

Draft
New England Wind
Construction and Operations Plan
for Lease Area OCS-A 0534

Volume I
Appendices

Submitted to:

Bureau of Ocean Energy Management
45600 Woodland Road
Sterling, Virginia 20166

Prepared by:

Epsilon Associates, Inc.
3 Mill & Main Place
Maynard, Massachusetts 01754

October 29, 2021

Epsilon
ASSOCIATES INC.

Draft New England Wind Construction and Operations Plan for Lease Area OCS-A 0534

Volume I Appendices

Submitted to:

BUREAU OF OCEAN ENERGY MANAGEMENT
45600 Woodland Rd
Sterling, VA 20166

Prepared by:



3 Mill & Main Place, Suite 250
Maynard, MA 01754

In Association with:

Baird & Associates	JASCO Applied Sciences
Biodiversity Research Institute	Public Archaeology Laboratory, Inc.
Capitol Air Space Group	RPS
Geo SubSea LLC	Saratoga Associates
Geraldine Edens, P.A.	SEARCH, Inc.
Gray & Pape	Wood Thilsted Partners Ltd

October 29, 2021

Appendix I-G

Vineyard Wind 1 Offshore Export Cable Corridor Routing Analysis

Vineyard Wind 1 Offshore Export Cable Corridor Routing Analysis

Prepared by:

Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, MA 01754

October 2021

APPENDIX I-G VINEYARD WIND 1 OFFSHORE EXPORT CABLE CORRIDOR ROUTING ANALYSIS

Based upon careful consideration of multiple technical, environmental, and commercial factors, the New England Wind Offshore Export Cable Corridor (OECC) is largely the same OECC included in the Vineyard Wind 1 Construction and Operations Plan (COP) that was approved by the Bureau of Ocean Energy Management (BOEM). Using substantially the same OECC for New England Wind as Vineyard Wind 1 provides an efficient, consolidated route from the Southern Wind Development Area (SWDA) to the grid interconnection point at Eversource's 345 kV West Barnstable Substation that minimizes environmental, operational, and commercial impacts relative to longer alternative routes.

The OECC for Vineyard Wind 1 was developed through thorough routing analyses and refined significantly through extensive geophysical and geotechnical surveys as well as environmental sampling. A large amount of survey data was gathered to provide a strong understanding of the OECC in terms of potential environmental impact and construction feasibility. The following sections summarize the process by which potential routes were identified, evaluated, and refined to develop the Vineyard Wind 1 OECC.

1.0 Overview of Vineyard Wind 1 OECC Siting Process

The process of siting and refining the Vineyard Wind 1 OECC involved the following steps:

1. Identification of a Study Area for route selection;
2. Assessment of initial cable route concepts that would connect Lease Area OCS-A 0501 to possible grid interconnection points and elimination of options on the basis of excessive length;
3. Analysis of grid interconnection points within a feasible distance from Lease Area OCS-A 0501 based on capacity, reliability, and cost;
4. Assessment of potential landfall sites within proximity to the selected grid interconnection point based on environmental impact, constructability, and permitting considerations;
5. Identification and refinement of an OECC to connect Lease Area OCS-A 0501 to the potential landfall sites.

2.0 Grid Interconnection Points and Initial Cable Route Concepts

To ensure that all reasonable routing options were considered, a Study Area was delineated that encompassed all of southeastern Massachusetts as well as eastern Rhode Island. In selecting cable routes, considerations focused on:

- ◆ Locations of possible grid interconnection points to the ISO New England electric grid;
- ◆ Existing transmission infrastructure and its capacity for accommodating the 800 megawatt (MW) Vineyard Wind 1 project; and
- ◆ Existing offshore cables.

Within this Study Area, a wide range of initial cable route concepts connecting the Vineyard Wind 1 Wind Development Area (WDA) to suitable grid interconnection points were identified, including potential routing options through Narragansett Bay, Buzzards Bay, Nantucket Sound, and Cape Cod Bay to numerous landfall sites ranging from municipal beach parking lots to unimproved ways and other developed and undeveloped areas (see Figure 2-1).¹ The initial cable route concepts also encompassed possible interconnections at several substations located in southeastern Massachusetts as well as Rhode Island. The universe of routing options considered and their distance from the Vineyard Wind 1 WDA to possible grid interconnection points are presented in the table below. The various initial cable route concepts ranged from approximately 56 to 219 kilometers (km) (35 to 136 miles [mi]) in length.

