June 2023

BEACON WIND PROJECT:
BEACON WIND 1 AND BEACON WIND 2

CONSTRUCTION AND OPERATIONS PLAN

VOLUME 1: PROJECT DESCRIPTION

Prepared for

Beacon Wind LLC

Submitted to

Bureau of Ocean Energy Management

Prepared by

AECOM

Photo credit: Andrew Saunders, Equinor

Executive Summary

Beacon Wind LLC (Beacon Wind) proposes to construct and operate an offshore wind facility located in the designated Renewable Energy Lease Area OCS-A 0520 (Lease Area). The Lease Area covers approximately 128,811 acres (ac; 52,128 hectares [ha]) and is located approximately 20 statute miles (mi) (17 nautical miles [nm], 32 kilometers [km])[1] south of Nantucket, Massachusetts and 60 mi (52 nm, 97 km) east of Montauk, New York. The Lease Area was awarded through the Bureau of Ocean Energy Management (BOEM) competitive renewable energy lease auction of the Wind Energy Area (WEA) offshore of Massachusetts.[2] An overview is shown in **Figure ES-1.** Beacon Wind is a joint venture owned by Equinor U.S. Holdings, Inc. and bp Wind Energy North America, Inc.

Beacon Wind proposes to develop the entire Lease Area in two wind farms, known as Beacon Wind 1 (BW1) and Beacon Wind 2 (BW2) (collectively referred to hereafter as the Project). The individual wind farms within the Lease Area will be electrically isolated and independent from the other via transmission systems that connect two separate offshore substations to two onshore Points of Interconnection (POIs). However, if BW1 and BW2 both interconnect with the New York Independent System Operator (NY ISO), the Project will assess the possibility of cable linkage between BW1 and BW2. Each wind farm will gather the power from the associated turbines to a central offshore substation and deliver the generated power via a submarine export cable to an onshore substation for final delivery into the local utility distribution system at the selected POI. The purpose of the Project is to generate renewable electricity from an offshore wind farm(s) located in the Lease Area. The Project addresses the need identified by northeast states to achieve offshore wind goals: New York (9,000 megawatts [MW]), Connecticut (2,000 MW), Rhode Island (up to 1,000 MW), and Massachusetts (5,600 MW).

BW1 will be developed first and constitutes the northern portion of the Lease Area. It covers approximately 56,535 ac (22,879 ha). The BW1 wind farm has a 25-year offtake agreement with the New York State Energy Research and Development Authority (NYSERDA) to deliver the power to its identified POI in Queens, New York.

BW2 spans the southern portion of the Lease Area and will be developed after BW1. It covers approximately 51,611 ac (20,886 ha). Beacon Wind is considering an Overlap Area of 20,665 ac (8,363 ha) that may be included in either wind farm. BW2 is being developed to addresses the need for renewable energy identified by states across the region, including New York, Massachusetts, Rhode Island, and Connecticut. The interconnectedness of the New England transmission system, managed by the New England ISO (ISO-NE), allows a single point of interconnection in the region to deliver offshore wind energy to all of the New England states (Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and Maine). The magnitude of regional targets for offshore

[1] Distances throughout the COP are provided as statute miles (mi) or nautical miles (nm) as appropriate, with kilometers (km) in parentheses. For reference, 1 mi equals approximately 0.87 nm or 1.6 km.

[2] On December 13-14, 2018, BOEM held a competitive lease sale (i.e., auction) for Wind Energy Areas offshore Massachusetts, pursuant to 30 Code of Federal Regulations (CFR) § 585.211. Equinor Wind US LLC was the winner of Lease Area OCS-A 0520. The Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0520 (Lease) for 128,811 ac (52,128 ha) went into effect on April 1, 2019. Following issuance of the Lease, Equinor Wind US LLC began to conduct comprehensive desktop studies of the environmental resources found within the Lease Area. Equinor Wind US LLC assigned the Lease to Beacon Wind LLC effective January 27, 2021.

wind and the limited amount of developable area, given current and reasonably foreseeable BOEM leasing activity, demonstrates a need for full-build out of the Lease Area.

BW2 plans to deliver power to identified POIs either in Waterford, Connecticut or Queens, New York. Two locations are under consideration in Queens, New York for the single proposed BW1 landfall and onshore substation facility. These locations include the New York Power Authority (NYPA) site in the northeastern corner of the Astoria power complex and the Astoria Gateway for Renewable Energy (AGRE) site (which includes AGRE East and AGRE West) situated centrally and on the northern end of the complex adjacent to the East River, both collectively referred to hereafter as NYPA and AGRE. The Queens, New York, onshore substation facility sites that are not used (NYPA, AGRE East, or AGRE West) for BW1 will remain under consideration, in addition to the Waterford, Connecticut, site, for the single proposed BW2 onshore substation facility. A BW1 and BW2 overview is shown in **Figure ES-1** and the supporting onshore components in **Figure ES-2**.

Beacon Wind has adopted a Project Design Envelope (PDE) approach to describe Project facilities and activities. A PDE is defined as “a reasonable range of project designs” associated with various components of the Project (e.g., foundation and wind turbine generator [wind turbine] options) (BOEM 2018). The design envelope is then used to assess the potential impacts on key environmental and human use resources (e.g., marine mammals, fish, benthic habitats, commercial fisheries, navigation, etc.) focusing on the design parameter (within the defined range) that represents the greatest potential impact (i.e., the “maximum design scenario”) for each unique resource (BOEM 2017). The primary goal of applying a design envelope is to allow for meaningful assessments by the jurisdictional agencies of the proposed project elements and activities while concurrently providing the Leaseholder reasonable flexibility to make prudent development and design decisions prior to construction.

FIGURE ES-1. PROJECT OVERVIEW (LEASE AREA AND SUBMARINE EXPORT CABLE ROUTES)

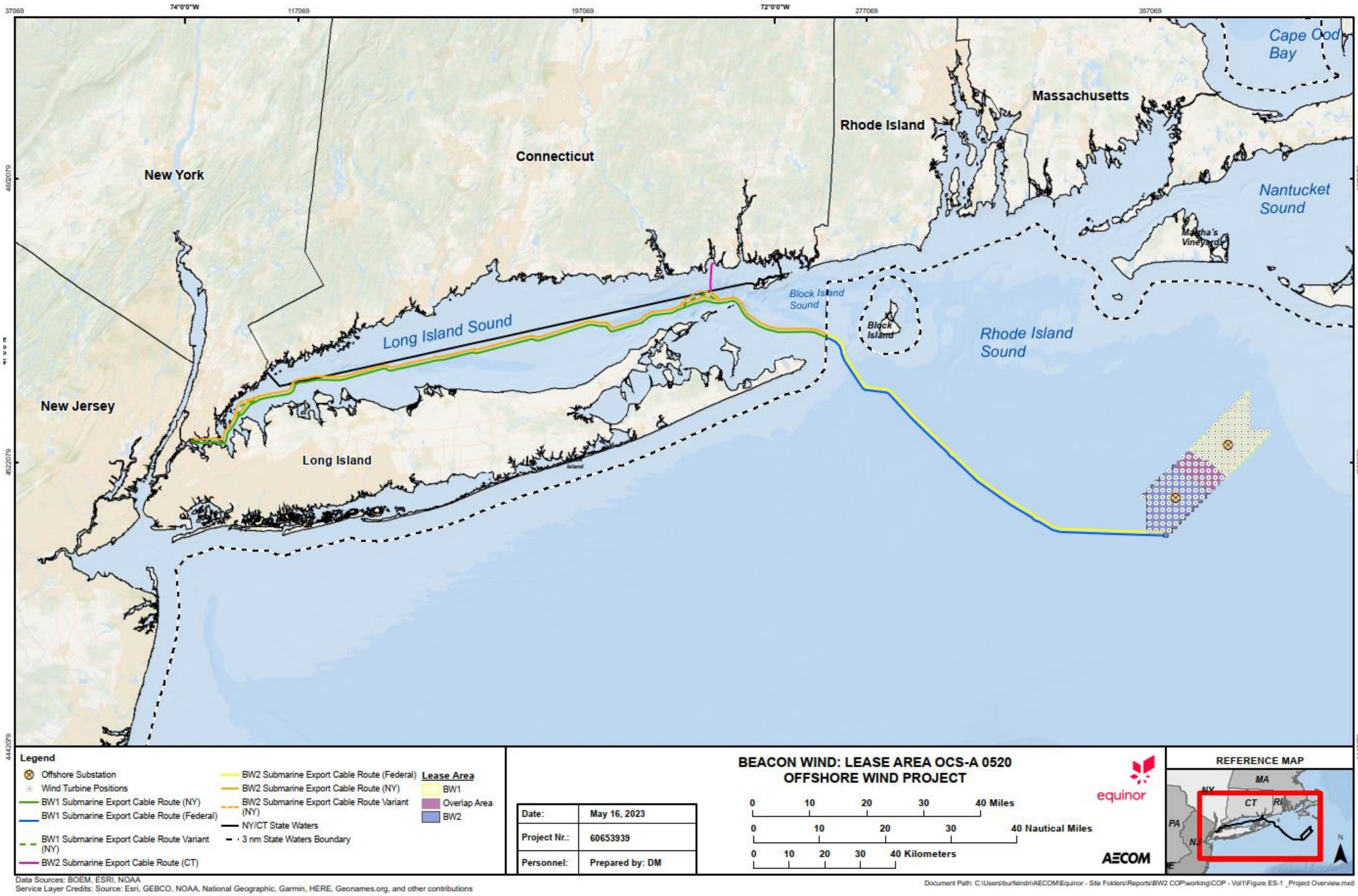
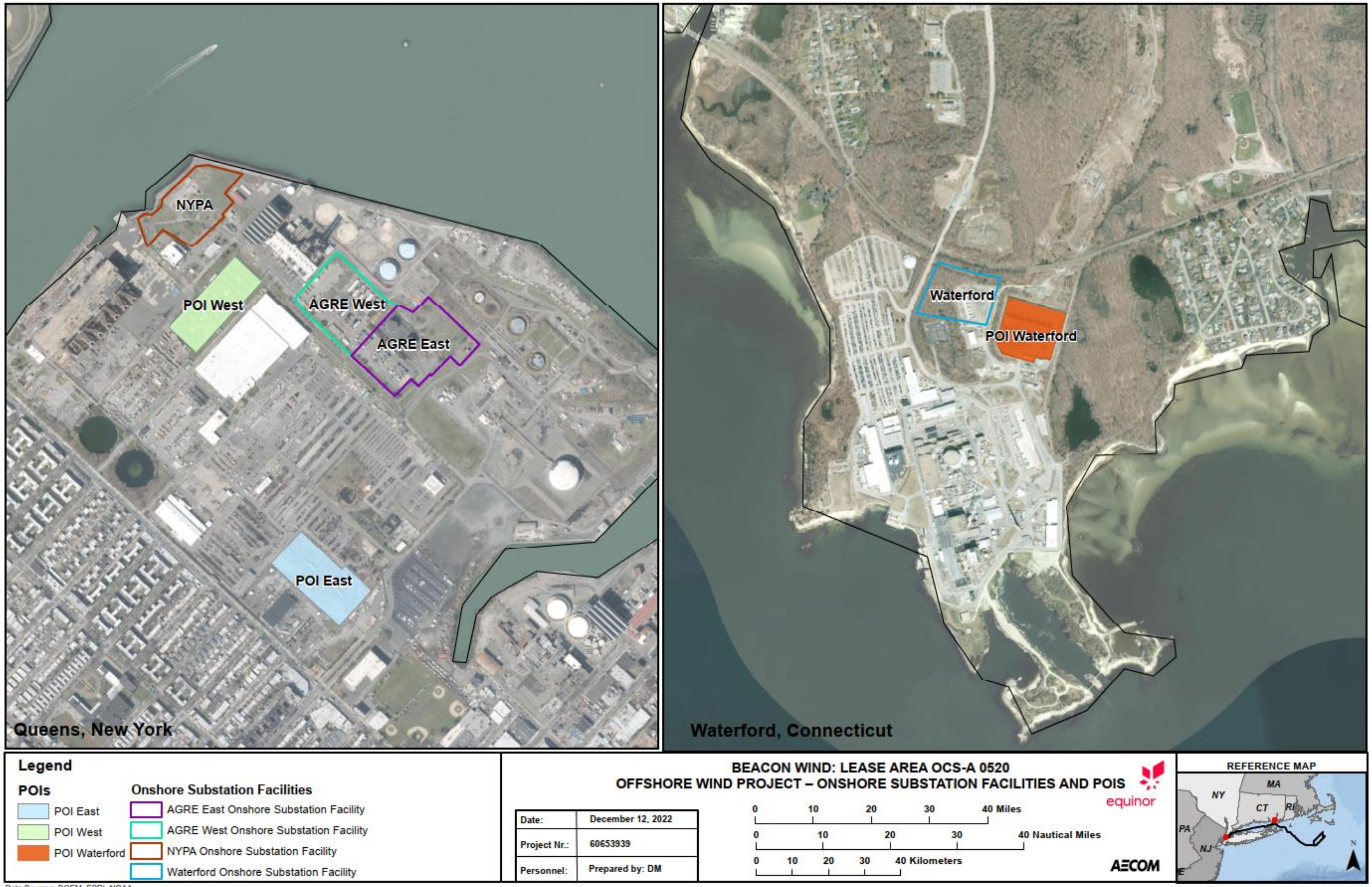


FIGURE ES-2. PROJECT OVERVIEW (ONSHORE SUBSTATION FACILITIES AND POIS)



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

Document Path: C:\Users\MarolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\COP - Vol1\Figure ES-2 _Offshore_Wind_Project.mxd

Offshore components of the Project will consist of up to 155 wind turbines[3] and up to two offshore substation facilities for a total of up to 157 foundations. In addition, there will be up to 324 nm (600 km)[4] of interarray cable, all of which will be located in federal waters within the Lease Area (see further details in **Section 3.0 Project Description**). Renewable energy produced in the Lease Area will be delivered onshore via:

- BW1: high-voltage direct-current (HVDC) submarine export cable route to the State of New York:
  - Up to 202 nm (375 km) to the BW1 landfall in Queens, New York, of which 87 nm (162 km) is in federal waters and 115 nm (213 km) is in state waters; and
- BW2: HVDC submarine export cable route to a landfall location in the State of New York or State of Connecticut:
  - Up to 202 nm (375 km) to the BW2 landfall in Queens, New York, of which 87 nm (162 km) is in federal waters and 115 nm (213 km) is in New York state waters; or
  - Up to 113 nm (209 km) to the BW2 landfall in Waterford, Connecticut, of which 87 nm (162 km) is in federal waters, 26 nm (48 km) is in state waters with 21 nm (39 km) in New York state waters and 5 nm (9 km) in Connecticut state waters.

