	Max. Sound Level (dBA) at 50 feet
Mobile Crane *(duct bank and manhole installation)*	85 (1)
Pavement Saw *(trench excavation)*	90 (1)
Asphalt Paver *(manhole installation, street restoration)*	85 (1)
Pneumatic Hammer *(trench excavation)*	85 (1)
Mounted Impact Hammer (Hoe Ram) *(trench excavation if ledge)*	90 (1)
Backhoe *(trench excavation)*	80 (1)
Dump Truck *(manhole installation, trench excavation)*	84 (1)
Generator (cable pulling and splicing)	82 (2)
Air Conditioning (cable splicing)	60 (at 3 feet) (2)

Source:

1. Thalheimer, E., “Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project”, Noise Control Eng. Journal 48 (5), 2000 Sep-Oct.
2. US EPA, “Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances”, prepared by Bolt, Beranek and Newman, Report No. NTID300.1, December 31, 1971.

Construction equipment proximity to noise-sensitive land uses will vary along the proposed onshore export cable route. Because sound levels from a point source drop off due to geometric divergence (hemispherical spreading) at a rate of 6 dB per doubling of distance, the reference sound levels at 50 feet in Table 5-9 will decrease by 6 dBA for locations 100 feet back from the edge of construction. For example, maximum backhoe sound levels at 100 feet would be expected to be approximately 74 dBA. Similarly, if setbacks are less than 50 feet, sound levels will be higher. For example, if a setback is 25 feet from construction activity, sound levels from each piece of equipment would increase by 6 dBA. Therefore, the same backhoe at 25 feet would be expected to produce a maximum sound level of 86 dBA. To reiterate, the 80 dBA is the maximum expected backhoe sound level, while typical levels would be much lower.

Construction equipment is generally not operated continuously at maximum load, with significant variation in power and usage. Actual received sound levels would fluctuate depending on the construction activity, equipment type, and separation distances between source and receiver. Other factors, such as terrain and obstacles such as buildings, will act to further limit the impact of construction-period noise levels.

Trench excavation and manhole installation are typically the loudest phases of construction. Under normal trenching conditions (i.e., no ledge, no excessive underground utilities), the construction crews involved in trench excavation are expected to progress at an average rate of approximately 80 to 200 feet per day for an average duration of approximately seven days at any one location. If rock is encountered during construction, equipment such as a hoe ram will be used, which would temporarily increase noise levels.

In general, cable pulling and splicing phases are not expected to generate significant noise. Once adjacent cable sections are installed, they will be spliced together inside the manholes. Splicing high-voltage solid-dielectric transmission cable is a complex operation; splicing activities will not be continuous, but will take place over four or five extended work days at each manhole location. The splicing operation requires a splicing van and a generator, and an air conditioning unit may be used to control the moisture content in the manhole. A portable generator will provide electrical power for the splicing van and air conditioning unit, and will be muffled to minimize noise; this technique has been used successfully in locations with sensitive receptors. Typically, the splicing van will be located at one manhole access cover while the air conditioner will be located near a second manhole access cover, and the generator will be located in a convenient area that does not restrict traffic movement around the work zone.

The electric generator and truck with ventilation fans will generate some noise when manholes are occupied; however, the Proponent will make every practicable effort to limit noise disturbance from this source. Mitigation measures will include use of a low-noise/muffled generator, portable sound walls (temporary noise barriers) as needed, blocking the path of generators, and working with municipalities to coordinate work.

The Company has developed construction procedures and policies to govern the manner in which construction will occur on existing public roadways, and construction management is described in Section 5.4. During construction, BMPs will be implemented to minimize and mitigate potential impacts to the surrounding area and sensitive resources, and the hours of construction will be coordinated with local authorities.

5.4.13.2 Sound Level Considerations – Trenchless Crossings

HDD will be used to accomplish the offshore-to-onshore transition at the landfall site, and a trenchless crossing is also possible at the crossing of the Centerville River. In addition, the crossing beneath Route 6 is likely to be accomplished via pipe jacking.

HDD has three major processes: (1) conductor sleeve drilling; (2) pilot hole drilling, and (3) pull-back. Conductor sleeve drilling involves the hammering of a conductor sleeve using a pneumatic hammer powered by a compressor and suspended by an excavator. A drill then creates a pilot hole through the sleeve path, and lastly is reversed back through the sleeve while displacing the bulk of the ground composite. While there are multiple noise sources associated with the HDD process, the loudest activity is conductor sleeve drilling. Reference sound level measurements of conductor sleeve drilling activity were performed by Epsilon Associates, Inc. for another project; Table 5-10 provides a series of sound pressure levels at different distances expected from HDD conductor sleeve drilling based on measured data.

5.4.13.2.1 Landfall Site HDD

Sensitive receptors in the vicinity of the HDD will be at a variety of setback distances from the actual activity. The closest residence to potential HDD activity at the Craigville Public Beach Landfall Site is located approximately 200 feet from where conductor sleeve drilling will take place. This corresponds to an outdoor estimated sound level of approximately 90 dBA (unmitigated) at the residence. For a point of reference, a typical gas-powered lawnmower is approximately 95 dBA at 3 feet. Many residences in proximity to the landfall sites are seasonal and off-season construction will reduce the number of affected residents, but the Company will assess additional sound mitigation techniques and will work with any homeowners who may be in the area during HDD operations. Noise mitigation techniques are discussed in Section 5.4.13.3.

Table 5-10 may be used for reference to worst-case sound levels at the identified distances. Conductor sleeve drilling will be limited to a daytime-only activity unless the Town requests otherwise. Additionally, the HDD schedule will avoid the summer season at all locations where it is being considered.

Table 5-10 Conductor Sleeve Drilling Sound Levels (part of HDD)

Distance (ft)	Sound Pressure Level (dBA)
50	102
100	96
250	88
500	82
1,000	76
1,500	72
2,000	70
3,000	66

5.4.13.2.2 Route 6 Trenchless Crossing

The trenchless crossing that would be utilized underneath Route 6 would occur within an existing utility ROW, and no residences are located within approximately 400 feet.

5.4.13.3 Noise Mitigation

While intermittent increases in noise levels are expected during construction activities, the Company is committed to minimizing these impacts. Vineyard Wind will mitigate noise from construction equipment along the selected route near sensitive locations such as residences. The distance between the construction equipment and the sensitive locations will vary along the selected route. Mitigation equipment may include temporary noise barriers.

The Company will require that construction equipment be operated such that construction-related noise levels will comply with applicable sections of the MassDEP Air Quality Regulations at 310 CMR 7.10, particularly subsections (1) and (2), which pertain to the use of sound-emitting equipment in a considerate manner as to reduce unnecessary noise. The Project will make every reasonable effort to minimize noise impacts from construction. The Town of Barnstable does not have a bylaw applicable to construction-related noise.

Noise mitigation measures expected to be incorporated into the Project include:

- Minimizing the amount of work conducted outside of typical construction hours;
- Ensuring that appropriate mufflers are installed and maintained on construction equipment;
- Ensuring appropriate maintenance and lubrication of construction equipment to provide the quietest performance;
- Requiring muffling enclosures on continuously-operating equipment such as air compressors and welding generators;
- Turning off construction equipment when not in use and minimizing idling times; and
- Mitigating the impact of noisy equipment on sensitive locations by using shielding or buffering distance to the extent practical.

Blasting is not anticipated, nor is construction expected to result in noticeable vibrations.

5.4.13.4 Offshore Construction-Related Noise

During offshore export cable installation, potential acoustic impacts would consist of vessel noise produced during transit to and from ports as well as the vessel noise produced during cable installation. The primary source of noise during offshore export cable installation will come from the ships' engines.

Marine mammals in the Project area are regularly subjected to commercial shipping noise and would potentially be habituated to vessel noise as a result of this exposure.[19] For example, North Atlantic Right Whales are known to continue to feed in Cape Cod Bay despite disturbance from passing vessels[20], indicating some level of habituation to the sound levels of local traffic. This habituation may also apply to sea turtles and fish. As noise from vessel traffic associated with construction is likely to be similar to background vessel traffic noise, additional vessel noise risk to marine mammals and sea turtles would be low. Furthermore, construction activities will be temporary and short-term in nature, especially for cable-laying, which typically involves continuous movement as the cable is installed along the route. Cable installation is expected to progress at a rate ranging from 100-500 meters/hour (well under 1 knot).

While NOAA has established acoustic guidelines for marine mammals, they have not done so for sea turtles that occur in the Project Area. However, it is believed that sea turtles are far less sensitive to sound than marine mammals, and therefore measures put in place to minimize impacts for marine mammals are more stringent than those required for sea turtles and other animals.

Mitigation of noise impacts specific to activities in federal waters, such as pile-driving activities associated with installation of WTGs, will be comprehensively and specifically addressed through federal review processes. The Company anticipates that mitigation of noise associated with pile-driving in federal waters may include TOY restrictions, dampening measures, and/or visual monitoring efforts and will include Passive Acoustic Monitoring (PAM).[21]

In addition, monitoring for marine mammals and turtles, and associated setbacks and speed-regulation procedures, will reduce the sound level of ships when in proximity to marine mammals and turtles, thus mitigating exposure of those species to engine noise.

The Company will follow reporting requirements as part of monitoring and mitigation plans.

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[19] BOEM. 2014. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts Revised Environmental Assessment. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS EIS/EIA BOEM 2014-603.

[20] Brown, M. W., & Marx, M. K. (2000). Surveillance, monitoring, and management of North Atlantic right whales, Eubalaena glacialis, in Cape Cod Bay, Massachusetts: January to mid-May, 2000. Final Report submitted to Division of Marine Fisheries, Department of Fisheries, Wildlife and Environmental Law Enforcement, Boston, Massachusetts. Contract No. SCFWE3000-8365027.

[21] Vineyard Wind will also implement a soft start during pile driving that will allow sensitive species to swim away from the noise before it gets louder. There are a variety of sound dampening measures that may be used during pile driving, including hammers that are optimized for sound reduction, underwater noise abatement systems, and/or bubble curtains.

5.4.14 Water Quality, Drainage, and Water Supply Protection

The Project will have no long-term impact on drainage or water quality, and construction is designed to avoid any impact to existing drainage systems. As discussed in Section 5.2.3, post-construction the Project will not generate nitrogen or hazardous liquids and will have no impacts to water quality.

For the construction period, procedures for refueling construction equipment will be finalized during consultations with the CCC to ensure proper safety and spill prevention, and are discussed in Section 5.4.8. High groundwater levels are not expected along the route, although depending on the relative elevation of proposed duct bank, dewatering may be necessary in the trench during construction and if affected by stormwater. Construction-period dewatering procedures are described in greater detail in Section 5.4.6. Standard erosion control practices will be employed to minimize erosion during trenching and construction activities, as described in further detail in Section 5.4.7.

As described in Section 5.2.3, the onshore routing options do not pass any Zone I protection areas, though they do pass through Zone II protection areas. A Zone II is an area identified by the MassDEP as that area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation). Project construction is not expected to result in impacts to any of these water supply protection areas.