Table 2-1 Universe of Initial Cable Route Concepts for Vineyard Wind 1

Route #	Grid Interconnection Point	Approximate Export Cable Route Length					
		Offshore		Onshore		Total	
		km	miles	km	miles	km	miles
1	Kent County Substation (National Grid), Rhode Island	126	78	5	3	130	81
2	Brayton Point	106	66	<1.6	<1	108	67
3	Pine Street Substation, New Bedford	100	62	<1.6	<1	101	63
4	Canal Station, via Cape Cod Canal	124	77	<1.6	<1	126	78
5	Canal Station, via onshore	114	71	11	7	126	78
6	Falmouth Tap Switching Station, via Buzzards Bay	93	58	6	4	100	62
7	Bourne Substation, via Buzzards Bay	105	65	16	10	121	75
8	Falmouth Substation, via south coast of Cape Cod	53	33	3	2	56	35
9	Mashpee Substation, via south coast of Cape Cod	50	31	23	14	72	45
10	Barnstable (West Barnstable Substation or Barnstable Switching Station)	66	41	10	6	76	47

¹ The figures included in Appendix I-G are from assessments for the Vineyard Wind 1 project that occurred prior to the segregation of Lease Area OCS-A 0501 into Lease Areas OCS-A 0534 and OCS-A 0501. Therefore, the figures show the original Lease Area OCS-A 0501, which encompasses both Lease Areas OCS-A 0534 and OCS-A 0501.

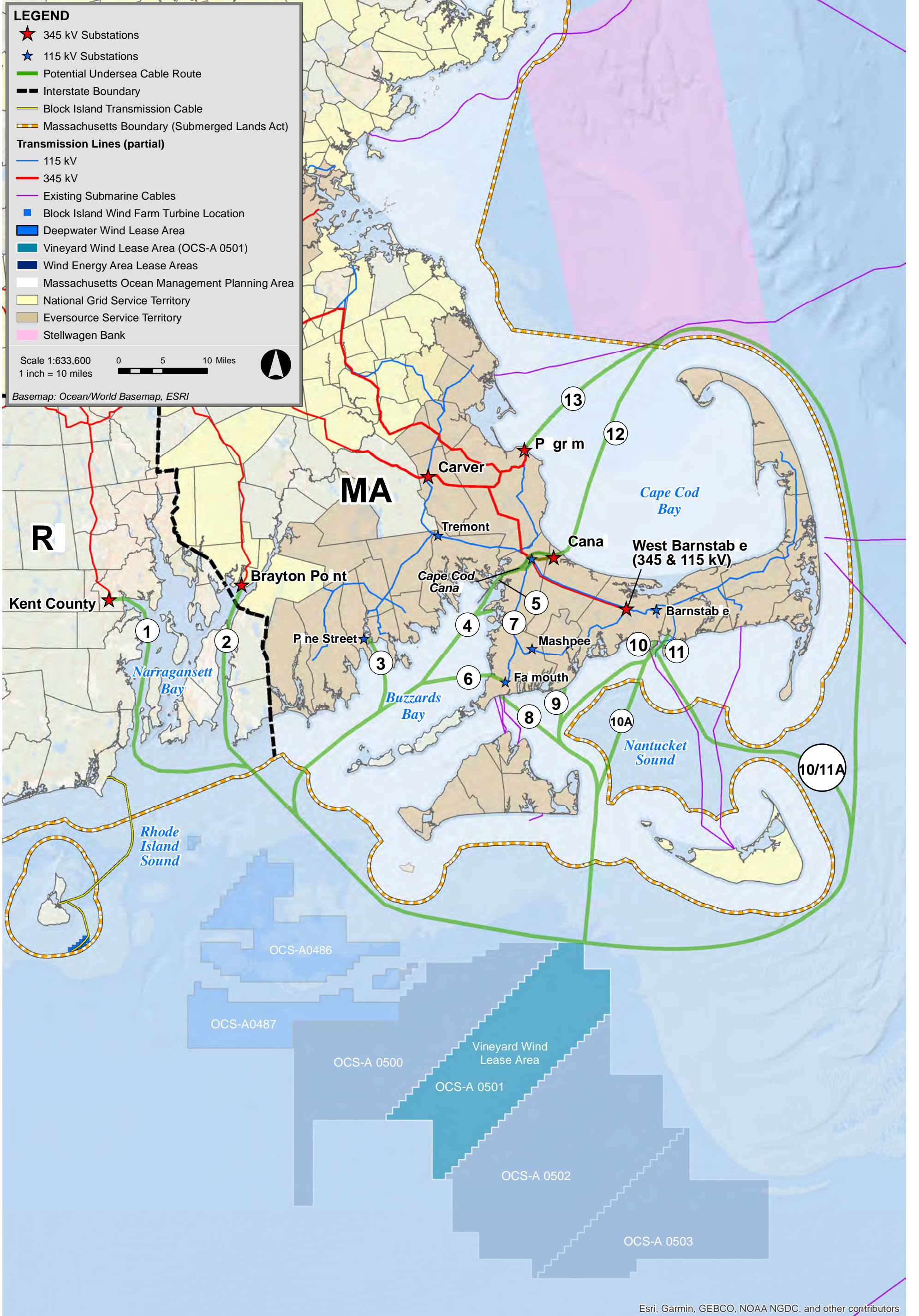
Table 2-1 Universe of Initial Cable Route Concepts for Vineyard Wind 1 (Continued)

Route #	Grid Interconnection Point	Approximate Export Cable Route Length					
		Offshore		Onshore		Total	
		km	miles	km	miles	km	miles
11	Barnstable (West Barnstable Substation or Barnstable Switching Station), via Yarmouth Landfall Site	69	43	10	6	79	49
10/11 A	Barnstable, via east end of Nantucket to Yarmouth	101	63	10	6	111	69
12	Canal Station, via ocean route	217	135	<1.6	<1	219	136
13	Pilgrim Station, via ocean route	204	127	<1.6	<1	206	128