The onshore components of the Project will include the landfall areas, HVDC onshore cables, HVDC converter stations, and high-voltage alternating-current (HVAC) interconnection cables:

- Two export cable landfall areas:
  - One export cable landfall area in Queens, New York for BW1; and
  - One export cable landfall area in Queens, New York or Waterford, Connecticut for BW2.
- Onshore export and interconnection cables, consisting of two routes:
  - One HVDC onshore export cable route of approximately 2,000 feet (ft, 600 meters [m]) and up to 0.93 mi (1.5 km) of HVAC interconnection cable route in Queens, New York for BW1; and
  - One HVDC onshore export cable route and HVAC interconnection cable route selected from two potential locations for BW2 in Queens, New York or (0.55 mi, 0.89 km) Waterford, Connecticut.
- Two onshore substation facilities:
  - One onshore substation facility (inclusive of an onshore converter station and onshore substation) in Queens, New York for BW1; and
  - One onshore substation facility (inclusive of an onshore converter station and onshore substation) will be selected from two potential locations for BW2 in Queens, New York or Waterford, Connecticut.

Beacon Wind evaluated numerous locations for the onshore substation facilities based on environmental resources, land availability, zoning, distance to shore, grid availability, upgrade

[3] Assuming full build-out of the Lease Area with use of all available locations under the 1x1 nm (1.9x1.9 km) layout described in the United States Coast Guard (USCG) Massachusetts and Rhode Island Port Access Route Study (MARIPARS) report, regardless of wind turbine size. See **Section 3.0Project Description** for more details. The number of wind turbines for the Project will not exceed 155. BW1 will include between 61 and 94 wind turbines and BW2 will include between 61 and 94 wind turbines. The Overlap Area includes 33 wind turbines that could be incorporated into either BW1 or BW2.

[4] Assuming up to 162 nm (300 km) for BW1 and up to 162 nm (300 km) for BW2.

requirements, etc. For each of the two landfall locations selected for consideration in Queens, New York for BW1 and BW2 and the location for BW2 in Waterford, Connecticut, the onshore export cable traverses to the onshore substation facility, which converts HVDC power to HVAC at the appropriate voltage, and then onshore interconnection cables, installed either aboveground or underground, connects to the POI, where power is delivered to the grid.

During construction, Beacon Wind will receive equipment and materials to be staged and loaded onto installation vessels at one or more existing third-party port facilities. Beacon Wind has not yet finalized the selection of facilities. Ports under consideration include, but are not limited to, the following:

- South Brooklyn Marine Terminal, Brooklyn, New York; and
- Port of New Bedford, New Bedford, Massachusetts.

On January 13, 2021, New York's Governor Cuomo announced the 1,230 MW Beacon Wind project as a project selected in the State's 2020 competitive solicitation for Offshore Wind Renewable Energy Credits. Governor Hochul announced finalized agreements on January 14, 2022.[5] Offshore construction is expected to commence no earlier than 2024, with first power expected 2028.

Several northeast states have signaled their intention to issue additional Offshore Wind Renewable Energy Credits solicitations in the coming years. For instance, the State of New York indicated that it intends to hold its next solicitation for offshore wind in 2022.[6]

Additionally, Rhode Island, Connecticut, Massachusetts, and New Hampshire have released information that they will be soliciting for additional PPAs for offshore wind energy. The power generated offshore and delivered to these states will provide service to consumers within the New England Independent System Operator Regional Transmission Organization (RTO). Beacon Wind may participate in one or more solicitations to secure the opportunity to pursue Project development for BW2. Depending on the timing and outcome of further solicitations, Project construction will commence in 2024 or later.

The Project components and locations presented in this COP have been selected based on environmental and engineering site characterization studies completed to date, existing information collection and analysis, as well as extensive engagement with regulators and stakeholders, and will be refined in the Facility Design Report (FDR) and Fabrication and Installation Report (FIR). The FDR/FIR will be reviewed by BOEM in accordance with 30 Code of Federal Regulations (CFR) §§ 585.700-702 prior to Project construction. In addition, a Certified Verification Agent, approved by BOEM, will conduct an independent assessment and verify that the Project components are fabricated and installed in accordance with both this COP and the FIR. It is anticipated that the FDR/FIR submittal will be phased and will be developed on a component-by-component basis.

Within this COP **Volume 1, Section 1** provides an Introduction; **Section 2** details the Project Design Development; and **Section 3** provides a Project Description. A **Quick Reference Guide** is provided after the **Table of Contents**. The **Site Characterization and Assessment of Impact-Producing Factors** are provided in **Volume 2**.

[5] The executed Purchase and Sale Agreement (PSA) between NYSERDA and Beacon Wind LLC allows for a maximum Project capacity of 1,415 MW. https://www.nyserda.ny.gov/-/media/Files/Programs/offshore-wind/beacon-wind-executed.ashx.

[6] https://www.nyserda.ny.gov/About/Newsroom/2021-Announcements/2021-10-08-Governor-Hochul-Announces-Largest-Single-New-York-State-Offshore-Wind-Supply-Chain-Award-of-86-Million-to-Support-Sunrise-Wind-Project

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PROJECT QUICK REFERENCE GUIDE

Key Project Term	Description
Beacon Wind	Beacon Wind LLC.
Beacon Wind 1	The portion of the Project and Lease Area which will be considered a single wind farm dedicated to the Astoria power complex Point of Interconnection (POI) for provision of power to New York Independent System Operator (NY ISO). Also referred to as "BW1."
Beacon Wind 2	The portion of the Project and Lease Area which will be considered a single wind farm dedicated to a POI in Queens, New York or Waterford, Connecticut to be determined for provision of power to NY ISO or the New England ISO (ISO-NE). Also referred to as "BW2."
Cable protection	Measures to protect cable in instances where sufficient burial is not feasible and/or at existing submarine asset crossings, which can include placement of material, typically stone or rocks on and around the cable.
Foundation	Support structure for a wind turbine generator, offshore substation or other offshore structures, including the structural and geotechnical components, extending into the seabed.
Interarray cable	Up to 150 kilovolt (kV) HVAC submarine export cable interconnecting the wind turbines and offshore converter station. The cable consists of a three-core copper or aluminum conductor with a fiber-optic cable integrated into the cable.
Interconnection cable	138 kV HVAC onshore cables connecting the onshore converter station to the POI.
J-tubes	Metal tubes that route and protect cables against sea and wind forces as the cables travel from the seabed, up the foundation, to the base of the wind turbine tower or offshore substation topside.
Landfall	Area where the submarine export cable is brought onshore.
Lease	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0520).
Lease Area	The geographic area defined in the Lease OCS-A 0520.
Metocean facilities	Includes one floating light and detection ranging (floating LiDAR) buoy, two wave and meteorological buoys, and two subsurface current meters installed in the Lease Area. These were permitted under the Site Assessment Plan and installed in November 2021. Beacon Wind is also proposing to temporarily moor a metocean buoy within the Lease Area during construction and installation operations to provide real-time weather conditions.

PROJECT QUICK REFERENCE GUIDE (continued)

Key Project Term	Description
Offshore installation corridor	Minimum 1,640 ft (500 m) wide siting corridor for the offshore cables from the Lease Area to the landfalls which will be temporarily disturbed during installation activities. The siting corridor serves as the maximum extent for the submarine export cable installation corridor.[7]
Offshore substation facilities	Topside structure which receives the power from the wind turbines through the interarray cables. This includes all primary auxiliary and supporting systems. Each offshore substation facility will include transformers to increase the voltage of the power received from the wind turbines so the electricity can be efficiently transmitted to the grid. The offshore substation facilities include the offshore substation and the offshore converter station that converts the HVAC power received from the interarray cables into HVDC power for transmission through the submarine export cables.
Offshore wind facility	Includes those facilities and wind energy development activities permitted by the Bureau of Ocean Energy Management through an outer continental shelf renewable energy lease.
Onshore construction corridor	Onshore cable corridor and additional area required for construction to install the onshore export cables from landfall to the onshore substation facility, as well as the interconnection cables from the onshore substation facility to the POI.
Onshore export cable	For BW1 and BW2, up to 400 kV HVDC cables connecting from the onshore landfall locations to the onshore substation facilities.
Onshore substation facility	The onshore substation facility collects the power from the submarine export cable and adjusts the voltage to support the interconnection into the existing grid. The onshore substation facility includes the onshore substation and the onshore converter station that converts the HVDC power received from the submarine export cable into HVAC power for connection to the existing power grid.
Point of Interconnection (POI)	The existing substation where the Project is interconnected to distribute power into the grid. For BW1: Location where BW1 interconnects into the New York Independent System Operator electricity grid at the Astoria power complex in Queens, New York. For BW2: Location where BW2 interconnects into electricity grid either in Queens, New York or Waterford, Connecticut.
Project	The offshore wind project for OCS-A 0520 proposed by Beacon Wind LLC consisting of BW1 and BW2.

[7] Installation corridor does not include the additional space required for anchor spread in areas where anchored installation vessels will be used.

PROJECT QUICK REFERENCE GUIDE (continued)

Key Project Term	Description
Project Area	Lease Area, BW1 and BW2 submarine export cable routes, and onshore project facility locations including the onshore export and interconnection cables, and onshore substation facilities.
Project Design Envelope (PDE)	The reasonable range of project designs associated with various components of the Project.
Scour protection	Material, typically stone or rocks, placed around/on top of a structure, if required, to prevent seabed sediment from being transported as a result of water flow.
Seabed penetration	The value specifies the required penetration depth of original seabed for the monopile, piled jacket, or suction bucket jacket foundations.
Seabed preparation	Preparation of the seabed for installation of scour material. For all foundation types, filter layer and armor layer scour protection will be evaluated and installed where required.
Submarine export cables	Up to 400 kV HVDC electric power transmission system used for the transmission of electrical power from offshore substation facilities to the onshore substation facilities.
Submarine export cable routes	For BW1, the path of the submarine export cable from the offshore substation facilities in the Lease Area to the POI in Queens, New York. For BW2, two options for the linear path of the submarine export cable from the offshore substation facilities in the Lease Area to a POI in Queens, New York or Waterford, Connecticut.
Take	Term related to the United States Fish and Wildlife Service from Section 3(18) of the Federal Endangered Species Act which refers to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.
Transition Piece (TP)	The portion of the foundation which forms the interface between the wind turbine tower and the foundation, which can also serve secondary purposes including housing electrical and communication equipment and mounting ancillary components such as boat access facilities, main access platforms, and J-tubes.
Wind turbine generator (wind turbine)	A machine consisting of a rotor with three blades connected to the nacelle, which contains an electrical generator and other equipment. Wind turbines transform the kinetic energy created by the rotation of the blades (due to wind energy) into electricity.

Abbreviations and Acronyms	
Acronym	**Definition**
ac	acre
AC	alternating current
ACHP	Advisory Council on Historic Preservation
ACPARS	Atlantic Coast Port Access Route Study
ADLS	Aircraft Detection Lighting System
AIS	Air Insulated Substation
ALARP	as low as reasonably practicable
Beacon Wind	Beacon Wind LLC
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
bp	bp Wind Energy Beacon Holding LLC
BW	Beacon Wind
BW1	Beacon Wind 1
BW2	Beacon Wind 2
Call	Call for Information and Nomination
CBRA	Cable Burial Risk Assessment
CCTV	Closed-Circuit Television
CECPN CFR	Certificate of Environmental Compatibility and Public Need Code of Federal Regulations
CGS ConEd	Connecticut General Statutes Consolidated Edison
COP	Construction and Operations Plan
CTDEEP	Connecticut Department of Energy and Environmental Protection
CTV	Crew Transfer Vessel
CVA	Certified Verification Agent
CWA	Clean Water Act
CWIS	cooling water intake system
CZMA	Coastal Zone Management Act of 1972
DC	direct current
DoD	U.S. Department of Defense
DOI	Department of the Interior
DP	dynamic positioning
EA	Environmental Assessment
ECL	New York Environmental Conservation Law
EFH	Essential Fish Habitat
EG	Eastern Power Generating Company
EIS	Environmental Impact Statement

Empire	Empire Offshore Wind LLC
EMF	electromagnetic field
ENGO	environmental non-governmental organization
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
FAA	Federal Aviation Administration
FAST	Fixing America’s Surface Transportation Act
FDR	Facility Design Report
FIR	Fabrication and Installation Report
FONSI	Finding of No Significant Impact
ft	feet
ft^2	square feet
gal	gallon
GBS	gravity base structure
GIS	geographic information system
GLD	Geographic Location Description
GW	gigawatt
ha	hectare
HAT	Highest Astronomical Tide
HDD	horizontal directional drilling
hr	hour
HRG	High-Resolution Geophysical
HVAC	high-voltage alternating-current
HVDC	high-voltage direct-current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICPC	International Cable Protection Committee
IEC	International Electrotechnical Commission
IECRE	IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications
IEEE	Institute of Electrical and Electronics Engineers
IHA	Incidental Harassment Authorization
in	Inch
IPaC	Information for Planning and Conservation
ISO	Independent System Operator
ISO-NE	New England Independent System Operator
ITP	Incidental Take Permit
kg	kilogram
kJ	kilojoule

km	kilometer
KP kts	Kilometer Point knots
kV	kilovolt
l	liter
LCOE	Levelized Cost of Energy
LED	light-emitting diode
LiDAR	Light Detection and Ranging
LIPA	Long Island Power Authority
LIRC	Long Island Reinforcement Cables
LNM	Local Notice to Mariners
LOA	Letter of Authorization
m	meters
m/s	meters per second
m^2	square meters
m^3	cubic meters
MARA	marine archaeological
MARACOOS	Mid-Atlantic Regional Association Coastal Ocean Observing System
MARCO	Mid-Atlantic Regional Council on the Ocean
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
MA WEA	Massachusetts Wind Energy Area
MA/RI WEA	Massachusetts Rhode Island Wind Energy Area
MBES	Multibeam Echosounder
MBTA	Migratory Bird Treaty Act of 1918
MEC	munitions and explosives of concern
mgd	million gallons per day
MHHW	Mean Higher High Water
mi	statute mile
mm	millimeter
MMPA	Marine Mammal Protection Act of 1972
MSFCMA	Magnuson-Stevens Fisheries Conservation and Management Act of 1976
MSL	mean sea level
MW	megawatt
N/A	Not Applicable
NCEI	National Centers for Environmental Information
NDAA	National Defense Authorization Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966
nm	nautical mile

NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NROC	Northeast Regional Ocean Council
NY	New York
NYCRR	New York Codes, Rules and Regulations
NY ISO	New York Independent System Operator
NYPA	New York Power Authority
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSE	New York Stock Exchange
NYSERDA	New York State Energy Research and Development Authority
NYSRHP	New York State Register of Historic Places
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OGS	New York State Office of General Services
OREC	Offshore Wind Renewable Energy Certificate
OSE	Oslo Stock Exchange
OSRP	Oil Spill Response Plan
PATON	Private Aids to Navigation
PDE	Project Design Envelope
PE	polyethylene
POI	Point of Interconnection
Project	The development and operation of the Project Area for the generation of offshore wind energy and its transmission to interconnections onshore. The Project will consist of BW1 and BW2.
PSN	Proposed Sale Notice
QMA	Qualified Marine Archaeologist
RICRMC	Rhode Island Coastal Resources Management Council
RCSA	Regulations of Connecticut State Agencies
RFI	Request for Interest
ROD	Record of Decision
RTO	Regional Transmission Organization
ROV	remotely operated vehicle
SAMP	Special Area Management Plan

SAP	Site Assessment Plan
SBMT	South Brooklyn Marine Terminal
SBP	Sub-bottom Profiler
SCADA	Supervisory Control and Data Acquisition
SF_6	sulfur hexafluoride
SHPO	State Historic Preservation Office
SOV	Service Operations Vessel
SPDES	State Pollutant Discharge Elimination System
SPS	Significant Peripheral Structure
THPO	Tribal Historic Preservation Office
TP	Transition Piece
TSHD	Trailing Suction Hopper Dredger
TSS	Traffic Separation Scheme
U.S.	United States
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VHF	very-high frequency
WEA	Wind Energy Area
XLPE	cross-linked polyethylene
yd^3	cubic yard

1.0 Introduction

Beacon Wind LLC (Beacon Wind) proposes to construct and operate an offshore wind facility located in the designated Renewable Energy Lease Area OCS-A 0520 (Lease Area). The Lease Area covers approximately 128,811 acres (ac; 52,128 hectares [ha]) and is located approximately 20 statute miles (mi) (17 nautical miles [nm], 32 kilometers [km])[8] south of Nantucket, Massachusetts and 60 mi (52 nm, 97 km) east of Montauk, New York. The Lease Area was awarded through the Bureau of Ocean Energy Management (BOEM) competitive renewable energy lease auction of the Wind Energy Area (WEA) offshore of Massachusetts.[9] The proposed Project Area is comprised of the Lease Area, the submarine export cable routes, and onshore project facility locations including the onshore export and interconnection cables, and onshore substation facilities.

Beacon Wind proposes to develop the entire Lease Area in what could potentially be up to two individual wind farms, known as Beacon Wind 1 (BW1) and Beacon Wind 2 (BW2) (collectively referred to hereafter as the Project). The Project includes the development and operation of the Project Area for the generation of offshore wind energy and its transmission to interconnection points onshore. BW1 includes wind turbines in the Project Lease Area and an export cable route to Queens, New York. BW2 includes wind turbines in the Project Lease Area and an export cable route to Queens, New York, or Waterford, Connecticut. Beacon Wind submits this updated supplement to the Construction and Operations Plan (COP) to support the siting, development, and operation of the Project.

1.1 COP Requirements

The purpose of this COP is to provide information about the Project to BOEM and other federal and state agencies. The COP was prepared in accordance with Title 30 of the Code of Federal Regulations (CFR) Part 585, BOEM's *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* (BOEM 2020), and other BOEM policy, guidance, and regulations. **Table 1.1-1** details the BOEM requirements for developing a COP and where the information can be found within this document.

[8] Distances throughout the COP are provided as statute miles (mi) or nautical miles (nm) as appropriate, with kilometers (km) in parentheses. For reference, 1 mi equals approximately 0.87 nm or 1.6 km.

[9] On December 13-14, 2018, BOEM held a competitive lease sale (i.e., auction) for Wind Energy Areas offshore Massachusetts, pursuant to 30 CFR § 585.211. Equinor Wind US LLC was the winner of Lease Area OCS-A 0520. The Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0520 (Lease) for 128,811 ac (52,128 ha) went into effect on April 1, 2019. Following issuance of the Lease, Equinor Wind US LLC began to conduct comprehensive desktop studies of the environmental resources found within the Lease Area. Equinor Wind US LLC assigned the lease to Beacon Wind LLC effective January 27, 2021.

TABLE 1.1-1. BOEM REGULATIONS FOR DEVELOPING A CONSTRUCTION AND OPERATIONS PLAN

BOEM Requirement	Location in COP
30 CFR § 585.105(a)	
(1) Design your projects and conduct all activities in a manner that ensures safety and will not cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components to the extent practicable; and take measures to prevent unauthorized discharge of pollutants, including marine trash and debris into the offshore environment.	Section 1.2.3 - Proposed Activities Section 3.0- Project Description Appendix D - Conceptual Project Design Drawings
30 CFR § 585.621(a-g)	
(a) The project will conform to all applicable laws, implementing regulations, lease provisions, and stipulations or conditions of the lease.	Section 1.5 - Regulatory Framework
(b) The project will be safe.	Section 8.12 - Public Health and Safety Appendix D - Conceptual Project Design Drawings Appendix E - Oil Spill Response Plan Appendix F - Safety Management System Appendix G - Marine Site Investigation Report Appendix BB - Navigation Safety Risk Assessment
(c) The project will not unreasonably interfere with other uses of the Outer Continental Shelf (OCS), including those involved with National security or defense.	Section 8.2 - Land Use and Zoning Section 8.6 - Aviation Section 8.7 - Marine Transportation and Navigation Section 8.9 - Department of Defense and OCS National Security Maritime Uses Section 8.10 - Marine Energy and Infrastructure Appendix Z - Obstruction Evaluation and Airspace Analysis
(d) The project will not cause undue harm or damage to natural resources; life (including human and wildlife); property; the marine, coastal, or human environment; or sites, structures, or objects of historical or archeological significance.	Section 4 - Physical Resources Section 5 - Biological Resources Section 6 - Cultural Resources Section 7 - Visual Resources Section 8 - Human Resources and the Built Environment Avoidance, Minimization, and Mitigation Measures are provided in each section of Volume 2 Appendix G - Marine Site Investigation Report Appendix I - Sediment Transport Analysis Appendix J - Air Emissions Calculations and Methodology Appendix N1/N2 - Wetlands Delineation Reports

	Appendix O - Ornithological and Marine Faunal Aerial Survey – APEM Studies Appendix P - Avian Impact Assessment Appendix Q - Offshore Bat Survey Report Appendix R - Bat Impact Assessment Appendix S - Benthic Resources Characterization Reports and Mapbooks Appendix T - Essential Fish Habitat Technical Report Appendix U - Marine Archaeological Resources Assessment Appendix V1/V2 – Terrestrial Archaeological Resources Assessments Appendix W – Historic Resources Visual Effects Assessment Appendix X - Seascape, Landscape, and Visual Impact Assessment Appendix CC - Offshore Electric and Magnetic Field Assessment Appendix DD - Onshore Electric and Magnetic Field Assessment Appendix EE - Scour Analysis Appendix FF - Air Traffic Flow Analysis
(e) The project will use the best available and safest technology.	Section 3 - Project Description
(f) The project will use best management practices.	Avoidance, Minimization, and Mitigation Measures are provided in each section of Volume 2
(g) The project will use properly trained personnel.	Section 8.12 - Public Health and Safety Appendix F - Safety Management System
30 CFR § 585.626(a)	
(1) Shallow Hazards	Section 4.1 - Physical and Oceanographic Conditions Appendix G - Marine Site Investigation Report
(i) Shallow Faults;	
(ii) Gas Seeps or shallow gas;	
(iii) Slump blocks or slump sediments;	
(iv) Hydrates; and	
(v) Ice Scour of seabed sediments.	
(2) Geological survey relevant to the design and siting of facility	Section 4.1 - Physical and Oceanographic Conditions Appendix G - Marine Site Investigation Report
(i) Seismic activity at your proposed site;	
(ii) Fault zones;	
(iii)The possibility and effects of seabed subsidence; and	
(iv) The extent and geometry of faulting attenuation effects of geological conditions near your site.	
(3) Biological	

(i) A description of the results of biological surveys used to determine the presence of live bottoms, hard bottoms, and topographic features, and surveys of other marine resources such as fish populations (including migratory populations), marine mammals, sea turtles, and sea birds.	Section 4.1 - Physical and Oceanographic Conditions Section 5 - Biological Resources Appendix G - Marine Site Investigation Report Appendix O - Ornithological and Marine Faunal Aerial Survey – APEM Studies Appendix P - Avian Impact Assessment Appendix Q – Offshore Bat Survey Report Appendix R - Bat Impact Assessment Appendix S - Benthic Resources Characterization Reports and Mapbooks Appendix T - Essential Fish Habitat Technical Report
(4) Geotechnical Survey	Section 4.1.2 - Geologic Conditions Appendix G - Marine Site Investigation Report Appendix I - Sediment Transport Analysis
(i) The results of a testing program used to investigate the stratigraphic and engineering properties of the sediment that may affect the foundations or anchoring systems for your facility.	
(ii) The results of adequate in situ testing, boring, and sampling at each foundation location, to examine all important sediment and rock strata to determine its strength classification, deformation properties, and dynamic characteristics.	
(iii) The results of a minimum of one deep boring (with soil sampling and testing) at each edge of the project area and within the project area as needed to determine the vertical and lateral variation in seabed conditions and to provide the relevant geotechnical data required for design.	
(5) Archaeological Resources	Section 6 - Cultural Resources Appendix U - Marine Archaeological Resources Assessment Appendix V1/V2 - Terrestrial Archaeological Resources Assessments
(i) A description of the historic and prehistoric archaeological resources, as required by the National Historic Preservation Act of 1966 (NHPA) (16 U.S.C. §§ 470 *et seq*.), as amended.	
(6) Overall Site Investigation	Section 4.1- Physical and Oceanographic Conditions Appendix G - Marine Site Investigation Report Appendix I - Sediment Transport Analysis Appendix EE - Scour Analysis
(i) Scouring of the seabed;	
(ii) Hydraulic instability;	
(iii) The occurrence of sand waves;	
(iv) Instability of slopes at the facility location;	
(v) Liquefaction, or possible reduction of sediment strength due to increased pore pressures;	

(vi) Degradation of subsea permafrost layers;	
(vii) Cyclic loading;	
(viii) Lateral loading;	
(ix) Dynamic loading;	
(x) Settlements and displacements;	
(xi) Plastic deformation and formation collapse mechanisms; and	
(xii) Sediment reactions on the facility foundations or anchoring systems.	
30 CFR § 585.626(b)	
(1) Contact information.	Section 1.8 - Authorized Representative
(2) Designation of operator, if applicable.	Not applicable
(3) The construction and operation concept.	Section 1.2 - Project Overview Section 1.4 - Purpose and Need for the Project Section 3 - Project Description
(4) Commercial lease stipulations and compliance.	Section 1.5 - Regulatory Framework
(5) A location plat.	Section 1.2 - Project Overview (Figure 1.2-1) Section 3 - Project Description (Figure 3.1-1)
(6) General structural and project design, fabrication, and installation.	Section 1.9 - Certified Verification Agent Section 3 - Project Description Appendix C - Certified Verification Agent Appendix D - Conceptual Project Design Drawings
(7) All cables and pipelines, including cables on project easements.	Section 1.2.3 - Proposed Activities Section 3 - Project Description
(8) A description of the deployment activities.	Section 1.2.3 - Proposed Activities Section 3 - Project Description Appendix E - Oil Spill Response Plan Appendix F - Safety Management System
(9) A list of solid and liquid wastes generated.	Section 3.4.1 - Construction and Installation Activities Section 3.5 - Operations and Maintenance Activities
(10) A listing of chemical products used (if stored volume exceeds Environmental Protection Agency (EPA) Reportable Quantities).	Appendix E - Oil Spill Response Plan Section 3.3.1.1 (Table 3.3-2 - Summary of Wind Turbine Oil/Grease/Fuel Maximum PDE Parameters) Section 3.3.1.2 (Table 3.3-4 - Summary of Offshore Substation Oil/Grease/Fuel Maximum PDE Parameters)
(11) A description of any vessels, vehicles, and aircraft you will use to support your activities.	Section 3.4 - Construction and Installation Activities Section 3.5.1 - Offshore Operations and Maintenance Activities
(12)(i) A general description of the operating procedures and systems under normal conditions.	Section 3.5 - Operations and Maintenance Activities

(12)(ii) A general description of the operating procedures and systems in the case of accidents or emergencies, including those that are natural or manmade.	Section 3.5 - Operations and Maintenance Activities Section 8.7 - Marine Transportation and Navigation Section 8.12 - Public Health and Safety Appendix F - Oil Spill Response Plan Appendix BB - Navigation Safety Risk Assessment
(13) Decommissioning and site clearance procedures.	Section 3.7 - Decommissioning Activities
(14)(i) A listing of all federal, state, and local authorizations, approvals, or permits that are required to conduct the proposed activities, including commercial operations. The U.S. Coast Guard (USCG), U.S. Army Corps of Engineers (USACE), and any other applicable authorizations, approvals, or permits, including any Federal, State or local authorizations pertaining to energy gathering, transmission or distribution (e.g., interconnection authorizations).	Section 1.5 - Regulatory Framework
(14)(ii) A listing of all federal, state, and local authorizations, approvals, or permits that are required to conduct the proposed activities, including commercial operations. A statement indicating whether you have applied for or obtained such authorization, approval, or permit.	Section 1.5 - Regulatory Framework
(15) Your proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts.	Summary of Avoidance, Minimization, and Mitigation Measures are provided in each resource section of Volume 2
(16) Information you incorporate by reference.	By Section, References
(17) A list of agencies and persons with whom you have communicated, or with whom you will communicate, regarding potential impacts associated with your proposed activities.	Section 1.6 - Agency and Public Outreach Appendix B - Summary of External Engagement Activities
(18) Reference.	By Section, References
(19) Financial assurance.	Section 1.10 - Financial Assurance
(20) Certified Verification Agent (CVA) nominations for reports required in subpart G of this part.	Section 1.9 - Certified Verification Agent Appendix C - CVA Statement of Qualifications
(21) Construction schedule.	Section 1.2.4 - Anticipated Construction Schedule
(22) Air quality information.	Section 4.3 - Air Quality Appendix J - Air Emissions Calculations and Methodology
(23) Other information.	Not applicable.