Storage areas for hazardous materials such as oils, greases, and fuels will be provided with secondary containment to ensure that no spills reach stormwater or other wetlands or waters. Contingencies for the proper disposal of contaminated soils shall be established (e.g., use of a licensed hauler and approved landfill) early in the construction period. Vineyard Wind will develop a Spill Prevention Control and Countermeasure (SPCC) Plan which will be overseen by the contractor’s environmental compliance manager. The contractor’s responsibilities will include:

- Monitoring waste collection and disposal;
- Preparing a pre-job inventory of lubricants, fuels, and other materials that could potential be discharged;
- Consulting with Vineyard Wind to determine reportable spill quantities for materials identified in the inventory;
- Classifying each material on the pre-job inventory as hazardous or non-hazardous waste;
- Identifying the approved waste transporters and disposal sites for both hazardous and non-hazardous wastes;
- Approving the contractor's list of equipment and spill procedures and impact minimization measures;

- Defining the duties and coordinating the responses of all persons involved in cleaning up a spill;
- Maintaining, with support from Vineyard Wind, an up-to-date list of names, addresses, and phone numbers of all persons to be contacted in case of a spill; and
- Conducting training for spill prevention and impact minimization.
- Conduct pre-planning meetings and trainings with foremen and crews for any work within 100 feet of wetlands waterways, or within 100 feet of known private or community potable wells, or when working within the Zone 1 of any Town wells.

5.4.15 Erosion and Sediment Control

The Company's objective is to minimize the potential for erosion and sedimentation impact during Project construction, and to effectively restore any disturbed areas. The Company will meet these objectives by implementing the erosion and sediment control measures described in this section. In general, the measures are designed to minimize erosion and sedimentation by:

- Minimizing the quantity and duration of soil exposure;
- Protecting areas of critical concern during construction by redirecting and reducing the velocity of runoff;
- Installing and maintaining erosion and sediment control measures during construction;
- Establishing vegetation where required as soon as possible following final grading; and
- Inspecting the construction route and maintaining erosion and sediment controls as necessary until final stabilization is achieved and final inspections completed.

It will be the responsibility of the contractor to implement and maintain erosion and sediment control measures during construction, and such measures will be overseen by the contractor's environmental compliance manager.

The sections below include erosion and sediment control techniques that apply to all areas of onshore construction. Erosion and sedimentation controls will be maintained until disturbed areas are stabilized. The Company anticipates that all upland areas affected by construction will be fully restored within two growing seasons.

In the offshore environment, the OECC is located in such high-energy, coarse-grained areas that turbidity generation is expected to be minor and short-term.

5.4.15.1 Temporary Erosion Control Barriers

Hay/straw bales and silt fences are interchangeable, except where noted below. Temporary erosion control barriers will be installed prior to initial disturbance of soil and maintained as described below:

- ♦ At the outlet of a slope break when existing vegetation is not adequate to control erosion;
- ♦ Down slope of any stockpiled soil in the vicinity of waterbodies and vegetated wetlands;
- ♦ At sideslope and downslope boundaries of the construction area where run-off is not otherwise directed by a slope break;
- ♦ Maintained throughout construction and remain in place until permanent revegetation has been judged successful, upon which they will be removed;
- ♦ At boundaries between wetlands and adjacent disturbed onshore areas;
- ♦ As necessary to prevent siltation of ponds, wetlands, or other waterbodies adjacent to/downslope of the Project;
- ♦ At the edge of the construction area as needed to contain soil and sediment; and
- ♦ Catch basins along the work area will be protected using "silt sacks" and perimeter hay bales. The silt sacks and hay bales will be installed before pavement removal and trench excavation begins and will remain in place until the area is repaired and the shoulder repaved and revegetated.

Temporary erosion control barriers will be inspected on a daily basis in areas of active construction or equipment operation, on a weekly basis in areas with no construction or equipment operation, and within 24 hours of a storm event that is 0.5 inches or greater.

In addition, the following provisions will be made as part of erosion control:

- ♦ Have a water truck on-site and use as necessary to minimize fugitive dust during demolition of existing pavement, or during excavation for trenches, vaults, foundations and general construction processes.
- ♦ Although stockpiling of soils will be discouraged, any stockpiled soils located in staging areas (topsoil, special structural fill, etc.) are to be covered to minimize fugitive dust and erosion.
- ♦ All exposed slopes are to be stabilized with erosion control netting and/or temporary plantings.

- Maintain a covered dumpster on or near the active construction site to minimize windblown debris from littering neighborhood and resource areas.

5.4.15.2 Silt Fence Installation and Maintenance

Any silt fence used as a construction-period control will be installed as directed by the manufacturer and applicable permit conditions. Accumulated sediment will be removed and the fence inspected to ensure it remains embedded in the soil as directed. Sufficient silt fence will be stockpiled onsite for emergency use and maintenance.

5.4.15.3 Hay/Straw Bale Installation and Maintenance

Hay/straw bale installation and maintenance will be performed as follows:

- Hay/straw bales will be anchored in place with at least two properly sized wooden stakes;
- Bindings on bales will be horizontal;
- Bales shall be replaced if damaged or allowing water to flow underneath;
- Damaged bales will be replaced with new bales as deemed necessary by the environmental compliance manager;
- A sufficient supply of bales will be maintained on site for emergency use;
- Bales bound with wire or plastic will not be used; and
- Properly placed and staked straw wattles or fiber rolls may be used in lieu of hay bales in certain circumstances. Such substitutions will be approved by the environmental compliance manager in advance.

5.4.16 Safety and Protection of Existing Utilities

During construction and installation of the proposed duct bank, the work area will be cordoned off to prevent unauthorized or accidental access. As described in Section 5.4.3, if at the end of the day construction is not complete along an active section of trenching, any street openings will be covered with steel plates and marked with drums and yellow flashers until pavement patching is accomplished. Openings in the shoulder will be protected and barricaded to ensure traffic and pedestrian safety.

Construction at the proposed substation will be contained within a secured fence line.

Final engineered drawings will be based on the most recent underground utility location information available. The contractor will comply with all Dig-safe regulations and protocols. The Proponent will also ensure their contractors are in strict compliance with the local town road opening requirements and work closely with the applicable department of public works and local utilities. Some existing utilities (storm drain, water etc,) may need to be relocated in accordance with utility company requirements. Other existing utilities may need to be "supported" (often times use of nylon straps attached to fix points such as jersey barriers to hang pipes) during excavations in accordance with utility company requirements. The work will be performed in a cautious manner, physical barriers, protection devices and hand digging may be required when in close proximity to anticipated utilities.

5.4.17 Conclusion

As described above, construction-period impacts from the Project will be spatially constrained and temporary. Appropriate construction management and mitigation measures will avoid and minimize impacts related to air quality, noise, water quality, erosion, and sedimentation. These construction-period impacts from the Project would be comparable for the Preferred Route and Notice Alternative, since the same construction methodologies and mitigation measures would be used for construction along either route.

5.5 Electric and Magnetic Field (EMF) Analysis

A detailed EMF Analysis, prepared by Gradient Corporation, is provided in Attachment I. This analysis is limited to magnetic fields from the offshore and onshore export cables. The analysis does not include electric field modeling, since underground lines produce no above-ground electric fields. Magnetic field modeling for both the offshore and onshore cables was performed using the full approximately 800-MW output, including charging currents. Since the annual capacity factor of Park City Wind is expected to be approximately 50%, modeling at 100% capacity provides a conservative estimate of magnetic fields.

5.5.1 Onshore EMF Analysis

Magnetic fields are a function of current flow or amperage and are expressed in units of milligauss (mG). A number of national and world health organizations have developed EMF exposure guidelines designed to be protective against any adverse health effects. The guideline limits should not be viewed as demarcation lines between “safe” and “dangerous” levels of EMFs, but rather, levels that assure safety with an adequate margin to allow for the uncertainties of science. For magnetic fields, these health-based guidelines range from 1,000 to 10,000 mG. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has established a guideline for allowable public exposure to magnetic fields at 2,000 mG (continuous basis).

As described in Attachment I, calculations demonstrate that modeled post-Project magnetic field values for onshore route segments beneath roadways are well below the health-based guideline issued by the ICNIRP for allowable public exposure to magnetic fields (2,000 mG); this is the case for the maximum values directly above the conductors and the significantly lower levels at lateral distances out to 20 feet on either side of the conductor centerline. For in-road underground 220-kV transmission, a maximum modeled magnetic field level directly above the duct bank centerline was 58.8 mG for the 2W by 4D duct bank configuration and 83.4 mG for the 4W by 2D duct bank configuration (see Table 1.1 and Figures 3.1, 3.4, and 3.5 in Attachment I). A specific analysis is also provided for a possible crossing of the Centerville River using a replacement bridge superstructure with integrated duct banks. As shown in Table 1.2 of Attachment I, magnetic field levels directly above the centerlines of the two short duct bank segments would be 155 mG, well below the 2,000 mG ICNIRP continuous exposure guideline.

Modeling was also performed for the short (0.2-mile) segment of 220-kV[22] and 345-kV underground transmission proposed in existing utility ROW 343 near the proposed Project substation off Shootflying Hill Road. The modeling shows that the Project will result in a small change (6.6 mG) in magnetic field levels on the northern edge of ROW 343 and a negligible change (0.1 mG) on the southern edge of the ROW (see Table 1.3 of Attachment I). The edge-of-utility-ROW magnetic field levels will remain below both the Massachusetts guideline for magnetic fields at ROW edges (85 mG) and the ICNIRP health-based guideline of 2,000 mG.

Modeling was also performed for the 0.5-mile stretch of 345-kV underground transmission proposed for existing ROW 345 that is part of the preferred grid interconnection route between the proposed Project substation and the West Barnstable Substation. As shown in Table 1.3 of Appendix J, modeled levels for the new underground line are negligible on the southern edge of the ROW and 8.2 mG on the northern edge.

For a given run of cable (one splice vault to the next), the duct bank configuration and the cable arrangement will be uniform. The depth of cover above the top of the duct bank will normally be a minimum of three feet, thus the modeled magnetic field levels will be constant from one splice vault to the next. Different portions of the onshore route may use a different duct bank configuration (2x4 or 4x2), and hence somewhat different magnetic field levels may result. However, as shown in the Gradient report in Attachment I, the modeled levels in either case are far below the ICNRP guideline. The analysis accounts for multiple duct bank configurations, which are a function of the available work space within the roadway or ROW, existing utility density and depth to utilities, future plans for use of the roadway or ROW, and soil conditions. There are some differences in modeled magnetic field levels based on the duct bank configuration together with the arrangement of conductors within the duct bank. As a general matter, more closely spaced conductors will yield somewhat lower magnetic field levels. There may, however, be competing design considerations. For example, some spacing between the conductors may be desirable for thermal purposes. As shown on Figure 3.1 of Attachment I, two conduits or sleeves are left open in the center of each of the duct bank configurations.

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[22] The EMF analysis focused on 220-kV and 345-kV cables. The option to use 275-kV cables was not separately analyzed, since the higher voltage cables would have lower amperage, and hence a lower magnetic field.