The first step in screening the initial cable route concepts was to eliminate routes with excessive length. Approximately 100 km (62 miles) was defined as the maximum distance that Vineyard Wind 1’s 220 kV high voltage alternating current (HVAC) cables could be laid without requiring mid-point reactive compensation and special switching devices,² which would impose significant additional costs and could make the Vineyard Wind 1 project uncompetitive on a cost basis. This eliminated 10 routes, which are highlighted in gray in the table above, and identified four possible grid interconnection points:

- ◆ **Falmouth Substation:** The Falmouth Substation could likely accommodate only up to approximately 360 MW without significant upgrades to the transmission system. Since the Falmouth substation would require significant transmission system reinforcements to accommodate the full 800 MW capacity of Vineyard Wind 1, potentially including a new transmission line to one of the substations in the Bourne area, this potential grid interconnection point was eliminated from further consideration.
- ◆ **Mashpee Substation:** Similarly, the Mashpee Substation was eliminated because it would require significant transmission system reinforcements to support an 800 MW connection, including adding another transmission circuit to West Barnstable (more than 24 km [15 miles] to northeast).
- ◆ **West Barnstable Substation:** While the West Barnstable substation could accommodate an 800 MW project, interconnection into this substation at either 115 kV or 345 kV would require potential system upgrades and substation modifications. A 115 kV

² For Vineyard Wind 1, 100 km (62 miles) was used as a preliminary screening tool. The actual maximum distance is not a definitive value, as it depends on the precise technology used (e.g. 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.



Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

interconnection at West Barnstable would require additional bus work, and a 345 kV interconnection at West Barnstable would require a new four-breaker ring bus and transformer additions/modifications. Therefore, although the West Barnstable Substation could be considered a potential interconnection point for Vineyard Wind 1, it is considered less suitable than the Barnstable Switching Station for interconnection of the Vineyard Wind 1 project.

- ◆ **Barnstable Switching Station:** The Barnstable Switching Station was determined to be the most feasible interconnection point for Vineyard Wind 1 for several reasons. It has the capacity to accommodate the full 800 MW with a 115 kV interconnect. This 115 kV switching station connects a number of 115 kV lines which supply power to the middle and eastern portions of the Cape. Three 115 kV lines from Barnstable Switch run to the west and connect with other major elements of the Eversource transmission system at the recently-constructed West Barnstable 345/115 kV Substation. In addition, Barnstable Switching Station has two spare bays that could accommodate the Vineyard Wind 1 interconnection without any significant infrastructure work.

Thus, the Barnstable Switching Station was selected as the grid interconnection point for Vineyard Wind 1.

3.0 Identification of Potential Landfall Sites

Having selected the Barnstable Switching Station as the most favorable grid interconnection point for Vineyard Wind 1, potential landfall sites (where the transition from offshore cabling to onshore cabling could occur) were examined. The criteria used to identify potential landfall sites for Vineyard Wind 1 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);
- ◆ Potential for direct access to offshore allowing for an open trench cofferdam transition, possibly eliminating a need for horizontal directional drilling (HDD) or minimizing length and time to execute landfall;
- ◆ Clear egress onto a road of sufficient width to accommodate the duct bank;
- ◆ Enough space to accommodate the HDD entry pit and drilling equipment associated with HDD, should that methodology be selected over open trench;
- ◆ In the case of residential surrounding land uses, a preference for seasonal use, rather than year-round, to avoid and minimize construction-period impacts to the public;
- ◆ Environmental considerations such as wetland resource areas and mapped eelgrass habitat; and

◆ Onshore route length.

Initially, approximately 50 possible landfall sites were identified along the south coast of Cape Cod and on the east coast of Buzzards Bay (see Figure 3-1). These initial landfall sites were first reviewed in the context of cable length limitations and proximity to the selected grid interconnection point. As a result of this analysis, most of the initial landfall sites were eliminated from further consideration, focusing the next step of analysis on potential landfall sites in the southern stretch of the Cape Cod coast from Mashpee to Yarmouth.

To avoid congested areas, eight landfall sites along the stretch of the south coast of Cape Cod from Mashpee to Yarmouth were considered (see Figure 3-2):

- Keys Beach, Barnstable
- Bay View Beach, Yarmouth
- South Cape Beach, Mashpee
- Baxter Avenue, Yarmouth
- Seagull Beach, Yarmouth
- Great Island, Yarmouth
- New Hampshire Avenue, Yarmouth
- Covell's Beach, Barnstable

Meetings were held with local officials in the Towns of Mashpee, Barnstable, Yarmouth, and Falmouth to discuss potential landfall sites and likely onshore routes. As a result of these discussions and reviews, two potential landfall sites and associated routes were eliminated from further consideration (Keys Beach and Bay View Beach).