30 CFR § 585.627(a)	
(1) Hazard information.	Section 4.1 - Physical and Oceanographic Conditions Section 8.10 - Marine Energy and Infrastructure Appendix G - Marine Site Investigation Report Appendix I - Sediment Transport Analysis
(2) Water quality.	Section 4.2 - Water Quality Appendix I - Sediment Transport Analysis
(3) (i) Benthic Communities.	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix S - Benthic Resource Characterization Reports and Mapbooks
(3) (ii) Marine Mammals.	Section 5.6 - Marine Mammals
(3) (iii) Sea turtles.	Section 5.7 - Sea Turtles
(3) (iv) Coastal and marine birds.	Section 5.3 - Avian Species Appendix O - Ornithological and Marine Faunal Aerial Survey – APEM Studies Appendix P - Avian Impact Assessment
(3) (v) Fish and shellfish.	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix S - Benthic Resource Characterization Reports and Mapbooks Appendix T - Essential Fish Habitat Technical Report
(3) (vi) Plankton.	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix T - Essential Fish Habitat Assessment
(3) (vii) Seagrasses.	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix T - Essential Fish Habitat Technical Report
(3) (viii) Plant life.	Section 5 - Biological Resources Section 5.2 - Wetlands and Waterbodies Appendix N1/N2 - Wetlands Delineation Reports
(4) Threatened or endangered species. (5) Sensitive biological resources or habitats	Section 5 - Biological Resources Appendix M – United States Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) Report and State Listed Species Appendix N1/N2 - Wetlands Delineation Reports Appendix O - Ornithological and Marine Faunal Aerial Survey – APEM Studies Appendix P - Avian Impact Assessment Appendix Q - Offshore Bat Survey Report Appendix R - Bat Impact Assessment

	Appendix S - Benthic Resources Characterization Reports Appendix T - Essential Fish Habitat Technical Report
(6) Archaeological resources.	Section 6 - Cultural Resources Appendix U - Marine Archaeological Resources Assessment Appendix V1/V2 - Terrestrial Archaeological Resources Assessments
(7) Social and economic resources.	Section 8.1 - Population, Economy, Employment and Housing and Property Values Section 8.3 - Recreation and Tourism Section 8.4 - Environmental Justice Section 8.8 - Commercial and Recreational Fishing Appendix GG – Socioeconomic Report
(8) Coastal and marine uses.	Section 8.8 - Commercial and Recreational Fishing Section 8.11 - Other Marine Uses
(9) Consistency Certification.	Section 1.5.3 - State Permits, Approvals, and Consultations Appendix A - Coastal Zone Management Consistency Statements
(10) Other resources, conditions, and activities.	Not applicable.
30 CFR § 585.627(b)	
Consistency certification.	Section 1.5.3 - State Permits, Approvals, and Consultations Appendix A - Coastal Zone Management Consistency Statements
30 CFR § 585.627(c)	
Oil spill response plan.	Appendix E - Oil Spill Response Plan
30 CFR § 585.627(d)	
Safety management system.	Appendix F - Safety Management System

1.2 Project Overview

Beacon Wind proposes to construct and operate an offshore wind facility located in the Lease Area . The Lease Area covers approximately 128,811 acres (52,128 ha) and is located approximately 20 mi (17 nm, 32 kilometers [km])[10] south of Nantucket, Massachusetts and 60 mi (52 nm, 97 km) east of Montauk, New York (**Figure 1.2-1** and **Figure 1.2-2**, below).

Beacon Wind proposes to develop the entire Lease Area with up to two individual wind farms, known as BW1 and BW2. BW1 is located in the northern 56,835 ac (22,879 ha) of the Lease Area and BW2 is located in the southern 51,611 ac (20,886 ha) of the Lease Area, with a 20,665 ac (8,363 ha) Overlap Area that could be included in either BW1 or BW2. The Overlap Area is included in the event that engineering or technical challenges arise at certain locations within the Lease Area, to provide flexibility for final selection of a wind turbine supplier for the Project (which will determine the final number of wind turbine positions needed for BW1 and BW2), and for environmental or other considerations. All positions in the Overlap Area are intended for development and are required to meet the Project's purpose and need.

Each wind farm will be electrically isolated and independent from the other via transmission systems that connect two separate offshore substations to two onshore Points of Interconnection (POIs). However, if BW1 and BW2 both interconnect with the New York Independent System Operator (NY ISO), the Project will assess the possibility of cable linkage between BW1 and BW2. BW1 will connect to the NY ISO transmission network at an existing substation in the Astoria power complex in Queens, New York. Beacon Wind is assessing two submarine export cable route options for BW2, one to Queens, New York and one to Waterford, Connecticut. It is anticipated that the onshore POI for BW2 will interconnect with the NY ISO or the New England Independent System Operator (referred to as ISO-NE) grid.

Beacon Wind is developing up to 155 wind turbines and supporting tower structures, and up to two offshore substation facilities, using up to 157 foundations in the Lease Area (encompassing both BW1 and BW2). BW1 will include between 61 and 94 wind turbines and BW2 will include between 61 and 94 wind turbines, see **Section 2.1.5 BW2 Submarine Export Cable Routes, Landfalls and Onshore Substation - Waterford, Connecticut** for additional details. The Overlap Area includes 33 wind turbines that could be incorporated into either BW1 or BW2.

The layout of the wind turbine positions within the Lease Area is based on the agreement negotiated with the other Massachusetts Rhode Island Wind Energy Area (MA/RI WEA) leaseholders. A regional layout with 1 nm (1.9 km) spacing in the cardinal directions (N/S/E/W) has been proposed to improve navigation safety for mariners across the multiple projects being developed concurrently (herein referred to as the 1x1 nm [1.9x1.9 km] layout). As of the initial February 2022 submittal date for this COP, BOEM has approved at least two projects that adopt this layout configuration. As such, Beacon Wind interprets that approval by BOEM, including USCG and other cooperating agencies to be an endorsement of the layout agreement.

[10] Distances throughout the COP are provided as statute miles (mi) or nautical miles (nm) as appropriate, with kilometers (km) in parentheses. For reference, 1 mi equals approximately 0.87 nm or 1.6 km.

FIGURE 1.2-1. PROJECT OVERVIEW (LEASE AREA AND SUBMARINE EXPORT CABLE ROUTES)

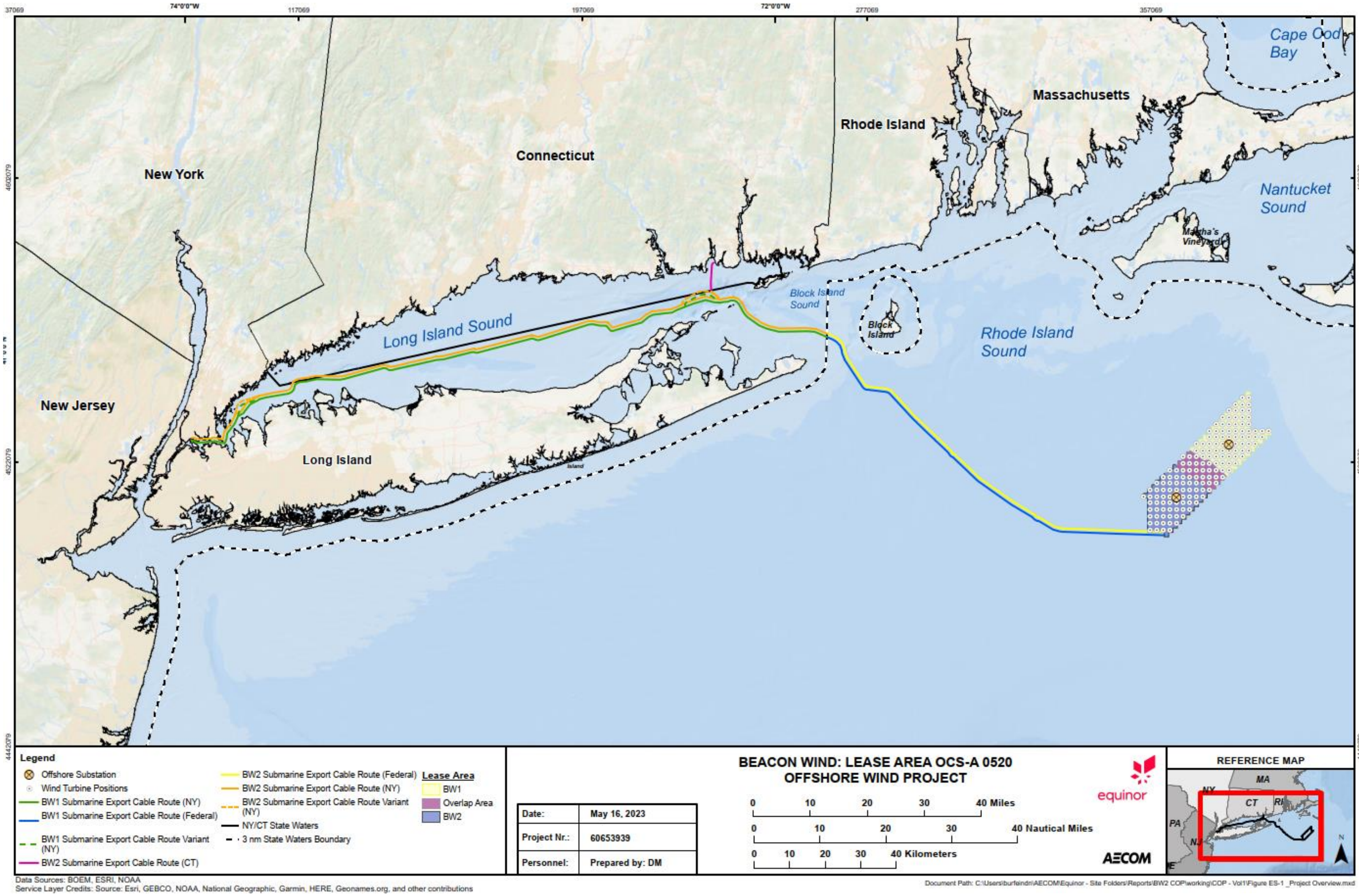
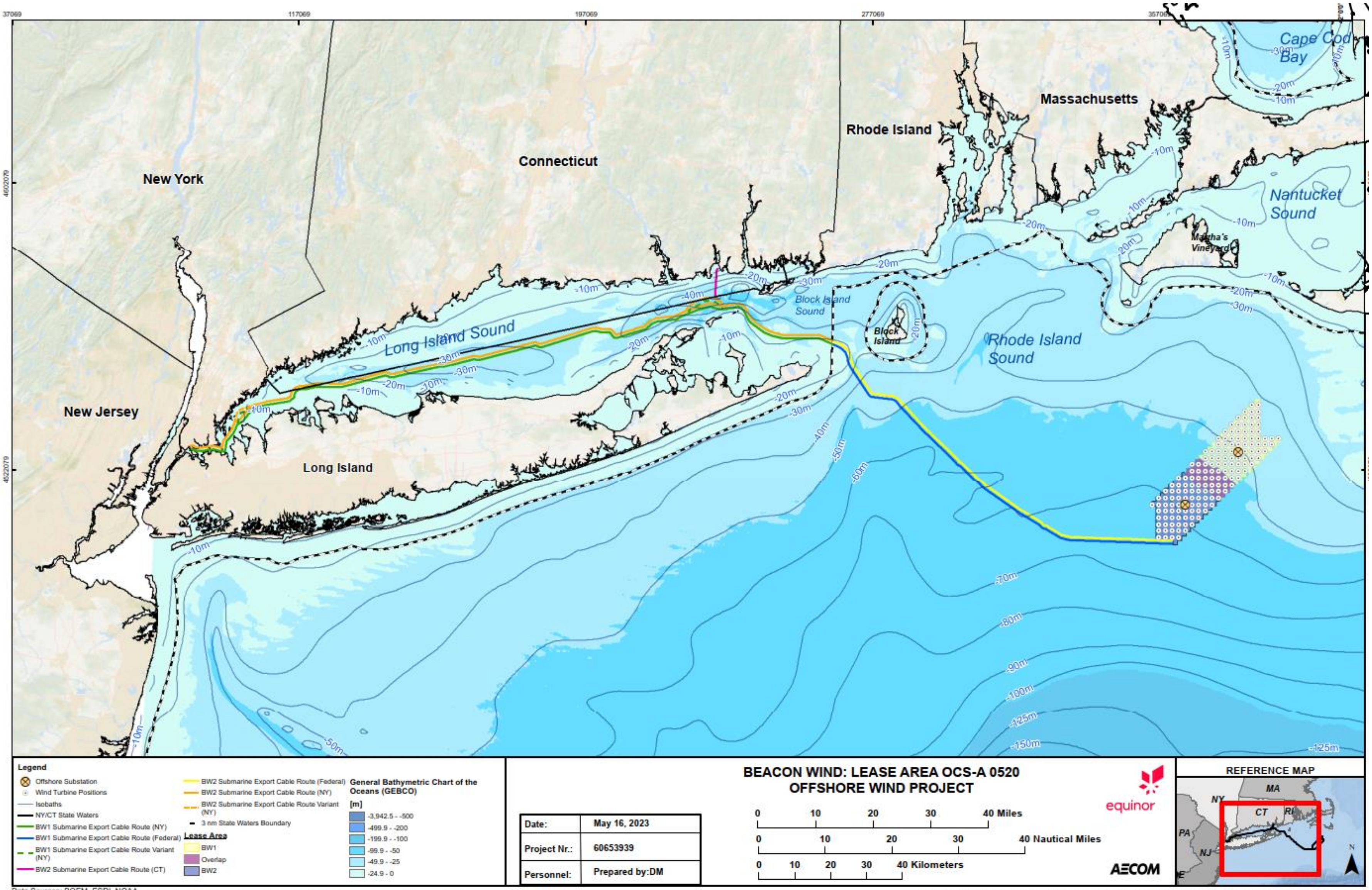


FIGURE 1.2-2. PROJECT OVERVIEW (LEASE AREA AND SUBMARINE EXPORT CABLE ROUTES) WITH BATHYMETRY



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

Document Path: C:\Users\burfeindn\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\COP - Vol1\Figure ES-1 _Project OverviewV2.mxd

1.2.1 BOEM OCS Wind Energy Offshore Massachusetts Development

In 2009, BOEM began the process of evaluating areas off the coast of New England for potential suitability of offshore wind development. This process included both public stakeholder consultation and desktop analysis.[11] This included the formation of the Massachusetts-BOEM task force, with representation from federal, state, tribal governments, and local government agencies and also incorporated public stakeholder meetings. Following these initial steps and consultation, BOEM published a Request for Interest (RFI) on December 29, 2010 for a preliminary Massachusetts Wind Energy Area (MA WEA) of approximately 1,884,920 ac (762,800 ha), referred to as the “RFI area.” This RFI requested expressions of commercial interest from potential wind energy developers, as well as any information from the public relevant to determining the suitability of the RFI area for offshore wind development. After the first round of responses to the RFI, BOEM announced a second public comment period, which closed on April 18, 2011. A total of 10 companies, responded to the RFI and 260 public comments were received through this process. After careful consideration of the public comments, as well as input from the Massachusetts-BOEM task force, BOEM extensively modified the RFI area to address stakeholder concerns (**Figure 1.2-3**). For example, BOEM decided to exclude certain areas identified as important habitats that could be adversely affected if ultimately used for offshore wind energy development. The distance from the WEA to the nearest shore was also extended, in an effort to further reduce potential visual impacts. Following these revisions, the initial MA WEA was reduced in size by approximately 40 percent.