5.5.2 *Offshore EMF Analysis*

Modeled magnetic fields for a representative cross-section of the 220-kV offshore export cables show that the highest magnetic fields occur directly above the offshore export cables when assuming a 1.5-meter burial depth (84.3 mG). Magnetic fields diminish very rapidly with distance away from the conductors, dropping to 5.6 mG at a lateral distance of 20 feet (6 m) from the conductor centerline. Magnetic field values for offshore export cables are far below the health-based guideline issued by the ICNIRP for allowable public exposure to magnetic fields (2,000 mG).

The offshore export cable modeling presented in Attachment I assumes that the three cores contained in each offshore export cable have a straight concentric trefoil configuration. In reality, the conductors will have a helical, or twisted, configuration, which provides for significant cancellation of magnetic fields. Field measurements conducted on the Block Island cable, also a twisted configuration, indicate that actual levels were approximately 10 times lower than the modeled levels. This adds another layer of conservatism to the modeling provided in Attachment I.

The impact of EMF on marine organisms is the subject of ongoing research. A 2018 BOEM study of EMF effects on elasmobranch (sharks, rays, and skates) and American Lobster movement and migration found that EMF from operating direct current cables did not create a barrier to the movement of the species studied. The research was conducted by the University of Rhode Island Graduate School of Oceanography, and included extensive field studies and observations for these sensitive species.

Earlier work documented electrosensitivity in elasmobranchs (i.e., sharks, skates, and rays) and some teleost fish species (ray-finned fishes), though research on the impact of anthropogenic EMF on marine fish is limited. In general, elasmobranch species are present seasonally in the Project area; however, their abundance varies annually and is relatively low.[23] Fish use electromagnetic sense for orientation and prey detection, and therefore the function of key ecological mechanisms may be impacted by EMF generated by cables.[24] As noted above, a study completed by BOEM in 2018 focused on assessing potential EMF-related impacts to lobsters and skates. That study did not detect any harm caused to the animals, and detected only subtle changes in activity when exposed to EMF of a submarine direct-current cable.[25]

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[23] NODP (Northeast Ocean Data Portal). (2017). Fish: Individual species. Retrieved from http://www.northeastoceandata.org/data-explorer/?fish

[24] Riefolo, L., Lanfredi, C., Azzellino, A., Tomasicchio, G. R., Felice, D. A., Penchev, V., & Vicinanza, D. (2016). Offshore wind turbines: An overview of the effects on the marine environment. In The 26th International Ocean and Polar Engineering Conference. International Society of Offshore and Polar Engineers.

[25] Hutchinson, et. al. 2018. Electromagnetic field (EMF) impacts on elasmobranch (shark, rays, skates) and American Lobster movement and migration from direct current cables. OCS Study BOEM 2018-003. https://www.boem.gov/espis/5/5659.pdf

Because EMF produced by cables decreases with distance, and the target burial depth for the proposed cables is 5 to 8 feet (1.5 to 2.5 meters), the magnetic field at the seabed would be expected to be weak and likely only detectable by demersal species.[26] To date, there is no evidence linking anthropogenic EMF from wind turbine cables to negative responses in fish.[27]

Nevertheless, recognizing that development of offshore wind energy along the Atlantic coast has raised public concerns about the potential effects of EMF from offshore cables on commercially and recreationally important fish species, the BOEM, with the assistance of consultants at CSA Ocean Systems and Exponent, undertook a review of the currently available science on the subject. Results of BOEM's review are summarized and presented in an August 2019 report entitled *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Importance in Southern New England* (also referred to as the "Snyder study").[28]

The report was developed to help commercial and recreational fishing communities concerned about the potential effects of EMF on fish. BOEM notes that the report summarizes what is currently known about EMF issues, addresses common concerns and misconceptions, and provides background information about EMF in the environment and the relevance of EMF to fish species of concern in southern New England. The report itself includes an eight-page Executive Summary, a 36-page technical discussion, and a seven-page listing of literature cited (92 specific citations).

The Executive Summary of the report notes that BOEM has completed and funded multiple studies examining the effects of EMF, the most recent of which include crab harvest and eel behavior. Other agencies and organizations around the world have also funded studies and workshops to obtain additional data and understand the current level of knowledge regarding potential EMF impacts on marine life.

The report's Executive Summary provides a useful introduction to fish sensitivity, reading in part:

> *The sensitivity of fish to EMF is based on the basic functions of their sensory organs. All animals' sensory organs receive signals from the surrounding environment; fishes also have abilities to detect water motion with their lateral lines, and some fish can detect magnetic and sometimes electric fields with specialized sensory organs… Electrosensitive fish contain specialized organs that perceive naturally occurring electric fields and use them to locate prey or detect the presence of predators. The range over which these species can detect electric fields is limited to centimeters, not meters, around these species. Sharks, rays and sturgeon possess specialized sensory organs… that can detect*

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26 See Normandeau et al., 2011, above.

27 Baruah, E. (2016). A Review of the Evidence of Electromagnetic Field (EMF) Effects on Marine Organisms. Research & Reviews: Journal of Ecology and Environmental Sciences, 4(4), 22-26. And Normandeau et al., 2011, above.

28 OCS Study BOEM 2019-049. http://www.thefisherman.com/images/PDFs/BOEM2019-049.pdf

and process electric signals. Skates, because of their bottom-dwelling habitat preference, would be the most likely of the regional fishery species to potentially detect electric fields… There is little to no evidence that electrosensitive fish react to the weak levels of electric fields present around AC undersea power cables.

The Executive Summary goes on to explain that "for undersea power cables, the voltage on the copper conductors within the cable does not produce an electric field in the sea floor or ocean because it is shielded (blocked) by a grounded metallic covering on the cable."

There is some accompanying discussion of natural bioelectric fields produced by marine organisms (from a heartbeat or gill movement). Such fields are close to fish and may reach kvalues as high as 500 milli volts per meter (mV/m) but these fields drop quickly within 4 to 8 inches (10-20 cm) from the source animal. A mV/m is 0.000001 (one millionth) of a kilovolt per meter (kV/m), which is the unit of electric field strength used in the EFSB's 1.8 kV/m edge-of-ROW electric field strength convention for overhead electric power transmission lines. The report also describes how the 60 Hz AC magnetic field around the submarine cable induces a weak electric field. These induced levels are estimated as 0.2 to 2 mV/m directly over a cable, one meter above the seafloor.[29] This is roughly one million to ten million times less than the level the EFSB deems acceptable at the edge of ROW for overhead electric transmission lines, and up to 250 to 2,500 times less than the natural bioelectric fields produced by marine organisms.

With respect to magnetic fields, the report explains that an animal's ability to detect and respond to the Earth's natural static magnetic field is called magnetosensitivity. Many fish species, including bony fishes and sharks, use the Earth's natural static magnetic field for guidance during migration and to navigate in the oceans. Magnetic senses work with other senses to help fish find food, habitat, and spawning locations. Of greater importance, these magnetic senses of fish are "tuned" to the frequency of the Earth's DC (0 Hz) magnetic field, not the 60-Hz magnetic fields produced by undersea power cables associated with offshore wind energy projects. The 60-Hz magnetic field frequency associated with an undersea power cable is therefore outside the known range of magnetosensitive fish species.

The BOEM report's well-supported conclusion is clearly stated on page ES-7:

The operation of offshore wind energy projects is not expected to negatively affect commercial and recreational fishes within the southern New England area. Negligible effects, if any, on bottom-dwelling species are anticipated. No negative effects on pelagic species are expected due to their distance from the power cables buried in the sea floor.

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29 BOEM. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Importance in Southern New England.* OCS Study BOEM 2019-049. http://www.thefisherman.com/images/PDFs/BOEM2019-049.pdf. Table 3; page 15.

Lastly, the report includes a discussion of European studies on the effect of EMF from power cables associated with offshore wind energy projects:

> *Offshore wind energy projects along with the associated undersea power cables have operated in coastal environments of Europe for more than a decade. During this time, many surveys have been conducted to determine if fish populations have declined following offshore wind energy project installation. The surveys have overwhelmingly shown that offshore wind energy projects and undersea power cables have no effect on fish populations… Fish assessed as part of these surveys include flounder and other flatfish, herring, cod and mackerel. These are similar to the species harvested along the U.S. Atlantic coast.*

5.6 Conclusion

As demonstrated herein, potential impacts from installation of offshore export cables within the OECC as well installation of onshore export cables along the Preferred or Noticed Alternative transmission routes or grid interconnection routes have been avoided and minimized to the extent practicable. Any combination of the Preferred and Noticed Alternative onshore routes would satisfy the Project need. While all of the routes and variants are viable, the Company believes the Preferred Routes have advantages over the Noticed Alternatives.

Notably, the Preferred transmission route is 4 miles long, approximately 33% shorter than the Noticed Alternative transmission route, which is 6.1 miles long. In addition, the Preferred Route will pass fewer residences and sensitive receptors, while both routes have similar potential for traffic congestion. Nonetheless, construction-period impacts along the onshore route are largely expected to be minor, with access maintained to residences and sensitive receptors, and therefore the practical difference between the routing options is small.

The Preferred grid interconnection route is 0.7 miles long, less than half the length of the Noticed Alternative grid interconnection route, which is 1.8 miles long. The Preferred Route will also pass fewer sensitive receptors, historic resources, and residences than the Noticed Alternative, and will largely avoid temporary impacts within roadways.

The Project will not result in any change in land use, nor will it have any permanent environmental or human/community-related impacts. Because the onshore export cables are proposed primarily within existing roadway layouts beneath pavement or within ten feet of pavement, construction-period traffic management is being carefully considered and will be coordinated with the Town of Barnstable to ensure any impacts are minimized to the extent possible and that safe and efficient travel is maintained. The Company does not anticipate any large tree-cutting except on the substation site (including parcel #214-001) and potentially along portions of existing utility ROWs that have not been maintained to their full width. On the northernmost section of the Preferred transmission route, tree clearing within ROW #343 can be avoided by locating the duct bank alignment along the existing ROW access road.

There will be no visual impacts from the transmission line portion of the Project. Although the proposed substation will result in a permanent visual alteration, the Company is designing the substation with visual screening. Accordingly, the environmental impacts associated with the Project have been properly minimized.

Section 6.0

Consistency with the Current Health, Environmental Protection, and Resource Use and Development Policies of the Commonwealth

6.0 CONSISTENCY WITH THE CURRENT HEALTH, ENVIRONMENTAL PROTECTION, AND RESOURCE USE AND DEVELOPMENT POLICIES OF THE COMMONWEALTH

This section describes the Vineyard Wind Connector 2's consistency with current applicable health, environmental protection, and resource use and development policies of the Commonwealth. The Project is indeed consistent with these policies as described herein.

6.1 Introduction

G.L. c. 164, § 69J states, inter alia, that the Siting Board shall approve a petition to construct a facility if it determines that "plans for expansion and construction of the applicant's new facilities are consistent with current health, environmental protection, and resource use and development policies as adopted by the commonwealth." As discussed below and in more detail throughout the Analysis, the Project not only satisfies the requirements of G.L. c. 164, § 69J, but, moreover, is consistent with other important state energy policies as articulated in An Act to Promote Energy Diversity (c. 188 of the Acts of 2016), the Green Communities Act (c. 169 of the Acts of 2008), the Global Warming Solutions Act (c. 298 of the Acts of 2008), and the Electric Utility Restructuring Act of 1997 (Restructuring Act, c. 164 of the Acts of 1997).