The closest landfall site to the Vineyard Wind 1 WDA, South Cape Beach, was eliminated because it would require a lengthy onshore cable route of approximately 29 km (18 mi) to the Barnstable Switching Station by way of Great Neck Road and a utility right-of-way (ROW). Much of the ROW has not been maintained to its full width, thus installation of the underground cables would likely necessitate a large amount of land clearing. The ROW also passes through some relatively dense residential neighborhoods. The landfall site is also within the Waquoit Bay Area of Critical Environmental Concern (ACEC) and is a component of the Waquoit Bay National Estuarine Research Reserve, which is based in Falmouth and managed by the Massachusetts Department of Conservation and Recreation and the National Oceanic and Atmospheric Administration (NOAA).

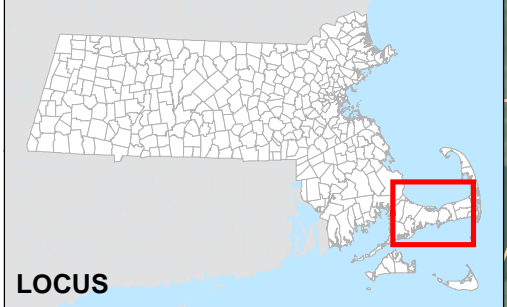


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.



LOCUS



LEGEND

- Potential Landing Site: Promising
- Eversource Right-of-Way w/345 kV Line(s)
- Eversource Right-of-Way w/115 kV Line(s)
- Town Boundary

Scale 1:72,000 0 3,000 6,000 Feet
 1 inch = 6,000 feet

Basemap: World Imagery, ESRI

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

Vineyard Wind 1 Project



Figure 3-2
Vineyard Wind 1 Potential Landfall Sites

The Baxter Avenue landfall site was eliminated because there is insufficient workspace available for HDD operations without the use of one of two adjacent private properties. In addition, the route inland from this potential site would be along busy sections of Route 28 and Willow Street in Yarmouth.

Finally, Seagull Beach was eliminated because construction would be in close proximity to areas of salt marsh and bordering vegetated wetlands. The area is also mapped with a wide swath of eelgrass. Thus, potential environmental impacts associated with this site informed elimination for further consideration.

Through this process of elimination, three of the eight potential landfall sites were retained for the initial submission of the Vineyard Wind 1 COP (New Hampshire Avenue and Great Island in Yarmouth, and Covell's Beach in Barnstable). However, Great Island was subsequently eliminated because, although initially there were productive discussions with the landowner about potential use of this site, upon further investigation it was determined that certain property rights were not as understood based on early-stage research. In addition, the Mass Wildlife's Natural Heritage & Endangered Species Program expressed concern over potential use of the site due to the presence of possible nesting habitat for Piping Plover.

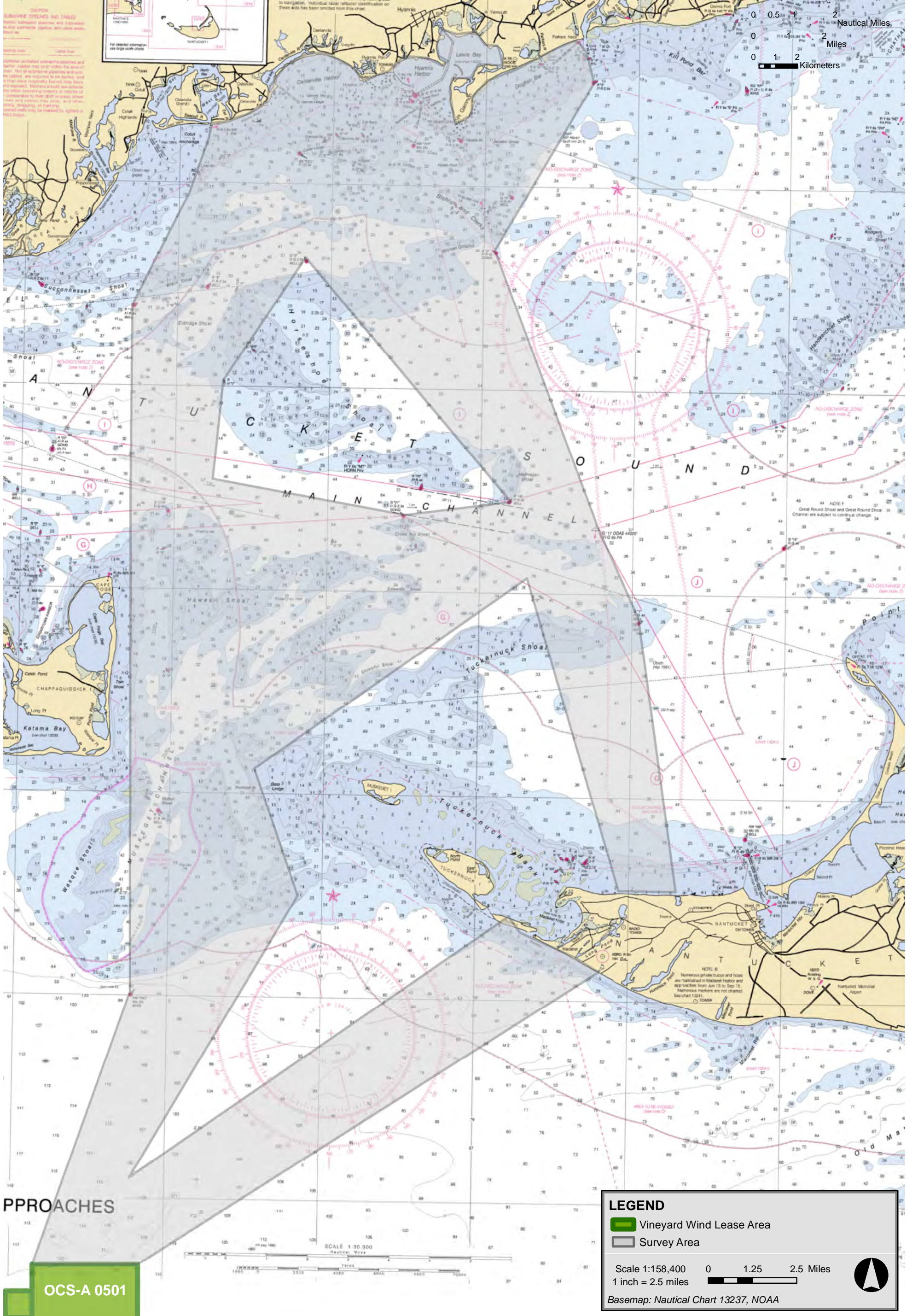
Thus, New Hampshire Avenue and Covell's Beach were selected as the viable landfall sites for Vineyard Wind 1.