On February 6, 2012, BOEM published a “Call for Information and Nominations” (“Call”) for areas within the revised MA WEA (the “Call Area”). The Call for Information and Nominations requested the submission of a nomination for a lease by those interested in potentially obtaining a commercial lease for the “Call Area” and also allowed interested and affected parties to provide comments about site conditions, resources, or uses within the “Call Area.” That same month, BOEM also published a Notice of Intent (NOI) to prepare an Environmental Assessment (EA) for the “Call Area.” The EA was made available for public review on November 12, 2012. Comments on the EA were considered and the revised EA for the WEA was issued on June 4, 2013. As a result of the analysis presented in the revised EA, BOEM issued a “Finding of No Significant Impact” (also known as a “FONSI”), which concluded that reasonably foreseeable environmental effects associated with the commercial wind lease issuance and related activities would not significantly impact the environment.

On June 17, 2014, BOEM and Massachusetts announced that approximately 742,000 ac (300,277 ha) comprising the MA WEA would be made available for commercial wind energy leasing. The Beacon Wind Lease Area was shown within Massachusetts Lease OCS-A 0502 at this stage **(Figure 1.2-4**). On January 29, 2015, BOEM held a competitive lease sale, conducted as an auction, for the lease areas within BOEM’s MA WEA. As a result of the 2015 auction, Lease Areas OCS-A 0500 and OCS-A 0501 were awarded to the highest bidders and Lease Areas OCS-A 0502 and OCS-A 0503 remained unleased.

On December 16, 2016, and January 4, 2017, Statoil Wind US LLC (which was renamed to Equinor Wind US LLC on May 15, 2018) and PNE Wind USA, Inc., individually submitted unsolicited lease requests for the previously unleased areas in the WEA offshore Massachusetts (Lease Areas OCS-A 0502 and OCS-A 0503). At the time, Lease Area OCS-A 0502 was approximately 248,015 acres

[11] Desktop analysis included the Assessment of Offshore Wind Energy Leasing Areas for the BOEM Massachusetts Wind Energy Area Report authored by the Department of Energy’s National Renewable Energy Laboratory (NREL). The report is available at: http://www.nrel.gov/docs/fy14osti/60942.pdf.

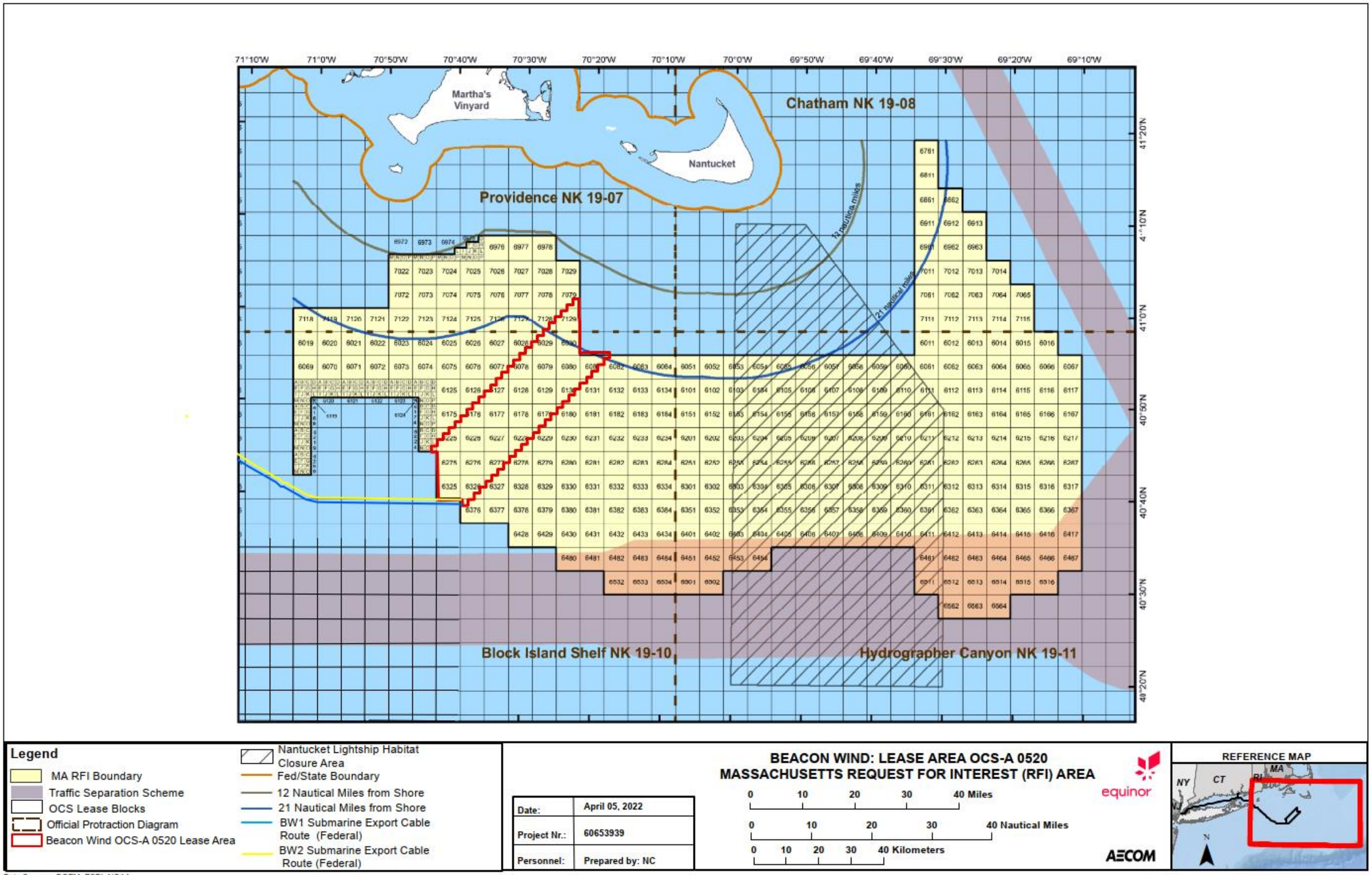
(100,368 ha) and Lease Area OCS-A 0503 was approximately 140,554 acres (56,880 ha). Due to the fact that both parties nominated the same areas, BOEM determined that competitive interest existed and made plans to proceed with the competitive leasing process outlined in BOEM's regulations. On April 6, 2018, BOEM announced the release of the Atlantic Wind Lease Sale 4-A Proposed Sale Notice (PSN) for 388,569 acres (157,352 ha) offshore Massachusetts. The PSN published in the Federal Register on April 11, 2018. On October 17, 2018, the Secretary of the Interior announced that there would be an auction for nearly 390,000 ac (157,827 ha) offshore Massachusetts on December 13, 2018 (**Figure 1.2-5**). Details were published in a Final Sale Notice appearing in the Federal Register on October 19, 2018. This announcement also solidified an updated lease area map which identified three leases within the space and introduced lease identification numbers OCS-A 520, OCS-A 0521, and OCS-A 0522.

From December 13 to December 14, 2018, BOEM held a competitive lease sale (i.e., auction) for the previously specified Wind Energy Areas offshore Massachusetts. This auction lasted 32 rounds, and Equinor Wind US LLC was identified as the winner for Lease OCS-A 0520 (128,811 ac; 52,128 ha), Mayflower Wind Energy, LLC was identified as the winner of Lease OCS-A 0521 (127,388 ac; 51,552 ha), and Vineyard Wind, LLC was identified as the winner of Lease OCS-A 0522 (132,370 ac; 53,568 ha). The current delineations of all the MA WEAs can be seen in **Figure 1.2-6**. **Figure 1.2-7** shows the milestones for Lease Area OCS-A 0520 from the original RFI through planned COP submittal.

The Lease was awarded to Equinor Wind US LLC with an effective date of April 1, 2019. On January 27, 2021, Equinor Wind US LLC assigned the Lease to Beacon Wind LLC.

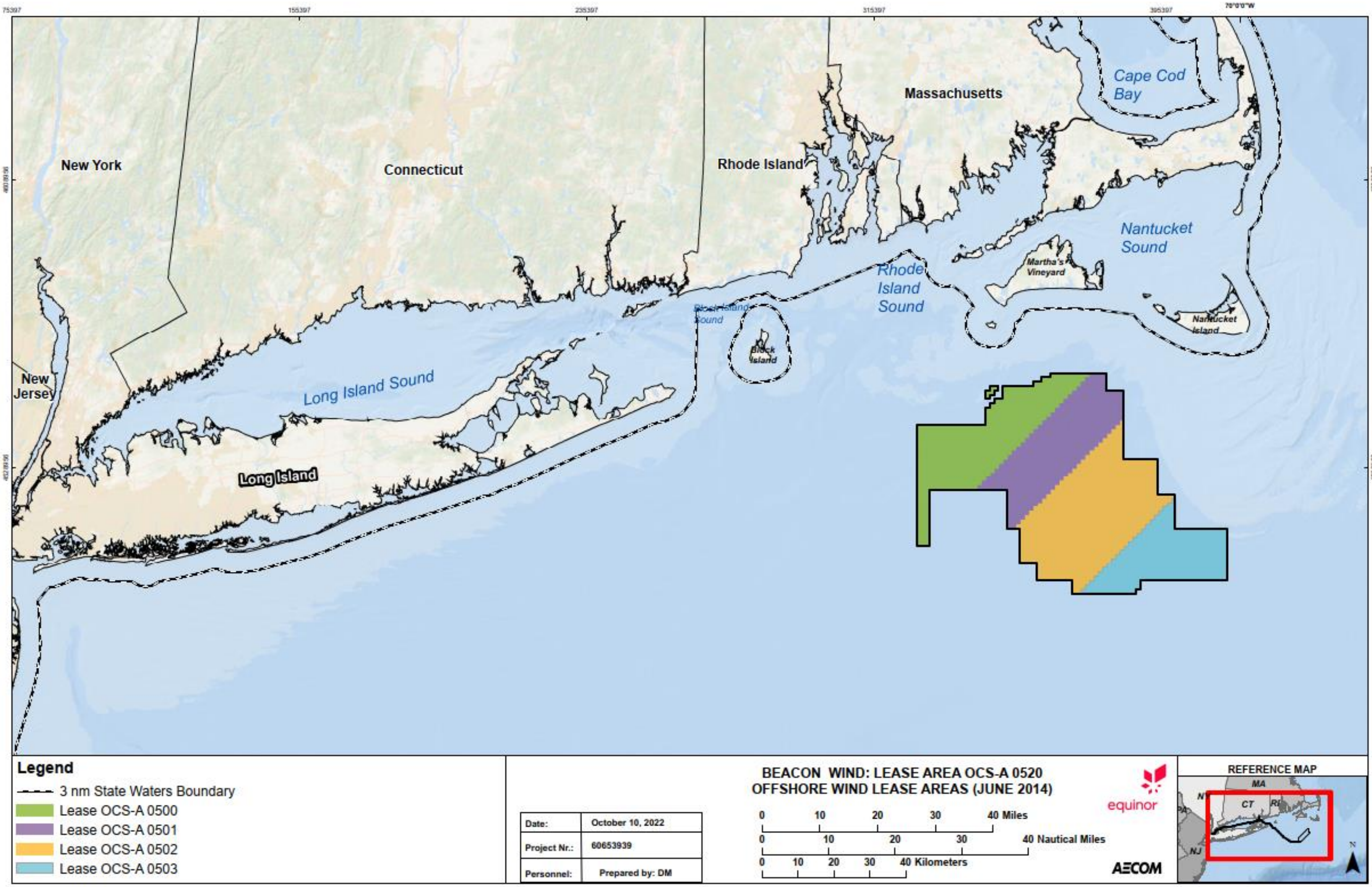
The Project will be located approximately 20 mi (17 nm, 32 km) southwest of Nantucket and contains water depths ranging from 120-200 feet (ft) (37-61 meters [m]) with average wind speeds at 33 ft (10 m) above mean sea level (MSL) of approximately 30-33 feet per second (ft/s) (9-10 meters per second [m/s]) and seabed conditions comprised of glacial zones, sand, and clay.