6.2 Health Policies

The Restructuring Act provides that reliable electric service is of "utmost importance to the safety, health and welfare of the Commonwealth's citizens and economy…" (*See* Restructuring Act, St. 1997, c. 164, § 1(h)). Thus, the Legislature has expressly determined that an adequate and reliable supply of energy is critical to the state's citizens and economy. The Project will be fully consistent with this policy. The Project will deliver approximately 800 MW of zero-carbon renewable energy to the New England electrical grid, helping to ensure the availability of clean and reliable electric service to the citizens and businesses of the Commonwealth and the region. It will also enhance winter reliability and will diversify the fuel mix away from natural gas. Thus, because the Project is consistent with, and will promote, the Commonwealth's energy policies as outlined in the Restructuring Act, it is also consistent with its health policies.

All design, construction, and operation activities will be in accordance with applicable governmental and industry standards such as the National Electrical Safety Code and Occupational Safety and Health Administration (OSHA) regulations such that the health and safety of the public are protected. As discussed in Section 5.0, the Project is being designed in a manner to avoid and minimize potential impacts related to traffic, noise, air and water quality, and EMF. For example, Vineyard Wind will comply with requirements of the MassDEP Diesel Retrofit Program (see Section 5.4.12).

6.3 Green Communities Act, as amended by the 2016 Energy Legislation

The Project is consistent with, and directly advances, the Commonwealth's policies for the development of offshore wind energy resources. In 2016, the Commonwealth enacted legislation specifically intended to bring about the development of offshore wind energy generation projects such as those that would be enabled by the Vineyard Wind Connector 2. Section 83C of the *Green Communities Act* (Chapter 169 of the Acts of 2008), as amended by Chapter 188 of the Acts of 2016, *An Act to Promote Energy Diversity* aims to establish a commercial-scale offshore wind industry in Massachusetts by procuring cost-effective long-term contracts for 1,600 MW of offshore wind energy within the next decade. The Massachusetts Department of Energy Resources (DOER) has also recommended pursuing an additional 1,600 MW of offshore wind energy generation. Offshore wind has the potential to more broadly support other renewable energy goals in the Commonwealth. For example, Massachusetts has the most solar energy generation in New England, and the daily and seasonal production profiles pair nicely with those of offshore wind (e.g., more solar energy generation in the summer, with more offshore wind energy generation in the winter).

While Vineyard Wind 1/Vineyard Wind Connector 1 was the winner of the initial Massachusetts solicitation for commercial-scale offshore wind issued pursuant to the *Act to Promote Energy Diversity*, Park City Wind/Vineyard Wind Connector 2 was the winner of the State of Connecticut's first dedicated solicitation for offshore wind. As described in Section 1.2, since New England has a shared regional electric grid, the states have a tremendous opportunity to collaborate productively in support of this budding industry and maximize its benefits for the entire region. The Vineyard Wind Connector 2 and the associated Park City Wind project will be another significant step forward in meeting the region's growing demand for clean energy.

As described in Section 2.0, without new transmission facilities such as the Vineyard Wind Connector 2, the offshore wind energy sought by the Act would not be able to deliver power to the New England electrical grid.

6.4 Environmental Protection Policies

The Project is consistent with, and advances, the Commonwealth's environmental protection policies.

6.4.1 State and Local Environmental Policies

The Project will obtain all environmental approvals, licenses, and permits required by federal, state, and local agencies and will be constructed and operated in compliance with applicable federal, state, and local environmental policies. Thus, the Project will contribute to a reliable, diverse, and low-carbon energy supply for the Commonwealth and region with minimal environmental impact. In addition to the Siting Board's review, the Project will undergo a MEPA review and a federal consistency review by the Massachusetts CZM, and will secure state permits from MassDEP and MassDOT.[1]

Following completion of the MEPA review process, the Project will be reviewed on the regional level as a Development of Regional Impact (DRI) by the CCC and Martha's Vineyard Commission (MVC). On the local level, the Project will secure the appropriate wetlands approvals from local conservation commissions, as well as appropriate road opening permits/grants of location from local authorities.

Table 6-1 identifies the anticipated principal environmental reviews, permits, and approvals required for the Vineyard Wind Connector 2; federal permits required for the Park City Wind project are included for background. By meeting the requirements for each of these review programs, permits, and approvals, the Project will demonstrate compliance with applicable state and local environmental policies.

Table 6-1 Environmental Permits, Reviews, and Approvals for the Vineyard Wind Connector 2 and Park City Wind

Agency/Regulatory Authority	*Permit/Approval*	*Status*
Federal (for Park City Wind)		
Bureau of Ocean Energy Management (BOEM)[2]	Site Assessment Plan (SAP) approval	Not required[3]
	Construction and Operations Plan (COP) approval/Record of Decision (ROD)	Expected to be filed June 2020
	National Environmental Policy Act (NEPA) Environmental Review	To be initiated by BOEM
	Facilities Design Report (FDR) and Fabrication & Installation Report (FIR)	To be filed (TBF)

1 The Proponent also anticipates filing petitions with the Massachusetts Department of Public Utilities under G.L. c. 164, § 72 and G.L. c. 40A, § 3, which it expects will be referred to the Siting Board and consolidated with this proceeding for joint review.

2 In its review of the COP, BOEM must comply with its obligations under the NEPA, the National Historic Preservation Act (NHPA), the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), the Migratory Bird Treaty Act (MBTA), the Clean Air Act (CAA), and the Endangered Species Act (ESA). Thus, BOEM coordinates and consults with numerous other federal agencies including the National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFW), the Environmental Protection Agency EPA), and the United States Coast Guard (USGC)) during the review process. BOEM also coordinates with the state under the Coastal Zone Management Act (CZMA) to ensure that the project is consistent with the state's coastal zone management program.

3 Vineyard Wind installed a meteorological-oceanographic buoy (metocean buoy) in Lease Area OCS-A 0501 in May 2018, which has provided data used to inform the design of and permitting strategy for Park City Wind. The metocean buoy will remain in Lease Area OCS-A 0501 and will not require submitting an additional SAP to BOEM. Therefore, this initial step in federal permitting is already complete for Park City Wind.

Table 6-1 Environmental Permits, Reviews, and Approvals for the Vineyard Wind Connector 2 and Park City Wind (Continued)

Agency/Regulatory Authority	*Permit/Approval*	*Status*
Federal (for Park City Wind)		
U.S. Environmental Protection Agency (EPA)	National Pollutant Discharge Elimination System (NPDES) Permit(s)	TBF
	Outer Continental Shelf (OCS) Air Permit	TBF
U.S. Army Corps of Engineers (USACE)	Clean Water Act (CWA) Section 404 Rivers and Harbors Act of 1899 Section 10 Individual Permit	Joint application TBF
U.S. National Marine Fisheries Service (NMFS)	Letter of Authorization (LOA) or Incidental Harassment Authorization (IHA)	NMFS concurrence that no IHA required for 2019 survey activities received April 1, 2019. LOA or IHA for pile-driving activities TBF.
U.S. Coast Guard (USCG)	Private Aids to Navigation (PATON) authorization	TBF
Federal Aviation Administration (FAA)	No Hazard Determination (for activities at construction staging areas and vessel transits, if required)	TBF
State/Massachusetts (for the Vineyard Wind Connector 2)		
Massachusetts Environmental Policy Act Office (MEPA)	Certificate of Secretary of Energy and Environmental Affairs (EEA) on Final Environmental Impact Report	Environmental Notification Form (ENF) to be filed in May 2020
Energy Facilities Siting Board (EFSB)	G.L. c. 164, § 69 Approval	Accompanies this Analysis
Massachusetts Department of Public Utilities (DPU)	G.L. c. 164, § 72, Approval to Construct G.L. c. 40A, § 3 Zoning Exemption	Filed with or shortly after the Petition under G.L. c. 164 Sec. 69J
Massachusetts Department of Environmental Protection (MassDEP)	Chapter 91 Waterways License and Dredge Permit Water Quality Certification (Section 401 of the CWA)	Joint Application TBF
Massachusetts Department of Transportation (MassDOT)	Non-Vehicular Access Permits	TBF
Massachusetts Board of Underwater Archaeological Resources (MBUAR)	Special Use Permit	TBF
Natural Heritage and Endangered Species Program (NHESP)	Conservation and Management Permit (if needed)	TBF (if needed)

Table 6-1 Environmental Permits, Reviews, and Approvals for the Vineyard Wind Connector 2 and Park City Wind (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
State/Massachusetts (for the Vineyard Wind Connector 2)		
Massachusetts Historical Commission (MHC)	Field Investigation Permits (980 C.M.R. § 70.00)	Reconnaissance survey application and Project Notification Form (PNF) TBF
Massachusetts Division of Marine Fisheries (DMF)	Letter of Authorization and/or Scientific Permit (for surveys and pre-lay grapnel run)	TBF
Massachusetts Office of Coastal Zone Management (CZM) / Rhode Island Coastal Resources Management Council (CRMC)	Federal Consistency Determination (15 CFR 930.57)	TBF
Regional (for portions of the Vineyard Wind Connector 2 within regional jurisdiction)		
Cape Cod Commission (CCC)	Development of Regional Impact (DRI) Review	TBF
Martha's Vineyard Commission (MVC)	DRI Review	TBF
Local (for portions of the Vineyard Wind Connector 2 within local jurisdiction)		
Barnstable Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	TBF
Barnstable DPW and/or Town Council	Street Opening Permits/Grants of Location	TBF
Barnstable Planning/Zoning	Zoning approvals (if necessary)	TBF
Edgartown Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act) for OECC within Edgartown waters	
Mashpee Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws) for OECC within Mashpee waters (if needed)	TBF
Nantucket Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws) for OECC within Nantucket waters	TBF

6.4.2 Global Warming Solutions Act

Enacted in 2008, the GWSA established aggressive GHG emissions reduction targets mandating that the Commonwealth reduce its GHG emissions by 10 to 25% from 1990 levels by 2020 and by at least 80% from 1990 levels by 2050 (St. 2008, c. 298). Pursuant to the GWSA, the Secretary of the EEA issued the Clean Energy & Climate Plan for 2020 in December 2010, and updated that plan in December 2015. Among other provisions, the GWSA obligates administrative agencies such as the Siting Board to consider reasonably foreseeable climate change impacts (e.g., additional GHG emissions) and related effects (e.g., sea level rise) in evaluating and issuing permits. As the only major renewable energy source in New England, offshore wind energy generation is critical to meeting the GWSA targets.