4.0 Analysis of Potential Offshore Export Cable Corridors

Upon selecting the grid interconnection point and potential landfall sites for Vineyard Wind 1, the initial cable route concepts were developed into potential OECCs.

Potential OECCs were identified by considering a number of factors, including mapping of special, sensitive or unique (SSU) areas from the Massachusetts Ocean Management Plan (OMP), bathymetric data (water depths and slopes), the locations of navigation corridors, water currents, and mapped obstacles such as rock outcroppings and shipwrecks.

In 2017, building on the results of the desktop study, an initial geophysical survey was performed along more than 290 km (156.5 nautical miles [NM]) of potential offshore route segments to find a suitable route to link Lease Area OCS-A 0501 to the south shore of Cape Cod (see Figure 4-1). That same year, geotechnical surveys and environmental sampling (e.g. benthic grab samples and under water video) of the potential OECCs were performed. 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 (see Figure 4-2). A third potential corridor crossing the island of Nantucket was not advanced for further consideration.

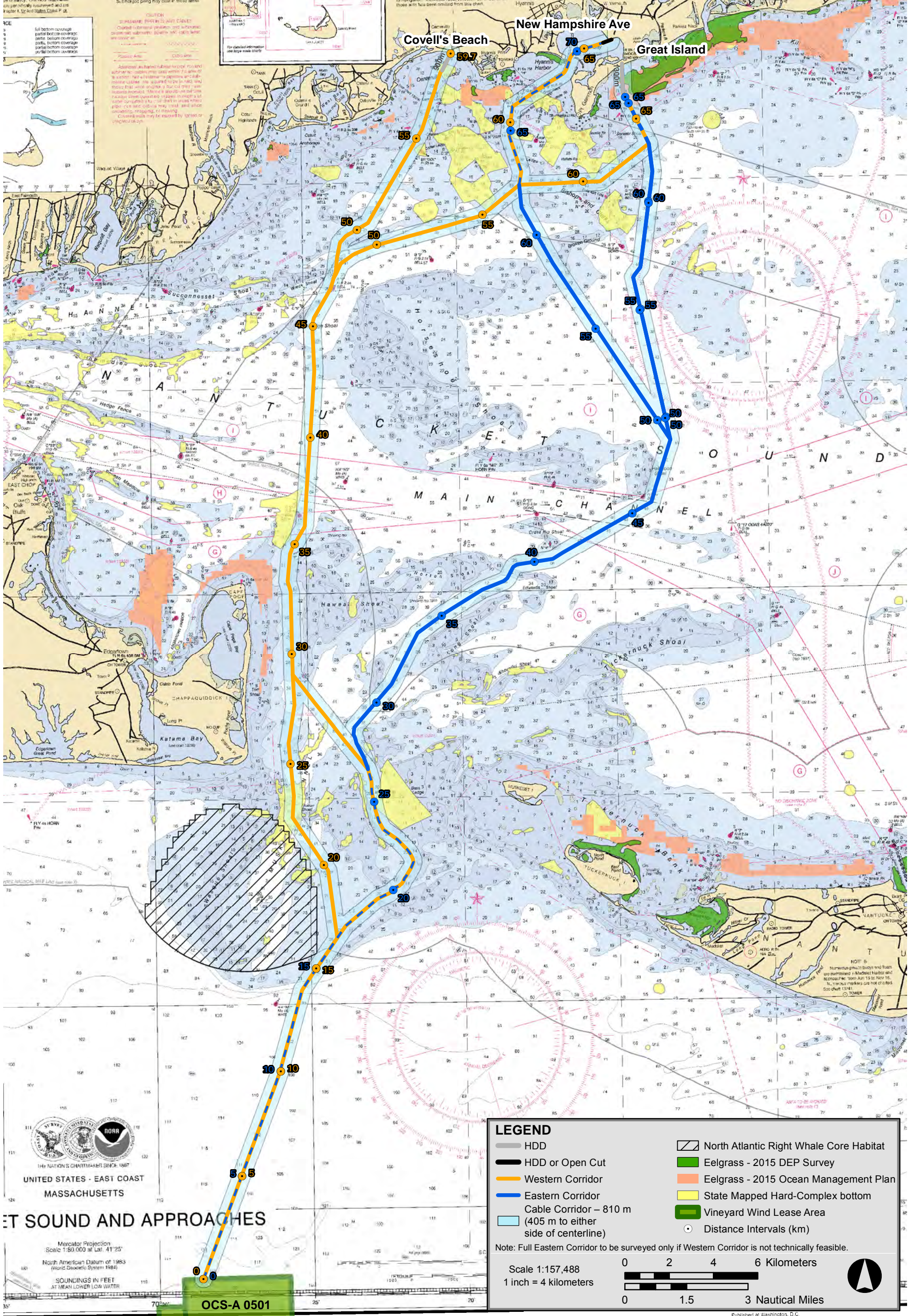


This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

Vineyard Wind 1 Project



Figure 4-1
Vineyard Wind 1 August 2017 Survey Area



As shown in Figure 4-1, a third potential Nantucket Offshore Export Cable Corridor was initially identified and surveyed. The Nantucket Offshore Export Cable Corridor extended northeastward from the Vineyard Wind 1 WDA, making landfall on the southwest corner of Nantucket at Madaket. This alternative would have crossed the island via underground duct bank beneath paved public roads, re-entered the water at Dionis Beach, and