FIGURE 1.2-3. BOEM INITIAL PLANNING AREAS FOR MASSACHUSETTS WIND ENERGY AREA LEASES



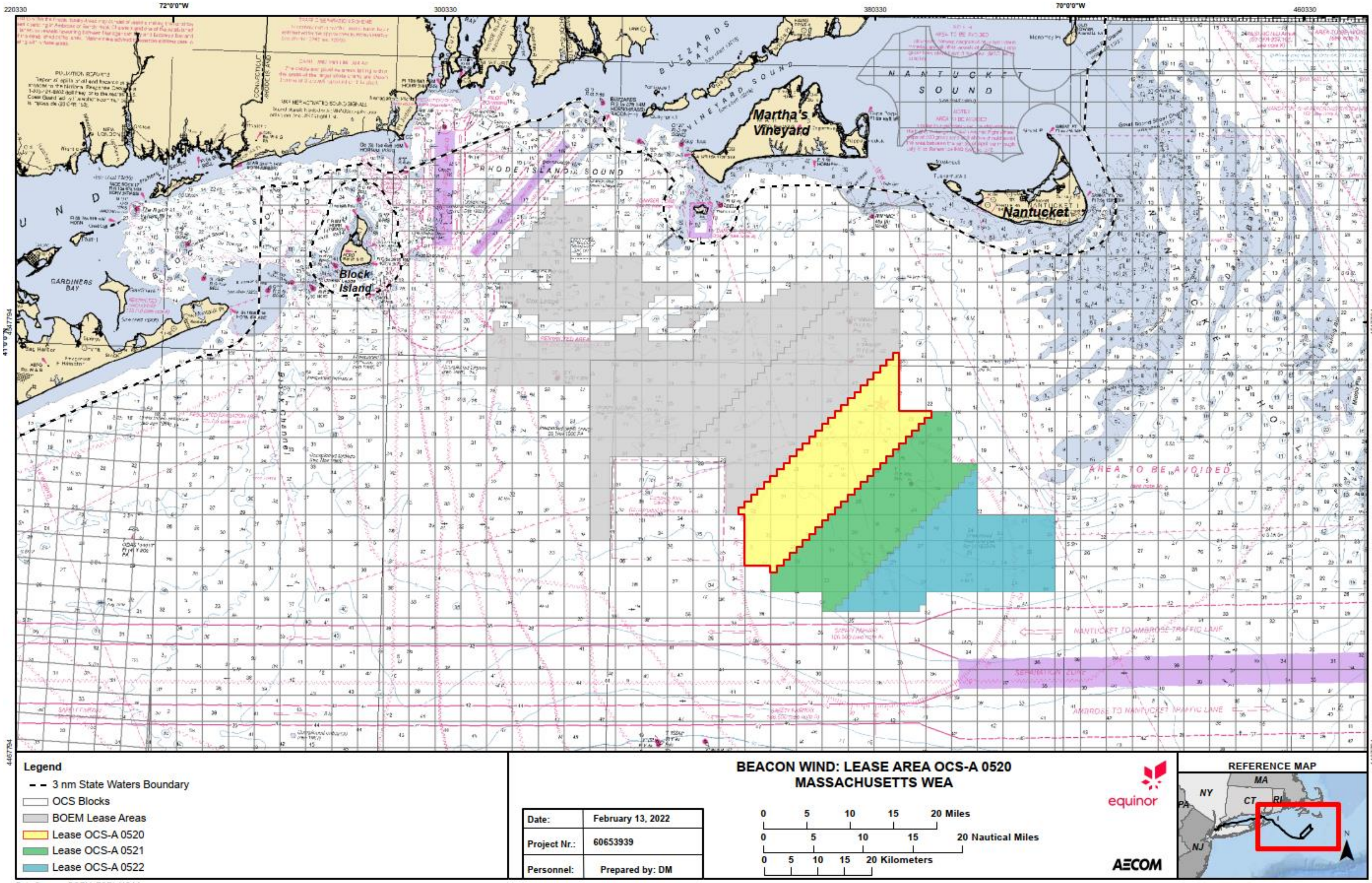
Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 1.2-4. BEACON WIND LEASE AREA DURING BOEM PLANNING PHASE (JUNE 2014)



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 1.2-5. DECEMBER 2018 MASSACHUSETTS WIND ENERGY AUCTION LEASE AREAS



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 1.2-6. CURRENT 2022 STATUS OF MASSACHUSETTS/RHODE ISLAND WIND ENERGY AREAS

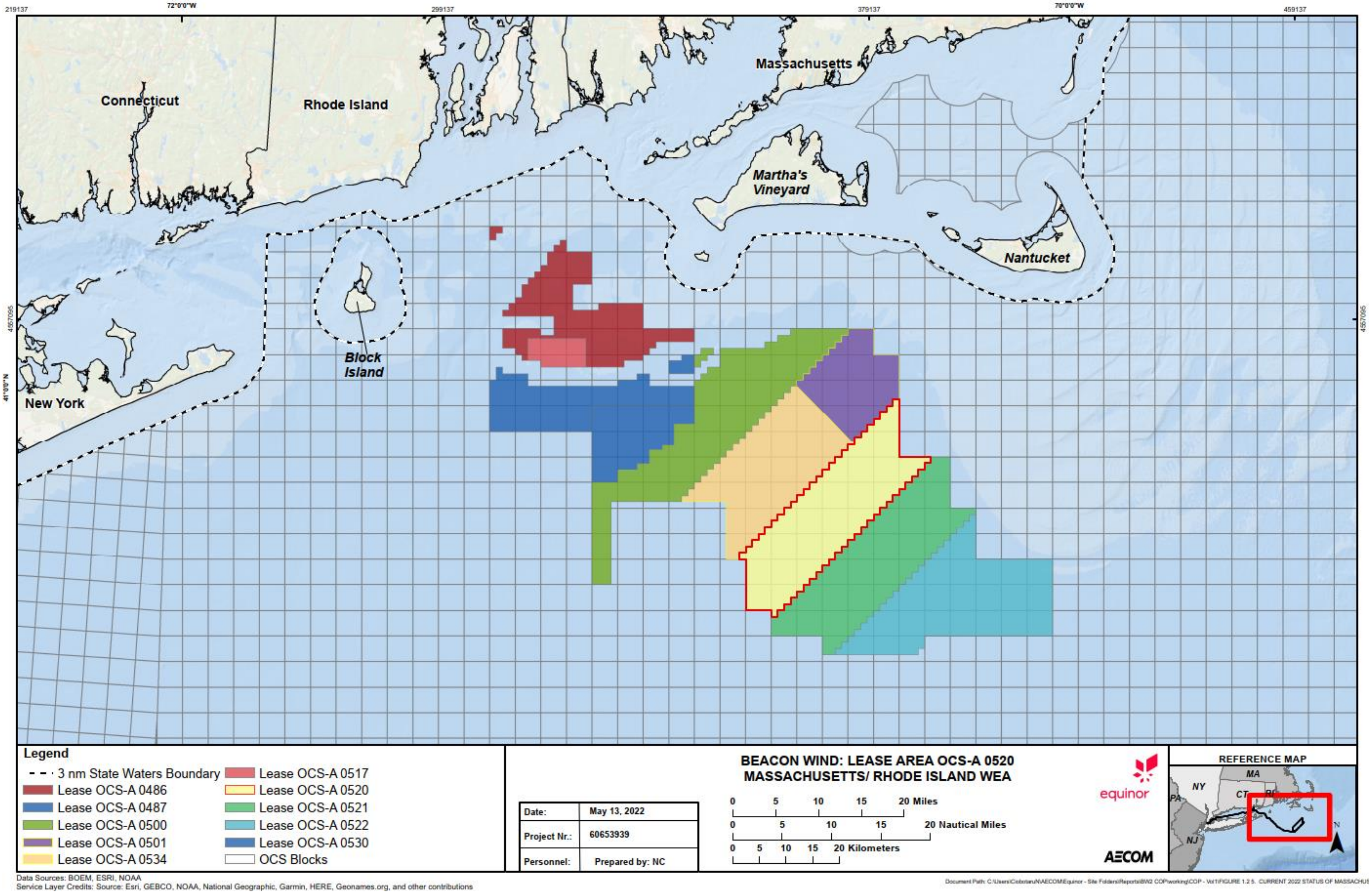
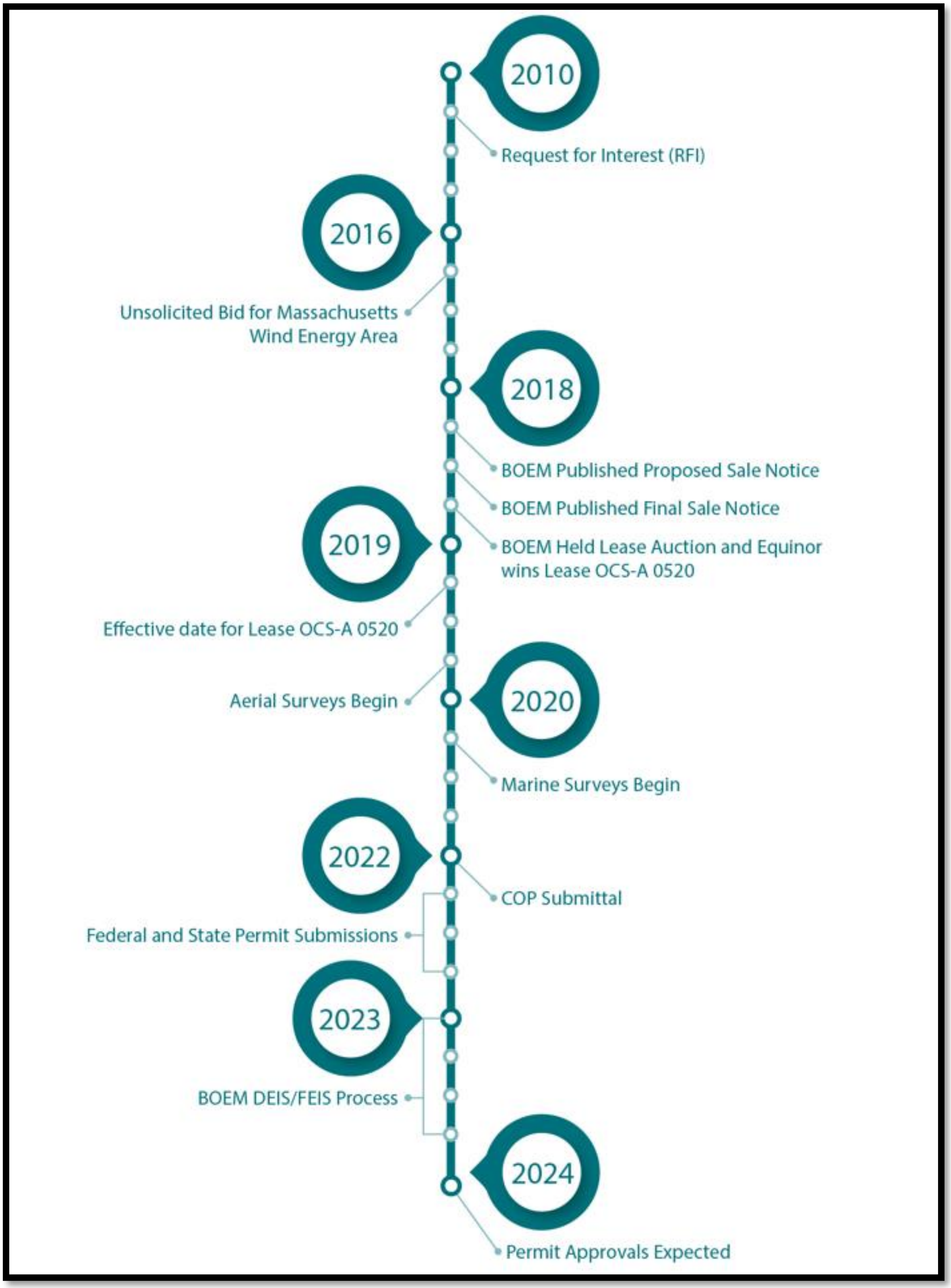


FIGURE 1.2-7. OVERVIEW OF PROJECT MILESTONES



1.2.2 BOEM Renewable Energy Lease OCS-A 0520

The Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0520 (Lease) for 128,811 ac (52,128 ha) went into effect on April 1, 2019. On January 27, 2021, Equinor Wind US LLC assigned the Lease to Beacon Wind LLC, and on January 29, 2021, Equinor Wind US LLC sold 50 percent of non-operated interests in the Project to bp Wind Energy Beacon Holding LLC (bp) as part of a larger transaction in which Equinor Wind US LLC and bp formed a strategic partnership to develop offshore wind in the United States (U.S.). Therefore, the COP and associated attachments refer to Beacon Wind as the Leaseholder. Following issuance of the Lease, Beacon Wind began to conduct comprehensive desktop studies of the environmental resources found within the Lease Area and requested a 12-month extension of the Preliminary Term of the Lease from BOEM on February 11, 2020.[12] BOEM approved the request on March 24, 2020, extending the Preliminary Term from April 1, 2020 to April 1, 2021.

As required by Addendum C, Lease Stipulation 2.1.1, Beacon Wind submitted a High Resolution Geophysical (HRG) and Geotechnical Survey Plans to BOEM on April 4, 2019, January 28, 2020, May 13, 2020, and December 18, 2020, respectively, to conduct site characterization surveys of the entire Lease Area and submarine export cable routes. The survey plans were deemed satisfactory by BOEM on August 6, 2019, August 5, 2020, August 27, 2020, and March 24, 2021, with survey work commencing in August 2020 and are ongoing. The results of these surveys are presented in detail in **Appendix G Marine Site Investigation Report**.

On December 8, 2020, Beacon Wind submitted its Site Assessment Plan (SAP).[13] BOEM determined the proposed facilities to be “not complex or significant” and deemed the SAP complete and sufficient and was approved by BOEM on September 24, 2021, allowing for the installation of one Floating Light Detection and Ranging (floating LiDAR) Buoy, two wave and meteorological buoys, and two subsurface current meter moorings in the Lease Area. The Metocean Facilities were deployed on November 10, 2021 and will collect wind profile and metocean data for an approximately two-year period. Historical and near-real time data from these Beacon Wind metocean facilities detailing wind speed, wind direction, air temperature, relative humidity, barometric pressure, directional waves, current velocity, water temperature, salinity, depth sensor can be publicly viewed at the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) website. [14]

Table 1.2-1 summaries the Lease stipulations and Beacon Wind’s statement of compliance.

[12] Some aspects of developing the Lease Area were performed by Equinor Wind US LLC prior to the assignment of the Lease to Beacon Wind. For simplicity, the COP refers to only Beacon Wind in such instances, unless otherwise noted.

[13] A public version of the SAP is available on BOEM’s website (https://www.boem.gov/BeaconWind).

[14] MARACOOS OceansMap and ERDDAP - Search (maracoos.org)

TABLE 1.2-1. SUMMARY OF LEASE STIPULATIONS

Lease Stipulations	Description	Statement of Compliance/ COP Document Location
Section 4: Payments	(a) The Lessee must make all rent payments to the Lessor in accordance with applicable regulations in 30 CFR § 585, unless otherwise specified in Addendum "B." (b) The Lessee must make all operating fee payments to the Lessor in accordance with applicable regulations in 30 CFR § 585, as specified in Addendum “B”.	Beacon Wind has and will continue to comply with this condition.
Section 5: Plans	The Lessee may conduct those activities described in Addendum "A" only in accordance with a SAP or COP approved by the Lessor. The Lessee may not deviate from an approved SAP or COP except as provided in applicable regulations in 30 CFR § 585.	Beacon Wind has and will continue to comply with this condition.
Section 6: Associated Project Easements	Pursuant to 30 CFR § 585.200(b), the Lessee has the right to one or more project easement(s), without further competition, for the purpose of installing, gathering transmission, and distribution cables, pipelines, and appurtenances on the OCS, as necessary for the full enjoyment of the lease, and under applicable regulations in 30 CFR § 585. As part of submitting a COP for approval, the Lessee may request that one or more easement(s) be granted by the Lessor. If the Lessee requests that one or more easement(s) be granted when submitting a COP for approval, such project easements will be granted by the Lessor in accordance with the Act and applicable regulations in 30 CFR § 585 upon approval of the COP in which the Lessee has demonstrated a need for such easements. Such easements must be in a location acceptable to the Lessor and will be subject to such conditions as the Lessor may require. The project easement(s) that would be issued in conjunction with an approved COP under this lease will be described in Addendum "D" to this lease, which will be updated as necessary.	Beacon Wind herein requests that BOEM issue project easements for the portions of the submarine export cable routes located in federal waters.