By enabling the interconnection of large-scale offshore wind generation to the regional electric grid, the Vineyard Wind Connector 2 is entirely consistent with the goals of the GWSA. Even though the Project is in response to a procurement from the State of Connecticut, as a substantial clean energy project it will have significant benefits to the regional electric grid. As discussed in Section 1.6.3, the approximately 800-MW Park City Wind project operating at an annual capacity factor of approximately 50% enabled by the Vineyard Wind Connector 2 will reduce CO_{2e} emissions by approximately 1.59 million tons per year across the New England electrical grid, including displacement of fossil fuel emissions in Massachusetts. The Vineyard Wind Connector 2/Park City Wind will have no adverse climate change impacts or negative effects on sea level; rather, the Project will deliver approximately 800 MW of renewable, zero-carbon energy to the New England electrical grid. The Project is therefore consistent with the GWSA.

6.4.3 The Restructuring Act

The Project is consistent with the environmental policies of the Restructuring Act as more thoroughly addressed in Sections 3.0 through 5.0. The Restructuring Act provides that the Proponent must demonstrate that the Project minimizes environmental impacts consistent with the minimization of costs associated with mitigation, control, and reduction of the environmental impacts of the Project. Accordingly, an assessment of all effects of a proposed facility is necessary to determine whether an appropriate balance is achieved both among potentially competing environmental impacts and benefits, as well as among environmental impacts, cost, and reliability.

A facility that achieves the appropriate balance thereby meets the Chapter 164 requirement to minimize environmental impacts at the lowest possible cost. To determine if a petitioner has achieved the proper balance among environmental impacts, cost, and reliability, the Siting Board first determines if the petitioner has provided sufficient information regarding environmental impacts and potential mitigation measures in order to make such a determination. The Siting Board then determines whether environmental impacts are minimized. Similarly, the Siting Board evaluates whether the petitioner has provided sufficient cost information in order to determine if the appropriate balance among environmental impacts, cost, and reliability has been achieved.

Sections 3.0 through 5.0 of this Analysis demonstrate that the Company has compared a range of alternatives and has proposed specific plans to mitigate potential environmental impacts associated with construction, operation, and maintenance of the proposed Project, consistent with cost minimization. As such, the Project is consistent with the environmental policies of the Commonwealth as set forth in Chapter 164 of the General Laws.

6.4.4 Environmental Justice Policy

The Project is consistent with the Commonwealth's Environmental Justice (EJ) Policy, which was originally promulgated in 2002 by the predecessor to the current EEA. On November 25, 2014, the Commonwealth's EJ Policy was updated by then-Governor Patrick through Executive Order #552. More recently, the EJ Policy was adopted and updated by then-Secretary Beaton on January 31, 2017.

The underlying purpose of the EJ Policy is to reinforce "*that all communities must have a strong voice in environmental decision-making regardless of race, color, national origin, income, or English language proficiency, that such voices can influence environmental decision-making, and that increased investment in the preservation and enhancement of the Commonwealth's open spaces and urban park network must also remain a priority.*" EJ Policy of the EEA, page 2.

High-minority and low-income communities are at increased risk of being unaware of or unable to participate in environmental, energy, or climate-change decision-making, and may face barriers to becoming involved in state permitting and approval processes (e.g., a foreign language-speaking community may not understand a public notice published in English). The EJ Policy contains provisions that apply to projects that are proposed near EJ populations, including provisions that require enhanced public participation under MEPA, provisions that require enhanced analysis of impacts and mitigation under MEPA for projects which exceed specific thresholds, and provisions applicable to both public participation and analysis of impacts and mitigation by the Siting Board specifically.

The criteria for Enhanced Public Participation under MEPA are at #16 of the EJ Policy and apply to projects that meet two criteria:

1. The project exceeds an ENF threshold for air, solid and hazardous waste (other than remediation projects), or wastewater and sewage sludge treatment and disposal; **and**

2. The project site is located within one mile of an EJ population (or in the case of projects exceeding an ENF threshold for air, within 5 miles of an EJ population).

The criteria for Enhanced Analysis of Impacts and Mitigation under MEPA are at #17 and apply to projects that meet two criteria:

1. The project exceeds a mandatory EIR threshold for air, solid and hazardous waste (other than remediation projects), or wastewater and sewage sludge treatment and disposal; **and**

2. The project site is located within one mile of an EJ population (or in the case of projects exceeding a mandatory EIR threshold for air, within 5 miles of an EJ population). The project proponent may submit actual air modeling data on the project's area of potential air impacts in its EIR scope to modify the presumed five-mile impact area referred to in this condition.

Specific criteria for Enhanced Public Participation and Enhanced Analysis of Impacts and Mitigation in Siting Board proceedings are at #20. Those criteria incorporate the MEPA parameters from #16 and #17. Siting Board-specific aspects of the EJ policy address the Siting Board's notice and translation requirements and the Siting Board's consideration of "cumulative health impacts."

The Project does not exceed any ENF thresholds for air, solid and hazardous waste, or wastewater and sewage sludge treatment and disposal. Thus, although portions of the proposed substation and onshore export cable route for the Vineyard Wind Connector 2 are located within one mile of an EJ population as identified by the Commonwealth using census block information on income and/or minority status, neither the Enhanced Public Participation requirements nor the Enhanced Analysis of Impacts and Mitigation under MEPA apply, and the corresponding provisions for Siting Board proceedings are similarly inapplicable. Vineyard Wind will work with the Siting Board to develop appropriate notices for the Project consistent with Siting Board precedent.

Moreover, Vineyard Wind's environmental analysis is intended to minimize the Project's potential impacts to all populations, including EJ populations. Regardless of any legal obligation, and consistent with the Commonwealth's EJ Policy, Vineyard Wind undertook diligent efforts to identify EJ communities in the vicinity of the Project and has undertaken and will continue to undertake extensive community outreach efforts to facilitate meaningful opportunities for all potentially affected parties to participate.

The Commonwealth of Massachusetts defines an EJ Population as any area that:

1. Has one or more Census block groups where 25% of households have an annual median household income equal to or less than 65% of the statewide median ($79,835 in 2018), which equates to $51,893; or

2. Has one or more Census block groups where 25% or more of the residents identify as minority; or

3. Has one or more Census block groups where 25% or more of households have no member over the age of 14 who speaks only English or English "very well" (i.e., English Isolation).

Figures 6-1 and 6-2 show only a single mapped EJ area in the Town of Barnstable, as of the full 2010 federal Census, that is located in the Project vicinity. The census block centered on the Hyannis Airport and adjoining commercial areas, the western end of which is approximately 600 feet from the proposed substation and is adjacent to the Noticed Alternative grid interconnection route, is mapped as an EJ area on the basis of both income and minority population.

The Vineyard Wind Connector 2 is consistent with the Commonwealth's EJ Policy in that its impacts to all populations, including EJ populations, will be minimized and public participation will meet the requirements of the EJ Policy. Although the Project does not exceed any ENF thresholds for air, solid and hazardous waste, or wastewater and sewage sludge treatment and disposal, the

Project has made a diligent effort to conduct an inclusive community outreach program. This outreach program facilitates the meaningful opportunity for all interested parties, including proximate EJ residents, to participate. Further, potential impacts from construction will be temporary and carefully mitigated. Long-term impacts will be minimal and minimized, as described in Section 5.0.

Finally, one purpose of the EJ Policy is to promote climate change resiliency and minimize potential effects from climate change (pages 4-5 of the Policy). The Project will bring approximately 800 MW of renewable, emissions-free energy into the electrical grid in New England, advancing greenhouse gas reduction goals and improving air quality.

6.4.5 Massachusetts Ocean Management Plan

The Project is consistent with the Massachusetts Ocean Management Plan (OMP). Initially released in 2009 and subsequently revised in 2015, the Massachusetts OMP creates a framework for managing uses and activities within the state's ocean waters. As such, its geographic scope is broad and includes the ocean waters, seafloor, and subsurface. Jurisdiction covers the area from the seaward limit of state waters (generally three miles offshore) to a nearshore boundary that lies approximately 0.3 miles seaward from Mean High Water. Figure 4-6 illustrates the OECC and shows the limits of Massachusetts waters. As stipulated in the Oceans Act of 2008, and described in Chapter 1 of the OMP, implementation is achieved through existing state review procedures, whereby all licenses, permits, and leases are required to be consistent to the maximum extent practicable with the OMP. Since the OMP is incorporated into the Massachusetts Coastal Zone Management Plan, all federal actions must also be consistent with the OMP, to the maximum extent practicable. Any project that requires an EIR pursuant to MEPA is subject to the OMP. The Plan's mapped resources guide the scope of relevant aspects of the MEPA review.

The Project is located in the "Multi-Use Area" of the OMP, which covers the majority of the jurisdictional planning area. In Multi-Use Areas, proposed projects are subject to the siting and performance standards associated with allowable uses; those uses are governed by the Ocean Sanctuaries Act, as modified by the Oceans Act, and include power and communications cables. Cables are allowed in the OMP Multi-Use Area, subject to these siting and performance standards as well as other applicable law.

A large part of the planning process for the OMP was devoted to mapping and evaluating natural resources and existing water-dependent uses (e.g., navigation and fishing). This resulted in a series of maps identifying special, sensitive and unique (SSU) resources and existing water-dependent uses that are relevant for particular types of projects. The OMP's general siting and performance standards are directly tied to these SSUs and uses, and are discussed below in specific reference to cable projects.

6.4.5.1 Management Standards for Special, Sensitive, or Unique Habitats

The OMP and relevant OMP Regulations, found at 301 CMR 28.00, include management standards for SSU Resources. Specific to cable projects, the OMP identifies the following SSUs: (1) core habitat of the North Atlantic right whale, fin, and humpback whales; (2) hard/complex seafloor; (3) eelgrass; and (4) intertidal flats. These SSUs are delineated on a map contained within in the OMP, and this state mapping is reproduced on the left-hand side of Figure 4-6.

Within areas mapped as SSUs, uses are presumptively excluded, but this presumption can be overcome by demonstrating:

1. *The maps delineating the SSU resource do not accurately characterize the resource…; or*

2. *No less environmentally damaging practicable alternative exists…; and*

3. *The project proponent has taken all practicable measures to avoid damage to SSU resources, and the activity will cause no significant alteration to SSU resources…; and*

4. *The public benefits associated with the proposed activity outweigh the public detriments to the SSU resource.*[4]

As shown on Figure 4-6, SSUs located in the general Project area include hard/complex seafloor, eelgrass, and North Atlantic Right Whale core habitat. The Plan does not identify any existing water-dependent uses (i.e., navigation, fishing) for which cable projects must meet siting or performance standards. As described in Section 4.6, detailed marine surveys performed by the Company in 2017, 2018, and 2019 have refined the SSU areas within the OECC using data that comply with the data standards requirements in 301 CMR 28.08(1). These surveys were performed to ensure that the route and installation methods will avoid and/or minimize impacts to SSU resources. The Company met on multiple occasions with representatives of the EEA Secretary, CZM, and other relevant agencies before, during, and after the marine surveys to specifically discuss the refinement of the SSU areas. The Company believes that data collected as a result of those surveys is based on contemporary and accepted standards, as informed by the multiple consultations described above and therefore is appropriate to use under 301 CMR 28.08(1)(b). The Company discussed the use of the higher-resolution data obtained during its 2018 survey relative to the lower-resolution mapping in the OMP. Consistent with the OMP, and based on those discussions, the Company believes the new, higher-resolution data is suitable and appropriate to plan routing and to assess compliance with the OMP standards.