extended north toward the Cape Cod mainland. The landfall on the island's northern side would likely have been accomplished via HDD to avoid impacts to OMP-mapped eelgrass; the landfall methodology on the southern side was not selected before the route was eliminated. As the cables approached the Cape Cod mainland, the Nantucket Corridor provided options for reaching the New Hampshire Avenue Landfall Site or the discontinued Great Island Landfall Site. While the potential Nantucket Offshore Export Cable Corridor would have had some advantages, challenges included: (1) a longer export cable; (2) an onshore route across the island of Nantucket with two additional landfalls; and (3) a significantly greater HDD cost relative to the other OECCs that travel directly to the mainland. Together, these challenges meant that the Nantucket Export Cable Corridor would have added significantly to the Vineyard Wind 1 project's cost.

Both the Eastern OECC and Western OECC traveled north between Martha's Vineyard and Nantucket via Muskeget Channel to the east of mapped North Atlantic Right Whale Core Habitat (see Figure 4-2). In the Muskeget Channel area, the Eastern OECC avoided the scoured channel itself, passing to its east. The Eastern OECC then continued northward on the east side of Horseshoe Shoals to landfall sites at New Hampshire Avenue in Lewis Bay and Great Island.

The Western OECC included two possible variations through the Muskeget Channel area: the Western Option, which traveled through the channel itself, where water depths are greater but are accompanied by stronger currents, and the Eastern 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, the Western OECC included options for reaching landfall sites at Covell's Beach, New Hampshire Avenue, or Great Island.