Lease Stipulations	Description	Statement of Compliance/ COP Document Location
Section 7: Conduct of Activities	The Lessee must conduct, and agrees to conduct, all activities in the leased area in accordance with an approved SAP or COP, and with all applicable laws and regulations. The Lessee further agrees that no activities authorized by this lease will be carried out in a manner that: (a) could unreasonably interfere with or endanger activities or operations carried out under any lease or grant issued or maintained pursuant to the Act, or under any other license or approval from any Federal agency; (b) could cause any undue harm or damage to the environment; (c) could create hazardous or unsafe conditions; or (d) could adversely affect sites, structures, or objects of historical, cultural, or archaeological significance, without notice to and direction from the Lessor on how to proceed.	Beacon Wind has and will continue to comply with this condition.
Section 10: Financial Assurance	The Lessee must provide and maintain at all times a surety bond(s) or other form(s) of financial assurance approved by the Lessor in the amount specified in Addendum "B." As required by the applicable regulations in 30 CFR § 585, if, at any time during the term of this lease, the Lessor requires additional financial assurance, then the Lessee must furnish the additional financial assurance required by the Lessor in a form acceptable to the Lessor within 90 days after receipt of the Lessor's notice of such adjustment.	Beacon Wind has and will continue to comply with this condition.
Section 13: Removal of Property and Restoration of the Leased Area on Termination of Lease.	Unless otherwise authorized by the Lessor, pursuant to the applicable regulations in 30 CFR Part 585, the Lessee must remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by activities on the leased area and project easement(s) within two years following lease termination, whether by expiration, cancellation, contraction, or relinquishment, in accordance with any approved SAP, COP, or approved Decommissioning Application, and applicable regulations in 30 CFR Part 585.	Beacon Wind will comply with this condition.

Lease Stipulations	Description	Statement of Compliance/ COP Document Location
Section 14: Safety Requirements	The Lessee must: a. maintain all places of employment for activities authorized under this lease in compliance with occupational safety and health standards and, in addition, free from recognized hazards to employees of the Lessee or of any contractor or subcontractor operating under this lease; b. maintain all operations within the leased area and project easement(s) in compliance with regulations in 30 CFR Part 585 and orders from the Lessor and other Federal agencies with jurisdiction, intended to protect persons, property and the environment on the OCS; and c. provide any requested documents and records, which are pertinent to occupational or public health, safety, or environmental protection, and allow prompt access, at the site of any operation or activity conducted under this lease, to any inspector authorized by the Lessor or other Federal agency with jurisdiction.	Beacon Wind has and will continue to comply with this condition.
Section 15: Debarment Compliance	The Lessee must comply with the Department of the Interior's non-procurement debarment and suspension regulations set forth in 2 CFR Parts 180 and 1400 and must communicate the requirement to comply with these regulations to persons with whom it does business related to this lease by including this requirement in all relevant contracts and transactions.	Beacon Wind has and will continue to comply with this condition.
Section 18: Notices	All notices or reports provided from one party to the other under the terms of this lease must be in writing, except as provided herein and in the applicable regulations in 30 CFR Part 585. Written notices and reports must be delivered to the Lessee's or Lessor's Lease Representative, as specifically listed in Addendum "A," either electronically, by hand, by facsimile, or by United States first class mail, adequate postage prepaid. Each party must, as soon as practicable, notify the other of a change to their Lessee's or Lessor's Contact Information listed in Addendum "A" by a written notice signed by a duly authorized signatory and delivered by hand or United States first class mail, adequate postage prepaid. Until such notice is delivered as provided in this section, the last recorded contact information for either party will be deemed current for service of all notices and reports required under this lease. For all operational matters, notices and reports must be provided to the party's Operations Representative, as specifically listed in Addendum "A." as well as the Lease Representative.	Beacon Wind has and will continue to comply with this condition.

Lease Stipulations	Description	Statement of Compliance/ COP Document Location
F -Lease Term and Financial Schedule; Section III -Payments	The duration of each term of the lease is described below. The terms may be extended or otherwise modified in accordance with applicable regulations in 30 C.F.R. Part 585. Lease Term Duration - Preliminary Term: 1 year - Site Assessment Term: 5 years - Operations Term: 33 years Schedule: Addendum "C" includes a schedule and reporting requirements for conducting site characterization activities. Renewal: The Lessee may request renewal of the operations term of this lease, in accordance with applicable regulations in 30 CFR Part 585. The Lessor, at its discretion, may approve a renewal request to conduct substantially similar activities as were originally authorized under this lease or in an approved plan. The Lessor will not approve a renewal request that involves development of a type of renewable energy not originally authorized in the lease. The Lessor may revise or adjust payment terms of the original lease as a condition of lease renewal. (see Lease document for payment schedule).	Beacon Wind has and will continue to comply with this condition.

1.2.3 Proposed Activities

Beacon Wind proposes to build and operate the Project as two individual wind farms, BW1 and BW2, with associated transmission easements, as defined herein. This COP presents a comprehensive description of the construction and operation activities that are anticipated for BW1 with a landfall location in Queens, New York, and BW2 with a landfall in Queens, New York or Waterford, Connecticut.

As discussed in **Section 1.3 Project Design Envelope Approach**, Beacon Wind has adopted a Project Design Envelope (PDE) approach which consists of the components listed below. The range of options in the PDE applies to both BW1 and BW2, unless otherwise noted, and constitute reasonably foreseeable options over the timeline anticipated to reach commercial operation. Beacon Wind has surveyed and/or assessed resources and effects for the entirety of both BW1 and BW2 to the same level of detail. For a full review of the PDE, please see **Section 3.0Project Description**.

Project components in the Lease Area include:

- Up to 157 foundations and associated support and access structures for up to 155 wind turbines and supporting tower structures, based on the regional 1x1 nm (1.9x1.9 km) layout, and up to two offshore substations with HVDC converters, collectively referred to as the offshore substation facilities;
- BW1 and BW2 will each include up to 162 nm (300 km) of interarray cable;
- BW1 will include one submarine export cable route to Queens, New York, consisting of up to 202 nm (375 km) to the landfall, with 87 nm (162 km) in federal waters and 115 nm (213 km) in state waters); and
- BW2 will assess two options in support of a submarine export cable route to Queens, New York or to Waterford, Connecticut:
    - Up to 202 nm (375 km) to the BW2 landfall in Queens, New York, of which 87 nm (162 km) is in federal waters and 115 nm (213 km) is in state waters; or
    - Up to 113 nm (209 km) to the BW2 landfall in Waterford, Connecticut, of which 87 nm (162 km) is in federal waters, 26 nm (48 km) is in state waters with 21 nm (39 km) in New York state waters and 5 nm (9 km) in Connecticut state waters.

Project components onshore include:

- One export cable landfall area in Queens, New York for BW1.
- One export cable landfall area in Queens, New York or Waterford, Connecticut for BW2.
- Up to 0.93 mi (1.5 km) of BW1 onshore export and underground or aboveground interconnection cables.
- Up to 0.93 mi (1.5 km) of BW2 onshore export and underground or aboveground interconnection cables at Queens, New York, if selected.
- Up to 0.55 mi (0.86 km) of BW2 onshore export and aboveground interconnection cables at Waterford, Connecticut, if selected.
- Up to two onshore substations with HVDC/HVAC converters, collectively referred to as the onshore substation facilities, as follows:
    - BW1 onshore substation facility in Queens, New York.
    - BW2 onshore substation facility in Queens, New York, or Waterford, Connecticut.

Figure 1.2-1 depicts the location of the proposed Project components. Section 3.0Project Description provides a detailed description of the proposed Project components.

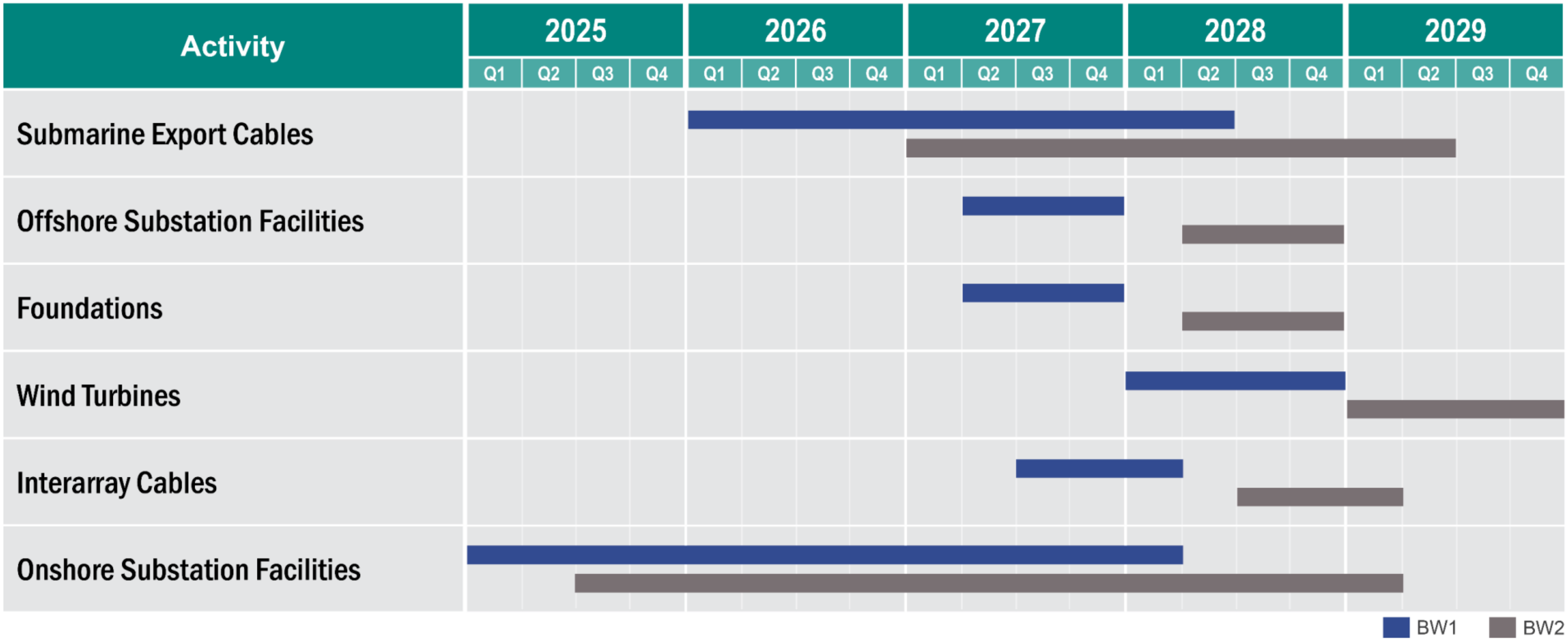
As discussed in **Section 3.4.1 Ports and Equipment**, construction activities will utilize a number of ports for construction and staging areas. Upgrades and improvements of port facilities that may be utilized by Beacon Wind are not assessed herein as any such upgrades are the responsibility of the port facility owners. Ports and construction and staging areas will be appropriately permitted and governed by applicable environmental standards; the use of these facilities by Beacon Wind will be consistent with the existing facilities' activities for which these sites were permitted and developed.

As discussed in **Section 3.5.1 Offshore O&M**, the offshore components will require routine maintenance and inspections. It is anticipated that Service Operations Vessels (SOVs) and smaller support vessels will be used to support operations and maintenance activities offshore. The onshore control room and primary supply warehouse for Beacon Wind will be co-located with those for Empire Offshore Wind LLC at the South Brooklyn Marine Terminal (SBMT). The Project is assessing New Bedford, Massachusetts to act as a satellite O&M facility.

1.2.4 Anticipated Construction Schedule

An anticipated construction schedule for the construction and development of BW1 and BW2 is provided in **Figure 1.2-8**. The schedule assumes that all permits and authorizations will be received by the start of onshore construction no earlier than Q3 2024 for BW1 and Q3 2025 for BW2. Construction schedules are subject to various factors, for example, state and federal permitting, financial investment decisions, power purchase contracts, and supply chain considerations. Therefore, flexibility on construction schedules, particularly in staged construction, is important. As such, the PDE covers reasonably foreseeable schedule scenarios, from which maximum design scenarios are selected as part of the assessment process. Based on the anticipated schedule, offshore construction for BW1 is expected to commence no earlier than Q1 2026 and onshore construction no earlier than Q1 2025, with first power expected in 2028, and for BW2, offshore construction is expected to commence no earlier than Q1 2027 and onshore construction no earlier than Q3 2025, with first power expected in no earlier than 2029.

FIGURE 1.2-8. BW1 AND BW2 ANTICIPATED CONSTRUCTION SCHEDULE



Note: Schedule shown represents current anticipated estimates at the time of the COP submittal. Dates and durations could shift depending on factors such as weather delays, procurement, or contracting issues.

1.3 Project Design Envelope Approach

Development of an offshore wind facility is an extensive and complex process spanning several years. Technology is rapidly advancing for wind turbine generators, foundations, and transmission systems, and BOEM's adoption of the "design envelope approach" allows Beacon Wind to take advantage of these innovations and drive down the Levelized Cost of Energy (LCoE). This is achieved by assessing the maximum parameters for key components (e.g., wind turbines, foundations, and installation methodologies). By assessing the realistic maximum design scenario for each component, the environmental, cultural, and social impact assessment can be robust while allowing for flexibility further on in the development process.

The primary goal of applying a design envelope is to allow for meaningful assessments by the jurisdictional agencies of the proposed project activities, while concurrently providing the Leaseholder reasonable flexibility to make prudent development and design decisions prior to construction. Offshore wind technologies are rapidly advancing, and the flexibility to take advantage of industry innovative technologies as a project progresses through development is critical to ensuring that the most technologically robust, environmentally sensitive, and cost-effective facility is constructed.

In an effort to analyze and apply industry-wide best practices in the U.S., BOEM funded a study entitled *Phased Approaches to Offshore Wind Developments and Use of the Project Design Envelope, Final Technical Report* (BOEM 2017). The study provided the foundation for BOEM's guidance document entitled *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM 2018). Within this guidance, BOEM defines a design envelope as "a reasonable range of project designs" associated with various components of the project (e.g., wind turbines, foundations, and installation methodologies) (BOEM 2018). The design envelope is used to assess the potential impacts on key environmental and human use resources (e.g., marine mammals, fish, benthic habitats, commercial fisheries, navigation, etc.) focusing on the design parameter (within the defined range) that represents the realistic maximum design scenario for each unique resource (BOEM 2017).