Using the refined SSU locations generated as a result of the marine survey, the Company has determined that it is not possible to completely avoid SSUs. As discussed in Section 4.6, numerous technical and environmental considerations and constraints factored into the selection of these

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4 Massachusetts Ocean Management Plan, pages 2-9 and 2-10.

routes, including avoidance of SSUs. However, the proposed OECC is still consistent with OMP Regulations because no less environmentally damaging practicable alternative exists, all practicable measures have been or will be taken to avoid damage to SSU areas, and the public benefits outweigh the public detriments. Compliance with this aspect of the OMP is also discussed below.

As a component of evaluating and minimizing potential impacts related to the Vineyard Wind Connector 2 and Park City Wind, the Company has conducted extensive surveys of the OECC and has mapped hard bottom, complex bottom (bedform fields), and eelgrass along the corridor (see Section 4.6). The OECC is shown in Figure 4-6 relative to these habitats mapped from the 2018 marine survey as well as OMP-mapped SSU areas. Based on these surveys and evaluation of the OECC, the proposed route is the least environmentally damaging practicable alternative and results in a Project with public benefits that clearly outweigh any detriments to SSU and other resources; benefits of the Vineyard Wind Connector 2/Park City Wind are thoroughly described in Section 1.6.

The Company's delineations, based on survey results, of hard bottom, complex bottom, and eelgrass along the OECC, are described in Section 4.6 and are shown on Figure 4-6. The only eelgrass bed observed during the survey, which is co-located with hard bottom associated with Spindle Rock southeast of the Craigville Beach Landfall Site, will be avoided. In addition, the Project will not impact core habitat of the North Atlantic Right Whale, which is mapped as an SSU area in the OMP.

As shown in Figure 4-6, in several cases small areas of hard bottom are present along the fringes of the OECC, where the cable alignments can avoid them; these include the small areas of hard bottom in the northern portion of the installation corridor. In other cases, areas of hard bottom in Muskeget Channel or complex bottom (e.g., sand waves) cover the full width of the corridor. The Company's engineers are evaluating the best possible cable alignments within the installation corridor based on survey results and engineering considerations to avoid and minimize impacts to hard bottom and complex bottom; therefore, a specific calculation for the length of cable proposed through these areas is not possible at this time.

Given the need to bring the offshore export cables to shore, although the Proponent has taken all practicable measures to avoid SSU areas (hard bottom, complex bottom, and eelgrass), including extensive evaluation of potential cable routes in the offshore project area, a commercially-viable route that completely avoids hard bottom and complex bottom is not available. Offshore survey results and considerations related to installation of the offshore cables together demonstrate that the OECC for the Project will unavoidably traverse some limited areas mapped as hard/complex bottom; these are shown on Figure 4-6. The area between Martha's Vineyard and Nantucket, in the vicinity of Muskeget Channel, has shoals and strong tidal currents. The feasible routes through the Muskeget Channel area would all affect some areas mapped in the OMP and confirmed through marine surveys as hard/complex bottom. As discussed in Section 4.0, there are potential offshore cable routes around the islands of Martha's Vineyard and Nantucket; however, these routes would be prohibitively long.

In addition to the OMP-mapped hard/complex bottom, the marine surveys have identified additional areas where greater than 50% of the seafloor is characterized by higher concentrations of boulders, bathymetric relief, and coverage by coarse material. The Company, in identifying the OECC, has sought to avoid and/or minimize passage through areas of hard/complex bottom, both due to their value as a resource and for potential installation challenges related to achieving the target cable burial depth. However, some of these areas are unavoidable given other physical constraints related to water depth and currents. Where possible, Project engineers have sought to maintain water depths of approximately 20 feet (6 meters) along the OECC.

While the OMP identifies some preliminary corridors for offshore wind transmission cables that are in presumptive compliance with the siting standards of the Plan (see Figure 6-3), those corridors are not suitable to the Project. The Project team considered these corridors while assessing offshore routing alternatives, but they were unsuitable for the Project given that water depths within the mapped preliminary corridors are frequently too shallow, and the mapped corridors do not accommodate a landfall site in Barnstable (the Proponent determined such a landfall was needed to minimize onshore and overall routing distances). Section 4.6 contains a detailed discussion of routing considerations for the OECC.

The Project is consistent with the OMP because:

- The Project is consistent with the siting and performance standards for cables, as the proposed OECC will avoid impacts to North Atlantic Right Whale core habitat and mapped eelgrass beds;

- The proposed OECC is the least environmentally damaging practicable alternative for the Project, as described in Section 4.0;

- All practicable measures to avoid damage to SSU resource and minimize impacts to those resources will be taken. The OECC avoids to the maximum extent practicable areas of hard/complex bottom, only passing through these areas where there is no less damaging practicable alternative (see Section 4.6 for a discussion of the OECC and routing considerations), and, where passage through hard/complex bottom is necessary, all practicable measures to avoid damage to SSU resources and minimize impacts to those resources will be taken (see Sections 5.4.1.1 and 4.6.3); and

- The public benefits analysis described in the context of the public benefit determination demonstrates that the Project's public benefits outweigh any detriments (see Section 6.4.6 and Section 1.6).

6.4.5.2 Hard Bottom

As described in Section 4.6, significant survey effort was directed towards assessing benthic conditions and revising boundaries of OMP-mapped hard/complex bottom along the OECC based on 2018 and 2019 survey results. Hard bottom delineated from survey results is depicted on

Figure 4-6. As described above, in some cases only a small portion of the installation corridor is characterized as hard bottom, as is the case in the northern reaches of the OECC. Offshore from the landfall site near Spindle Rock, Project engineers expect the final cable alignment will avoid impacts to the small areas mapped as hard bottom.

Along portions of the stretch of OECC traversing Muskeget Channel, the hard bottom covers the full width of the installation corridor. Thus, based on 2018 and 2019 survey data, it is not feasible for cable installation activities to completely avoid hard bottom. In this area, side slopes and strong currents limit where the cables can be safely and properly installed, and Project engineers have identified the installation corridor as the approximate boundary where construction is feasible.

6.4.5.3 Complex Bottom

Complex bottom is defined based on a measure of rugosity, or the bathymetric relief and complexity on the seafloor. As described in Section 4.6, the areal extent of bedforms such as sand waves is constantly changing with subtle environmental shifts in water depths, sediment grain size, and current flow. Within the OECC, this is a laterally extensive habitat due to the predominantly sandy seafloor and tidal currents flowing over the bottom that constantly rework the sediment. Due to the mobility of sediments in this habitat, development of infaunal communities is greatly reduced compared to more stable areas of seabed. While this equates to a lower productive infaunal benthic regime, the bottom morphology and dynamics of the habitat are reportedly attractive to finfish.

As shown on Figure 4-6, complex bottom as delineated from 2018 and 2019 survey results covers, in some cases, the entire lateral extent of the OECC.[5] Where complex bottom does *not* cover the full lateral extent of the installation corridor, Project engineers are evaluating whether the cable alignment can practicably avoid these areas taking into consideration cost, technology, and logistics. However, in most instances where sand waves are present, such as within Muskeget Channel and in the central reaches through Nantucket Sound, they do cover the lateral extent of the installation corridor.

In Muskeget Channel, side slopes and strong currents limit where the cables can be safely and properly installed, and Project engineers have identified the installation corridor as the boundary where construction is feasible. North of Muskeget Channel within Nantucket Sound, the OECC stays within optimal water depths and avoids shoal features that in some cases are present to

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5 Sand waves as small as approximately 1 foot in height are included in areas mapped as complex bottom. Since typical cable installation techniques would be sufficient within sand waves less than 3 to 5 feet in height (1 to 1.5 meters), the extent of complex bottom does not correspond to where discontinuous dredging may be required to achieve target burial depth.

either side. Given the need for a relatively straight alignment, where the route cannot turn more than 30 degrees at a time and rapid bathymetric changes must be avoided, the installation corridor presents the most practicable option for a successful cable installation. The principal factors used for identifying the OECC are described in Section 4.6.

6.4.5.4 Eelgrass

Eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) are both species of submerged aquatic vegetation (SAV) and are important protected resources that represent critical habitat in nearshore coastal ecosystems. These resources are important components of coastal ecosystems and provide food and shelter to numerous aquatic species, cycle nutrients from the water column, and stabilize marine sediments.

Evaluations of SAV within the OECC have included a desktop study making use data from MassDEP's *Eelgrass Mapping Project*, which, over multiple years, mapped eelgrass beds in state waters using high-resolution digital imagery and extensive fieldwork supported by high-accuracy GPS, high-resolution sonar, and underwater video cameras.

The desktop study was used to inform the location and extent of "Tier-1 SAV" on-site surveys which were conducted on July 12 and July 18, 2018. The on-site surveys determined the presence or absence of eelgrass and/or widgeon grass beds within pre-determined transect lines for four dive investigation areas along the cable corridor. These surveys were performed in conformance with guidance provided in Massachusetts Division of Marine Fisheries Technical Report TR-43, "*Technical Guidelines for the Delineation, Restoration, and Monitoring of Eelgrass (Zostera marina) in Massachusetts Coastal Water*" dated October 2010, and the Joint Federal Regulatory Resource Agency's Submerged Aquatic Vegetation Survey Guidance for the New England Region (June 21, 2011 Version).

The Company's 2018 survey identified a single area of eelgrass within the installation corridor. Sparse patches of eelgrass were identified around Spindle Rock in Centerville Harbor. Video transects included as part of the 2018 survey initially documented their presence, and a subsequent diver investigation provided a thorough mapping of the area. This patch of eelgrass, which is co-located with hard bottom (a rock pile), is shown on Figure 4-7 as well as on the plan set included in Attachment H. Patches of grass intertwined with macroalgae inhabit the discontinuous sandy bottom in and around the rock pile. These exhibit the bright green coloring common for healthy eelgrass during the growing season. The eelgrass is within the bounds of an OMP-mapped hard/complex bottom SSU that was confirmed during the 2018 surveys, and it is also co-located with an area of hard bottom associated with Spindle Rock, located southeast of the Craigville Public Beach Landfall Site. As described in Section 4.6 and shown on Figure 4-7, the alignment of the cables within the OECC and use of HDD from the landfall site will enable the Project to entirely avoid impacts to this area.

An additional nearshore survey was performed in early November 2019. This survey, which focused on the nearshore area offshore from the Craigville Public Beach Landfall Site, did not locate any additional eelgrass beds.

6.4.5.5 Core Habitat of the North Atlantic Right Whale

The Project avoids OMP-mapped core habitat mapped for whales, including the North Atlantic Right Whale.

6.4.6 Landlocked Tidelands Legislation/Public Benefit Determination

In November 2007, the Massachusetts House and Senate passed An Act Relative to the Licensing Requirements for Certain Tidelands (HB 4324), which was signed by Governor Patrick on November 15, 2007 (Chapter 168 of the Acts of 2007) and is known as the "Landlocked Tidelands Legislation." The legislation, among other things, names the Secretary of EEA as the "administrator of tidelands," and requires the Secretary to conduct a "public benefit review" for projects located on tidelands and to issue a written determination (the Public Benefit Determination, or PBD). Pursuant to 301 CMR 13.02(1), the Secretary is required to conduct a public benefit determination for any project that (a) files an ENF after November 15, 2007, (b) is required to file an EIR, and (c) is completely or partially located in tidelands or landlocked tidelands. Pursuant to 301 CMR 13.02(2), the Secretary may conduct a discretionary public benefit review for any project that (a) files an ENF after November 15, 2007, (b) is not required to file an EIR, and (c) is completely or partially located in tidelands or landlocked tidelands.