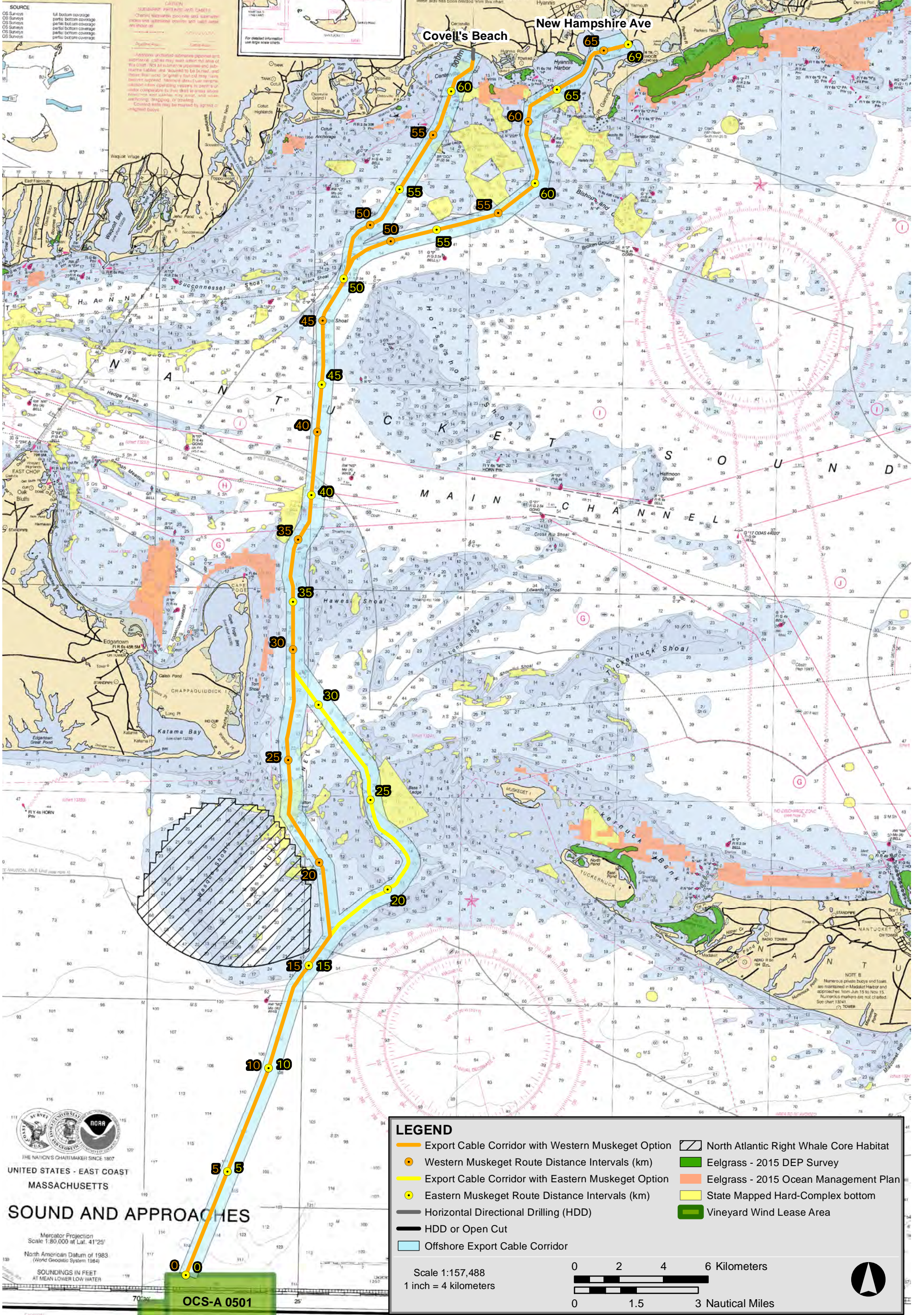
After extensive review and based on the results of additional geophysical and geotechnical surveys of the OECC in the spring of 2018, the Eastern OECC was eliminated from further consideration. The Western OECC was selected as the optimal route because it is technically suitable for cable installation, has several advantages over the Eastern OECC (e.g. the Western OECC is shorter, contains a smaller proportion of complex bottom, and has a lower frequency of sand waves above 2 m [6.6 ft] than the Eastern OECC), and otherwise avoids or minimizes potential environmental impacts. A shorter route allows for less impact area, fewer electrical line losses, and lower installation and operational costs. As more ferry traffic travels east from Lewis Bay, use of the Western OECC also minimizes potential impacts during construction to ferry traffic. The Great Island Landfall Site was also eliminated due to the presence of possible nesting habitat for Piping Plover, a relatively wide swath of eelgrass beds offshore, and property rights concerns.

Upon selection of the Western OECC, additional surveys were conducted. The 2018 marine surveys 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 in waters of sufficient depth. Surficial ground-truthing was provided by benthic grab samples and underwater video, and shallow subsurface confirmation of lithologies obtained via vibracores and cone penetration tests. In summary, the extensive 2018 survey effort in the OECC included more than 5,300 km (2,860 NM) of geophysical trackline data, 147 vibracores, 100 core penetration tests, 75 benthic grab samples with still photographs, and 44 underwater video transects. The focus of the investigations was the upper 2 to 3 m (6.5 to 9.8 ft) of seafloor sediments, where offshore export cable burial is planned.

By the conclusion of the 2018 surveys, the Western OECC was winnowed down to include two options through Muskeget Channel (the Western Option and an Eastern Option) as well as two potential Landfall Sites (Covell's Beach in Barnstable and New Hampshire Avenue in Yarmouth), as shown on Figure 4-3. In June 2020, the option to use the New Hampshire Avenue Landfall Site and the associated OECC variant were eliminated, avoiding potential short-term impacts to marine-dependent businesses in Lewis Bay and Hyannis Harbor. The Vineyard Wind 1 OECC included in the approved Vineyard Wind 1 COP is shown on Figure 4-4.

In summary, the extensive surveys and engineering analyses of potential OECCs conducted for Vineyard Wind 1 resulted in a thoroughly studied, vetted, and optimized OECC that connects Lease Area OCS-A 0501 to the south shore of Cape Cod.