The proposed OECC crosses through jurisdictional flowed tidelands for the extent of its length within Massachusetts' waters. The legislation outlined above requires analysis of a Project's impacts on the public's rights to access, use, and enjoy tidelands that are protected by Chapter 91 as well as the identification of measures to avoid, minimize, and mitigate any adverse impacts on such rights.

The standards that guide the Secretary in making the PBD are related to the water dependency of the project under review. Under 301 CMR 13.04, water-dependent projects are presumed to meet the criteria in 301 CMR 13.04 and provide adequate public benefit.

The Vineyard Wind Connector 2 is presumptively water-dependent: the Massachusetts regulations at 310 CMR 9.12(2)(e), provide that "in the case of a facility generating electricity from wind power (wind turbine facility) or any ancillary facility therefore, for which an EIR is submitted, the Department shall presume such facility to be water dependent if the Secretary has determined that such facility requires direct access to or location in tidal waters."[6] The Secretary and MassDEP determined that the Vineyard Wind Connector 1 was water-dependent, and Vineyard Wind anticipates the same determination for the Vineyard Wind Connector 2.

6.4.7 Massachusetts Coastal Zone Management Federal Consistency Statement

The Project is consistent with the coastal zone management program. That program will require a certification to CZM that the Project complies with the enforceable program policies of Massachusetts' approved coastal management program and will occur in a manner consistent with such policies. This certification will be made in accordance with the requirements of the Federal Coastal Zone Management Act (16 U.S.C. 1451 et seq.) (CZMA) and implementing regulations at 15 CFR Part 930, as amended, and pursuant to 301 CMR 21.00 and relevant statutory and regulatory authorities for the Commonwealth of Massachusetts' Coastal Zone Management Plan and Program Policies. The analysis contained in this section describes Project compliance with each of the Massachusetts coastal zone program policies and will be the core of the Proponent's future CZM Consistency filing.

6.4.7.1 Jurisdiction for Federal Consistency Certification

The Project requires a federal consistency certification because it requires a federal action and may affect, and is located within, the coastal zone. The Project will require approval of the Construction and Operations Plan (COP) by BOEM and, subsequently, a permit from the USACE pursuant to Section 404 of the federal Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. The official Massachusetts coastal zone includes the lands and waters within an area defined by the seaward limit of the state's territorial sea, extending from the Massachusetts-New Hampshire border south to the Massachusetts-Rhode Island border, and landward to 100 feet inland of specified major roads, rail lines, other visible rights-of-way, or in the absence these, at the coordinates specified by CZM. The coastal zone includes all of Cape Cod, Nantucket, Martha's Vineyard, and the Elizabeth Islands. As such, CZM jurisdiction over this Project extends to the entirety of the OECC within state waters, associated landfall sites, onshore routes, and substation. Applicable review procedures are set forth at 301 CMR 21.07 (see 301 CMR 21.04(2)).

The following section describes the Project's compliance with the program policies and management principles of Massachusetts' approved Coastal Zone Management Program Plan as set forth in the policy appendix at 301 CMR 21.98.

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[6] For nonwater-dependent projects, the Secretary is required to consider the following criteria: the purpose and effect of the project; the impact on abutters and the surrounding community; enhancement to the property; benefits to the public trust rights in tidelands or other associated rights, including but not limited to benefits provided through previously obtained municipal permits; community activities on the site; environmental protection and preservation; and public health and safety, and the general welfare.

6.4.7.2 Consistency with MCZM Program Policies

The following sections list each of the Program Policies and Management Principles contained in the Coastal Zone Management Plan and describe how the Vineyard Wind Connector 2 is consistent.

Coastal Hazards

<u>Coastal Hazard Policy #1</u>

Preserve, protect, restore, and enhance the beneficial functions of storm damage prevention and flood control provided by natural coastal landforms, such as dunes, beaches, barrier beaches, coastal banks, land subject to coastal storm flowage, salt marshes, and land under the ocean.

The coastal wetland resource areas located in the Project Area are generally not degraded and provide the beneficial functions that are protected interests of the WPA. Through careful route selection and proper use of construction techniques, the Project is designed to avoid potential wetlands impacts to the maximum extent practicable, and to minimize and mitigate for unavoidable impacts. Sections 4.0 and 5.0 contain more detailed discussions regarding route selection.

At the preferred or variant landfall sites (Craigville Public Beach or Covell's Beach, respectively), HDD is proposed to accomplish the offshore-to-onshore transition. This will avoid impacts to the most sensitive resource areas along and near the shoreline.

As described in Section 5.2.1, the onshore routes will require some work within wetland resource areas, principally LSCSF. No above-ground structures or changes to topography are proposed within LSCSF and the Project will have no effect on flood velocities or floodplain storage capacity, and therefore no permanent impact to LSCSF is anticipated.

While some work in the paved parking lots of either landfall site may be located within 100 feet of Coastal Dune, the Project will have no impacts to Coastal Dune itself except perhaps a very narrow strip of dune located between the paved Craigville Beach parking lot and Craigville Beach Road; the duct bank route may need to cross through this narrow strip, in which case the dune would be fully restored. Similarly, the Project will have no direct impacts to Coastal Beach, with the only impacts to the barrier beach system being within paved roadways. In addition, the Project will cross the Centerville River; while the bridge superstructure replacement would have some direct impacts, the trenchless crossing alternatives would avoid any direct impacts to the river or salt marsh (see Section 5.2.1.1).

Project activities along the OECC in Land Under the Ocean will not alter bathymetry in a way that would result in any significant changes to hydrodynamics. Section 4.6.3 contains additional wetlands-related details related to the OECC.

Coastal Hazard Policy #2

Ensure construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. Flood or erosion control projects must demonstrate no significant adverse effects on the project site or adjacent or downcoast areas.

The Project will not adversely interfere with water circulation or sediment transport, since it will not significantly alter the morphology or composition of the seafloor or coastal wetland resource areas. Any dredging performed for the Project will be discontinuous and limited to the tops of sand wave features where it may be necessary to remove material to achieve sufficient cable burial within the stable seabed. These existing sand waves are in high-energy areas where morphological changes occur constantly; therefore, any bathymetric changes due to dredging are expected to be temporary.

Coastal Hazard Policy #3

Ensure that state and federally funded public works projects proposed for locations within the coastal zone will: (1) not exacerbate existing hazards or damage natural buffers or other natural resources; (2) be reasonably safe from flood and erosion related damage; (3) not promote growth and development in hazard-prone or buffer areas, especially in velocity zones and Areas of Critical Environmental Concern; and (4) not be used on Coastal Barrier Resource Units for new or substantial reconstruction of structures in a manner inconsistent with the Coastal Barrier Resource/Improvements Acts.

The Project is not a state or federally funded public works project; therefore, this policy does not apply.

Coastal Hazard Policy #4

Prioritize public funds for acquisition of hazardous coastal areas for conservation or recreation use, and relocation of structures out of coastal high hazard areas, giving due consideration to the effects of coastal hazards at the location to the use and manageability of the area.

The Project does not involve public funds, and therefore this policy does not apply. Nevertheless, the Project does not propose any above-ground structures in state jurisdiction that will be subject to hazardous coastal conditions, since the proposed cable will be installed beneath the seafloor and underground. The Company has evaluated shoreline change rates at the landfall sites, and the Project's upland underground infrastructure will be located a sufficient distance landward to avoid risks from coastal erosion (see Section 5.2.5 for a discussion of climate change resiliency and sustainability).

Energy

Energy Policy #1

For coastally dependent energy facilities, consider siting in alternative coastal locations. For non-coastally dependent energy facilities, consider siting in areas outside of the coastal zone. Weigh the environmental and safety impacts of locating proposed energy facilities at alternative sites.

Large-scale offshore wind energy generation, and the transmission of that energy to shore, is by nature a coastally dependent energy facility. The Project is coastally dependent, since it is necessary to bring the energy generated offshore to an interconnection point onshore. In its analysis of routing alternatives, the Company considered numerous potential landfall sites and offshore routes for the Project before selecting the proposed OECC. The routing analysis is described in detail in Section 4.0.

Energy Policy #2

Encourage energy conservation and the use of alternative sources such as solar and wind power in order to assist in meeting the energy needs of the Commonwealth.

Consistent with the mandate provided by the *An Act to Promote Energy Diversity*, the Project will deliver approximately 800 MW of clean, renewable wind energy to the New England electric grid, interconnecting in Barnstable. The Project is therefore consistent with this policy.

Growth Management

Growth Management Policy #1

Encourage sustainable development that is consistent with state, regional, and local plans and supports the quality and character of the community.

As described above, the Project is a sustainable development of renewable energy, and is consistent with state policies such as the GWSA and the Restructuring Act. The Company's wind energy generation facility will be located approximately 23 miles south of Martha's Vineyard and approximately 25 miles south of Nantucket in federal waters. An assessment of the Project's visual impact is provided in Section 5.3.5. The offshore cables and infrastructure at the landfall site will be below-grade except for at-grade manhole covers, and hence will not alter local community character. Additionally, the Project's proposed substation is being designed to minimize visual impacts (see Section 1.3.4).

Growth Management Principle #2

Ensure that state and federally funded infrastructure projects in the coastal zone primarily serve existing developed areas, assigning highest priority to projects that meet the needs of urban and community development centers.

The Project involves private development of wind energy generation; therefore, this principle does not apply.

<u>Growth Management Principle #3</u>

Encourage the revitalization and enhancement of existing development centers in the coastal zone through technical assistance and federal and state financial support for residential, commercial and industrial development.

This is a privately financed Project that will supply the New England electrical grid with approximately 800 MW of clean, renewable wind energy, thus improving the reliability of the New England's energy mix. The Project will use regional port facilities for staging as well as vessel docking, transit, and support, thus generating local employment.

Habitat

<u>Habitat Policy #1</u>

Protect coastal, estuarine, and marine habitats – including salt marshes, shellfish beds, submerged aquatic vegetation, dunes, beaches, barrier beaches, banks, salt ponds, eelgrass beds, tidal flats, rocky shores, bays, sounds, and other ocean habitats – and coastal freshwater streams, ponds, and wetlands to preserve critical wildlife habitat and other important functions and services including nutrient and sediment attenuation, wave and storm damage protection, and landform movement and processes.

The Project is designed to avoid impacts to coastal habitats and wetland resource areas to the maximum extent practicable and to minimize and mitigate unavoidable impacts in accordance with applicable federal, state, and local regulations. By complying with performance standards identified in the Massachusetts WPA, the Project will serve the protected interests identified in the statute.

Wetlands impacts along the onshore routes will largely be limited to LSCSF, RFA, and paved areas within the large barrier beach system; only Variant 2 of the Noticed Alternative Route may affect BVW, but HDD would likely be used to avoid any impact (see Table 5-1). The transmission route from the landfall site to the proposed substation site will cross the Centerville River; as described in Section 5.2.1.1, the bridge superstructure replacement option would have some direct impacts within the river, but the trenchless crossing options would avoid any direct impacts to the river. Impacts to Land Under the Ocean and compliance with Performance Standards of the WPA are discussed in Section 4.6.3.1.5.

No above-ground structures or changes to topography are proposed within LSCSF. The Project will have no effect on flood velocities or floodplain storage capacity, and therefore no permanent impacts to LSCSF or RFA are anticipated.

No eelgrass beds will be impacted by the Project (see Section 6.4.5.4).

As described in Section 4.6, the OECC is located entirely within Land Under the Ocean and has been evaluated according to numerous factors including technical feasibility and environmental considerations, such as the presence of hard bottom habitat, mapped shellfish suitability areas, and the amount of sand wave dredging required. The OECC crosses some areas of mapped hard bottom and shellfish suitability areas, but the route has been selected as the most technically viable route that also avoids and minimizes impacts to resources (see Section 4.6.3.1). The Project has sought to avoid impacts to these areas to the greatest extent feasible and will include post-construction benthic monitoring to evaluate impacts and recovery.

<u>Habitat Policy #2</u>

Advance the restoration of degraded or former habitats in coastal and marine areas.

As described in Sections 4.6 and 5.2.1, the Project is designed to avoid impacts to wetland resource areas to the maximum extent practicable and to minimize and mitigate unavoidable impacts in accordance with applicable federal, state, and local regulations. Through careful route selection and the use of the most appropriate installation techniques, the Project will not permanently degrade any wetland resource areas.

Ocean Resources

<u>Ocean Resources Policy #1</u>

Support the development of sustainable aquaculture, both for commercial and enhancement (public shellfish stocking) purposes. Ensure that the review process regulating aquaculture facility sites (and access routes to those areas) protects significant ecological resources (salt marshes, dunes, beaches, barrier beaches, and salt ponds) and minimizes adverse effects on the coastal and marine environment and other water-dependent uses.

The Project is not an aquaculture project; therefore, this policy does not apply.

<u>Ocean Resources Policy #2</u>

Except where such activity is prohibited by the Ocean Sanctuaries Act, the Massachusetts Ocean Management Plan, or other applicable provision of law, the extraction of oil, natural gas, or marine minerals (other than sand and gravel) in or affecting the coastal zone must protect marine resources, marine water quality, fisheries, and navigational, recreational and other uses.

The Project does not involve extracting oil, natural gas, or marine minerals; therefore, this policy does not apply.

Ocean Resources Policy #3

Accommodate offshore sand and gravel extraction needs in areas and in ways that will not adversely affect marine resources, navigation, or shoreline areas due to alteration of wave direction and dynamics. Extraction of sand and gravel, when and where permitted, will be primarily for the purpose of beach nourishment or shoreline stabilization.

The Project does not involve offshore mining or beach nourishment; therefore, this policy does not apply.

Port and Harbors

Ports and Harbors Policy #1

Ensure that dredging and disposal of dredged material minimize adverse effects on water quality, physical processes, marine productivity and public health and take full advantage of opportunities for beneficial re-use.

The Project does involve some dredging within the OECC to ensure sufficient burial depth in areas of the seafloor affected by sand waves. Due to the coarse-grained nature of surficial sediments within the OECC, any Project-generated turbidity related to cable installation or the transition via HDD is expected to be temporary and limited in spatial scope. Dredged sediments are expected to be disposed of within similar sand wave areas of the surveyed OECC.

Ports and Harbors Policy #2

Obtain the widest possible public benefit from channel dredging and ensure that Designated Port Areas and developed harbors are given highest priority in the allocation of resources.

The Project does not involve the dredging any navigation channels or Designated Port Areas (DPAs); therefore, this policy does not apply. However, although the Project itself is not located in a DPA, the Proponent may utilize a number of port facilities, some of which are located within DPAs. Port facilities that may be used for the Vineyard Wind Connector 2/Park City Wind are discussed in Section 1.7.

Ports and Harbors Policy #3

Preserve and enhance the capacity of Designated Port Areas to accommodate water-dependent industrial uses and prevent the exclusion of such uses from tidelands and any other DPA lands over which an EEA agency exerts control by virtue of ownership or other legal authority.

Although this water-dependent Project itself is not located within a DPA, it may utilize a number of port facilities, some of which are located within DPAs. Port facilities that may be used for the Vineyard Wind Connector 2/Park City Wind are discussed in Section 1.7.

Ports and Harbors Policy #4

For development on tidelands and other coastal waterways, preserve and enhance the immediate waterfront for vessel-related activities that require sufficient space and suitable facilities along the water's edge for operational purposes.

The Project will have no impact on the availability of the waterfront for vessel-related activities except for brief periods during construction.

Ports and Harbors Policy #5

Encourage, through technical and financial assistance, expansion of water-dependent uses in Designated Port Areas and developed harbors, re-development of urban waterfronts, and expansion of physical and visual access.

This Project is not located in a DPA, developed harbor, or urban waterfront; therefore, this principle does not apply. However, although the Project itself is not located within a DPA, it may utilize a number of port facilities, some of which are located within DPAs. Port facilities that may be used for the Vineyard Wind Connector 2/Park City Wind are discussed in Section 1.7.

Protected Areas

Protected Areas Policy #1

Preserve, restore, and enhance coastal Areas of Critical Environmental Concern, which are complexes of natural and cultural resources of regional or statewide significance.

The Project is not located within or in the immediate vicinity of any ACECs, will therefore not have any adverse impacts on ACECs, and thus complies with this policy.

Protected Areas Policy #2

Protect state designated scenic rivers in the coastal zone.

The Project is not located in or near any state designated scenic rivers; therefore, this policy does not apply.

Protected Areas Policy #3

Ensure that proposed developments in or near designated or registered historic places respect the preservation intent of the designation and that potential adverse effects are minimized.

Construction and operation of the onshore portions of the Project will not affect any historic buildings or structures (see Figures 5-13 and 5-14). No historic buildings or structures identified along any of the onshore routes will be altered by proposed underground duct bank construction. Potential effects, if any, to archaeological resources will be addressed with the MHC, as applicable, through Section 106 and the State Register Review processes. BOEM is the lead federal agency for the Section 106 process, which will also include a visual impact assessment associated with the 501 South development activities in federal waters.

No previously identified archaeological resources are located within the OECC, as described in Section 4.6.3.5. Marine archaeological surveys have not identified any shipwrecks or aircraft debris along the OECC.

Public Access

Public Access Policy #1

Ensure that development (both water-dependent or nonwater-dependent) of coastal sites subject to state waterways regulation will promote general public use and enjoyment of the water's edge, to an extent commensurate with the Commonwealth's interests in flowed and filled tidelands under the Public Trust Doctrine.

The Project does not involve development of coastal sites, and will only use coastal sites for HDD landfall sites. Construction will occur off-season, and the underground infrastructure proposed at the landfall site will not alter the public's use or enjoyment of the area.

Public Access Policy #2

Improve public access to existing coastal recreation facilities and alleviate auto traffic and parking problems through improvements in public transportation and trail links (land- or water-based) to other nearby facilities. Increase capacity of existing recreation areas by facilitating multiple use and by improving management, maintenance, and public support facilities. Ensure that the adverse impacts of developments proposed near existing public access and recreation sites are minimized.

This Project does not involve any coastal recreation facilities, nor will it affect transportation; therefore, this principle does not apply.

Public Access Management Principle #3

Expand existing recreation facilities and acquire and develop new public areas for coastal recreational activities, giving highest priority to regions of high need or limited site availability. Provide technical assistance to developers of both public and private recreation facilities and sites that increase public access to the shoreline to ensure that both transportation access and the recreation facilities are compatible with social and environmental characteristics of surrounding communities.

This Project does not involve any recreation facilities; therefore, this principle does not apply.

Water Quality

Water Quality Policy #1

Ensure that point-source discharges and withdrawals in or affecting the coastal zone do not compromise water quality standards and protect designated uses and other interests.

The Project does not propose any new point-source discharges. Limited withdrawals during construction may include water for offshore cable installation (if jet-plow is used) and bilge/ballast water. These modest and temporary water withdrawals are not anticipated to have any meaningful impact on water quality.

Water Quality Policy #2

Ensure the implementation of nonpoint source pollution controls to promote the attainment of water quality standards and protect designated uses and other interests.

The Project will not alter existing stormwater volumes or drainage patterns and will not result in any new non-point source pollution. Construction-period sedimentation and erosion controls described in Section 5.4.7 are included in the Project design and construction practices. Since the Project will disturb more than one acre of land, a NPDES General Permit for Stormwater will be obtained.

Water Quality Policy #3

Ensure that subsurface waste discharges conform to applicable standards, including the siting, construction, and maintenance requirements for on-site wastewater disposal systems, water quality standards, established Total Maximum Daily Load limits, and prohibitions on facilities in high-hazard areas.

The Project does not propose any subsurface waste discharges; therefore, this policy is not applicable.

6.4.7.3 Conclusion

As described herein, the Vineyard Wind Connector 2 complies with the enforceable policies of Massachusetts' approved Coastal Zone Management Plan and will be conducted in a manner consistent with such policies.

6.5 Resource Use and Development Policies

The Project, which will supply the New England electrical grid with approximately 800 MW of clean, renewable energy, will be constructed and operated in compliance with Massachusetts' policies regarding resource use and development.

As embodied in Section 83C of *Green Communities Act* (Chapter 169 of the Acts of 2008), as amended by Chapter 188 of the Acts of 2016, *An Act to Promote Energy Diversity*, the Commonwealth has adopted a policy favoring the development of offshore wind generation. The Project is consistent with that policy.

As a further example of the Project's consistency with the Commonwealth's resource use and development policies, in 2007 the EEA's Smart Growth/Smart Energy policy established the Commonwealth's Sustainable Development Principles, including: (1) supporting the revitalization of city centers and neighborhoods by promoting development that is compact, conserves land, protects historic resources and integrates uses; (2) encouraging remediation and reuse of existing sites, structures and infrastructure rather than new construction in undeveloped areas; (3) protecting environmentally sensitive lands, natural resources, critical habitats, wetlands and water resources and cultural and historic landscapes; (4) increase job and business opportunities; (5) promote clean energy; and (6) implement regional solutions. As described more fully in Section 5.0, the Project will support these principles because, among other reasons, the onshore portion of the Project will be located primarily within existing roadways, thus utilizing previously-disturbed lands; where the onshore cables will not be located within existing roadways, they are proposed along existing transmission ROWs, thus minimizing clearing necessary to accommodate the proposed infrastructure. The Project has also been designed to minimize impacts to sensitive lands (see Sections 4.0 and 5.0), and it will bring approximately 800 MW of clean energy to New England as part of a regional solution for achieving GHG emission reduction goals while creating job and business opportunities. The Project, therefore, is in compliance with, and furthers, the Commonwealth's policies regarding resource use and development.