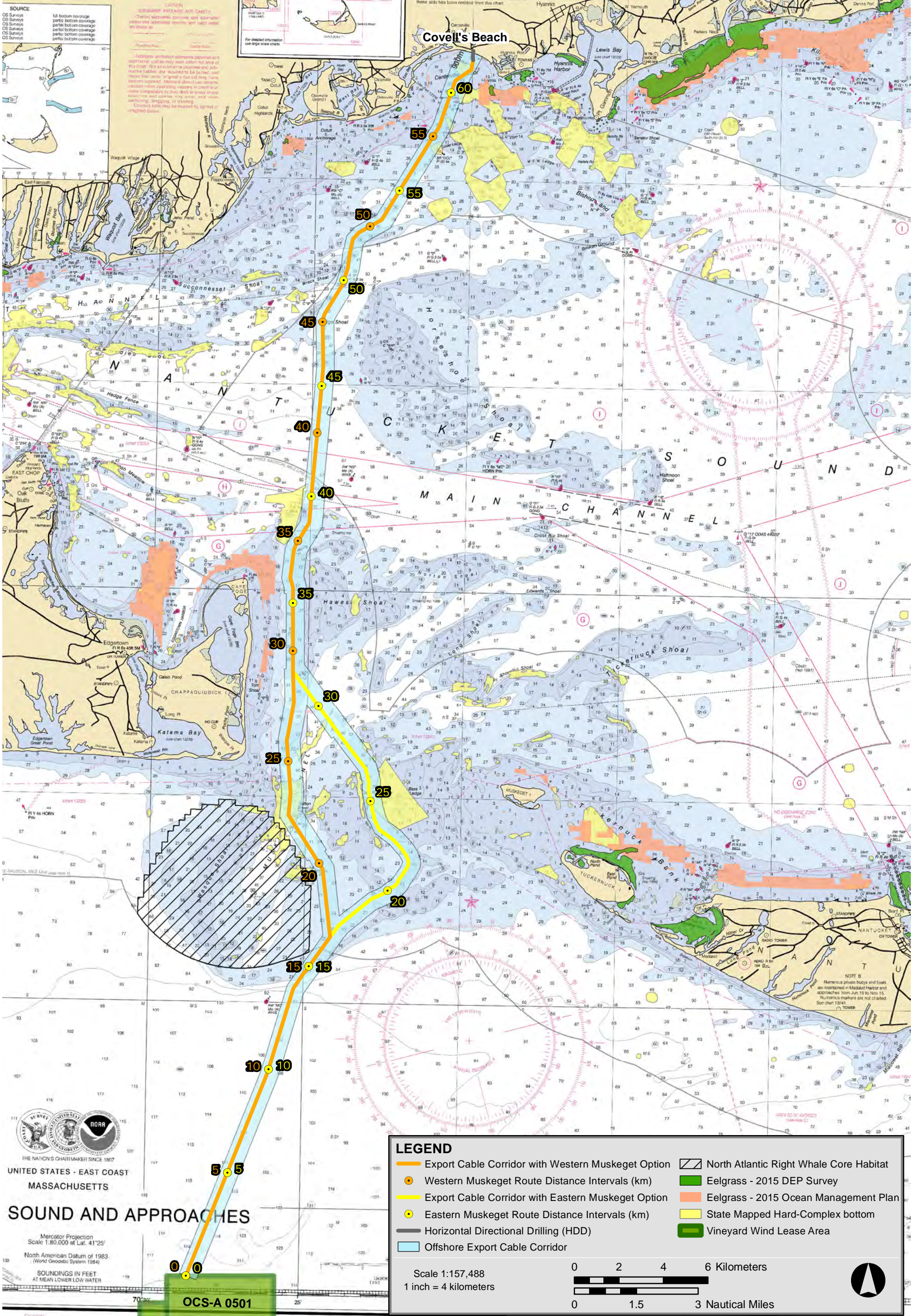


This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes. Map Projection: NAD83 UTM Zone 19

Vineyard Wind 1 Project



Figure 4-3
Vineyard Wind 1 Offshore Export Cable Corridor (October 2018)



SOURCE
 OS Surveys
 OS Surveys
 OS Surveys
 OS Surveys
 OS Surveys

Full bottom coverage
 partial bottom coverage
 partial bottom coverage
 partial bottom coverage
 partial bottom coverage

CAUTION
 SUBMERGED PILES AND CABLES
 Channel navigational profiles and surveys
 indicate the presence of piles and cables
 which may be present.

Submerged piles and cables are shown in red and yellow. Channel navigational profiles and surveys indicate the presence of piles and cables which may be present. Submerged piles and cables are shown in red and yellow. Channel navigational profiles and surveys indicate the presence of piles and cables which may be present.

THE NATIONAL CHARTING OFFICE
 UNITED STATES - EAST COAST
 MASSACHUSETTS

SOUND AND APPROACHES

Mercator Projection
 Scale 1:60,000 at Lat. 41°25'
 North American Datum of 1983
 (World Geodetic System 1984)

SOUNDINGS IN FEET
 AT MEAN LOWER LOW WATER

LEGEND

- Export Cable Corridor with Western Muskeget Option
- Export Cable Corridor with Eastern Muskeget Option
- Horizontal Directional Drilling (HDD)
- Offshore Export Cable Corridor
- North Atlantic Right Whale Core Habitat
- Eelgrass - 2015 DEP Survey
- Eelgrass - 2015 Ocean Management Plan
- State Mapped Hard-Complex bottom
- Vineyard Wind Lease Area

Scale 1:157,488
 1 inch = 4 kilometers

0 2 4 6 Kilometers
 0 1.5 3 Nautical Miles

This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes. Map Projection: NAD83 UTM Zone 19