The definition of what is considered the realistic maximum design scenario varies based on the potentially impacted resource and is provided at the beginning of each section within **Volume 2 Site Characterization and Assessment of Impact-Producing Factors**; the Maximum Project Design Scenario is also detailed in **Section 3.0 Project Description**. Beacon Wind has ensured that only 'realistic' development scenarios are considered when defining these. For example, while different sizes of foundations are included in the application, the largest foundations may not be required to support the smallest wind turbine. In this case, the assessment would identify and describe the greatest impact associated with the foundation type that would be installed with that size wind turbine. Due to environmental and physical conditions in the Lease Area, there may be more flexibility for wind turbine structures in certain areas, while in others there may be constraints that lead to fewer options for implementation of the full range of PDE design possibilities.

Beacon Wind will continue to mature design and engineering studies to identify facility components that are best suited for the site-specific conditions of the Lease Area. Once BOEM has issued an approval for this COP, the Facility Design Report (FDR) and the Fabrication and Installation Report (FIR) will be submitted for BOEM's review. These reports will also be reviewed by the Certified Verification Agent (CVA).

Based on continuous dialogue with BOEM and cooperating agencies that will be involved in the COP review, Beacon Wind has developed the PDE summarized in **Table 1.3-1**. Details regarding the PDE are provided in **Section 3.0 Project Description**.

TABLE 1.3-1. SUMMARY OF PDE PARAMETERS

Parameter	BW1	BW2	Total
Number of wind turbines a/	61 – 94	61 - 94	155
Number of offshore substation facilities	1	1	2
Number of foundations b/	62 – 95	62 - 95	157
Type of foundations (wind turbines)	piled jackets, suction bucket jackets, monopiles	piled jackets, suction bucket jackets, monopiles	-
Type of foundations (offshore substation facilities)	piled jackets, suction bucket jackets	piled jackets, suction bucket jackets	-
Rotor diameter	984 ft (300 m)	984 ft (300 m)	-
Hub height	591 ft (180 m)	591 ft (180 m)	-
Upper blade tip height	1,083 ft (330 m)	1,083 ft (330 m)	-
Voltage of interarray cables	150 kilovolt (kV)	150 kilovolt (kV)	-
Total length of interarray cables	162 nm each (300 km each)	162 nm each (300 km each)	324 nm (600 km)
Voltage of submarine export cable	Up to 400 kV		-
Total length of submarine export cable	202 nm (375 km)	202 nm (375 km) to Queens, NY 113 nm (209 km) to Waterford, CT	Up to 404 nm (750 km) Up to 315 nm (583 km)

Note:
a/ The maximum number of wind turbines for the Project will not exceed 155. If BW1 includes 61 wind turbines (the minimum) then the 33 wind turbines in the Overlap Area would be incorporated into BW2 which would include the remaining 94 wind turbines; and conversely if the Overlap Area is incorporated into BW1. Of the 33 wind turbines within the Overlap Area they may also be split between BW1 and BW2.
b/ Number of foundations will be based on the number of wind turbines in BW1 and BW2 with one offshore substation facility foundation located in each individual wind farm.

1.4 Purpose and Need for the Project

The purpose of the Project is to generate renewable electricity from offshore wind farms located in the Lease Area. The Project addresses the need for renewable energy identified by states across the region, including New York, Massachusetts, Rhode Island, and Connecticut. The interconnectedness of the New England transmission system, managed by ISO-NE, allows a single point of interconnection in the region to deliver offshore wind energy to all of the New England states (Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and Maine). The magnitude of regional targets for offshore wind and the limited amount of developable area, given current and reasonably foreseeable BOEM leasing activity, demonstrates a need for full-build out of the Lease Area.

In August 2016, the State of New York Public Service Commission adopted the Clean Energy Standard.[15] Under this standard, 50 percent of the State of New York's electricity must come from renewable sources of energy by 2030, with 2.4 gigawatts (GW) of electricity generated by offshore wind. The New York Climate Leadership and Community Protection Act set a goal for 70 percent of New York's electricity to come from renewable sources by 2030 and 100 percent renewable by 2040. As part of this plan, 9 GW of electricity must come from offshore wind by 2035. In 2018, the New York State Energy Research and Development Authority (NYSERDA) issued its first competitive solicitation for 800 MW or more of new offshore wind projects. In 2019, NYSERDA subscribed 1,700 MW and then commissioned another 2,490 MW of offshore wind energy in 2020. As of 2022, 50 percent of the State of New York's offshore wind target remains unsubscribed. On January 13, 2021, New York's Governor Cuomo announced that the State's 2020 competitive solicitation for Offshore Wind Renewable Energy Credits selected the 1,260 MW Empire Wind 2 project and the 1,230 MW BW1 Project. BW1 will be the first wind farm of the Project set forth in this COP.

Within New England, Rhode Island is drafting a request for proposals for up to 1,000 MW of offshore wind, while in March 2021, Massachusetts' Governor Baker signed legislation to allow the state to solicit an additional 2,400 MW, bringing the state's total offshore wind goal to 5,600 MW by 2040, and New Hampshire's legislature is working on a bill to set a 600 MW of offshore wind goal. In June 2019, the Connecticut Department of Energy and Environmental Protection (CTDEEP) and Governor Ned Lamont released notices announcing legislation advocating the development of offshore wind in Connecticut. This legislation authorized the state to purchase up to 2,000 MW of offshore wind. In December 2019, CTDEEP announced the selection of 804 MW of offshore wind power from the Park City Wind Project, which will supply 14 percent of Connecticut's electricity supply. Connecticut has a goal of 100 percent zero-carbon electricity supply by 2040. Beacon Wind's Lease Area has the potential to supply electricity in support of the various state goals described above.

1.5 Regulatory Framework

Under the Outer Continental Shelf Lands Act (OCSLA), the Secretary of the Interior was charged with the administration of mineral exploration and development of the OCS (Title 43, Chapter 29, Subchapter I, Section 1301). In 2005, the OCSLA was amended to authorize the Department of the Interior (DOI) to issue submerged lands leases for alternate uses and alternative energy development on the OCS (Section 388 of the Energy Policy Act of 2005). Through this amendment and subsequent delegation by the Secretary of the Interior, BOEM has the authority to issue these leases and regulate activities that occur within them, including the authorization of a COP.

[15] Case 15-E-0302 & Case 16-E-0270, (NYSERDA n.d.).

As the federal agency charged with issuing the OCS Lease and reviewing and, as appropriate, approving the COP, BOEM will serve as the lead federal agency throughout the permitting process. If this COP is approved, BOEM will also authorize an easement that will be necessary for the portion of the submarine export cable routes that are located in federal waters outside of the Lease Area.

As part of the COP approval process, BOEM must ensure that any activities approved are safe, conserve natural resources on the OCS, are undertaken in coordination with relevant Federal agencies, provide a fair return to the United States, and are compliant with all applicable laws and regulations (30 CFR § 585.102). This includes National Environmental Policy Act (NEPA), which requires the preparation of an Environmental Impact Statement (EIS) for any major federal action significantly affecting the quality of the human environment.

While OCSLA is the primary federal authority with the governing regulatory process for the development of a renewable energy facility within the Lease Area, several other federal, state, and local agencies also have regulatory authority over the Project, given the locations of the Project components. A detailed list of the required approvals and consultations is provided in **Table 1.5-1.**

1.5.1 NEPA Review

As the agency delegated the authority to regulate renewable energy activities on the OCS, BOEM is the Lead Federal Agency for NEPA review and compliance. It is expected that BOEM will prepare an EIS for the activities detailed in the COP. In addition, the U.S. Army Corps of Engineers' (USACE's) issuance of an Individual Permit under the Clean Water Act (CWA) is also considered a federal action and requires NEPA review. Therefore, the USACE could request to be a cooperating agency under BOEM's NEPA process.

During the NEPA process, BOEM will also coordinate and/or consult with other environmental resource agencies as necessary and appropriate, including, but not limited to, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Environmental Protection Agency (EPA), in accordance with other applicable federal statutes and associated regulations, including the Endangered Species Act of 1973 (ESA), Migratory Bird Treaty Act of 1918 (MBTA), the Bald and Golden Eagle Protection Act of 1940 (BGEPA), the Marine Mammal Protection Act of 1972 (MMPA), and the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSFCMA) as amended. These federal agencies could also request to be cooperating agencies under BOEM's NEPA process.

Additionally, BOEM will ensure that applicable federal statutes, which include the Coastal Zone Management Act of 1972 (CZMA, see **Section 1.5.2 CZMA Review**), National Historic Preservation Act of 1966 (NHPA), and Sections 401, 402, and 404 of the CWA, are properly implemented (see **Table 1.5-1**).

The NEPA modifications that were published in 2020 set the target of two years from NOI to Record of Decision (ROD) approval. This includes the "NEPA Substitution" process for integration of compliance under Section 106 of the NHPA into the NEPA review process, including any associated consultation, that was developed to combine scoping opportunities to shorten timeframe from initiation of the EIS process to completion.

Beacon Wind intends to submit a Fixing America's Surface Transportation Act (FAST)-41 Initiation Notice to the DOI requesting to include the Project under the FAST-41 process.[16]

1.5.2 CZMA Review

Similar to the NEPA process, the CZMA process requires that any federal action that has the potential to impact a state's coastal zone or use must be consistent with the state's federally approved coastal zone management plan. Under this federal consistency review, the state's coastal program has the authority to review the proposed action and confirm that it is consistent with the enforceable policies detailed in their plans. As approval of the COP by BOEM and Individual Permit issuance by the USACE are federal actions, a federal consistency determination must be issued before these authorizations can be issued.

As different Project elements occur within or near several states, CZMA review will be required from multiple states. The submarine export cables occur within New York jurisdictional waters and potentially in Connecticut jurisdictional waters for BW2, potential use of an O&M facility is being considered in Massachusetts, and the state of Rhode Island extended its CZMA authority beyond its state jurisdictional boundary and will review a portion of the export cable route corridors. In accordance with the "consistency" requirement of the CZMA (16 United States Code [U.S.C.] § 1456), as well as CZMA § 307(c)(3)(A) and 15 CFR § 930, an evaluation of how Beacon Wind is and will be consistent with relevant policies is provided in **Appendix A Coastal Zone Management Consistency Statements**. A cross reference between CZMA policies and relevant sections of the COP where the policy is addressed is also provided in **Appendix A Coastal Zone Management Consistency Statements**.

1.5.3 State and Local Permits, Approvals, and Consultations

Project components for BW1 are proposed in the State of New York, and approvals from the applicable state and local agencies will also be required. In the State of New York, Public Service Law defines a major electric transmission facility as any project with a design capacity of 100 kV or more extending for at least 10 miles (16.1 km), or 125 kV and over extending a distance of one mile (1.6 km) or more. As the proposed transmission system connecting the offshore wind farm to the interconnecting onshore substation meets this definition, the Project is required to submit an application for a major electric transmission line, as governed by the Article VII process described in 16 New York Codes, Rules and Regulations (NYCRR) Part 86 and 88. Project components for BW2 are proposed in the State of New York, which would be subject to the New York regulations discussed above, and potentially the State of Connecticut. The Connecticut Siting Council requires a Certificate of Environmental Compatibility and Public Need (CECPN) for a transmission line of 69 kV or more, including associated equipment, under the Public Utility Environmental Standards Act, Connecticut General Statutes (CGS) §16-50g.

Ports and construction and staging areas for the Project will be appropriately permitted and governed by applicable environmental standards; the use of these facilities by Beacon Wind will be consistent with the existing facilities' activities for which these sites were permitted and developed.

A summary of the federal and state authorizations and consultations required are detailed in **Table 1.5-1**.

[16] Additional information on the FAST-41 process can be found at https://www.permits.performance.gov/about/title-41-fixing-americas-surface-transportation-act-fast-41.

TABLE 1.5-1. FEDERAL, STATE AND LOCAL AUTHORIZATIONS AND CONSULTATIONS

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
Federal				
BOEM	Outer Continental Shelf Lands Act Commercial Lease, SAP, COP, FDR, and FIR	OCSLA 43 U.S.C. § 1337 Energy Policy Act of 2005	BOEM Final Rule on Renewable Energy Development on the OCS 30 CFR Part 585	The OCSLA delegated authority to the DOI to manage OCS submerged lands, which extend out to sea from the state seaward boundary (beyond 3 nm [5.6 km] generally, 9 nm [16.7 km] in the Gulf Coast). The Energy Policy Act of 2005 further gave the DOI the authority, subsequently delegated to BOEM, for issuing submerged lands leases for alternative energy development on the OCS (i.e., activities that produce or support production, transportation, or transmission of energy from sources other than oil and gas).
USACE New York & New England District	Section 10 Permit for structure in navigable U.S. waters Section 404 Dredge Discharge Permit in navigable U.S. waters Section 408 Permit for activities in a Civil Works Project	Rivers and Harbors Act – Section 10 33 U.S.C. § 333(e), 403 CWA Section 404 33 U.S.C. § 1344	33 CFR §§ 320 et seq.	Section 10 of the Rivers and Harbors Act requires a permit for construction of structures, including the laying of transmission cables, in, under, or over any navigable water or for work affecting those waters. Section 404 of the Clean Water Act requires a permit for the discharge of dredge or fill material into waters of the United States. Section 14 of the Rivers and Harbors Act (33 U.S.C. 408) requires USACE authorization for activities affecting a USACE civil works project.
NOAA Fisheries	Section 7 Consultation under ESA	ESA 16 U.S.C. § 1536	50 CFR § 402	Section 7 of the ESA requires that federal agencies consult with NMFS to ensure their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat to the extent that the species or habitat are within NMFS jurisdiction.
	MMPA Incidental Harassment Authorization (IHA) or Letter of Authorization (LOA)	MMPA 16 U.S.C. §§ 1361 et seq.	50 CFR § 216	A LOA or IHA is required for activities resulting in the incidental take of marine mammals.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
	Magnuson-Stevens Fishery Conservation and Management Act	Magnuson-Stevens Fishery Conservation and Management Act 16 U.S.C. §§ 1801 et seq.	50 CFR § 600	The Magnuson-Stevens Fishery Conservation and Management Act, reauthorized in 2005, set forth the essential fish habitat (EFH) provisions to identify and protect important habitats of federally-managed marine and anadromous fish species. Federal agencies that fund, permit, or undertake activities that may adversely affect EFH are required to consult with the NMFS regarding the potential effects of their actions on EFH.
USFWS Northeast Region (Region 5)	Section 7 Consultation under ESA	ESA 16 U.S.C. §1531	50 CFR §§ 13, 17, 402 50 CFR §§ 10, 22	The USFWS has jurisdiction over federally-listed non-marine species such as birds and some species of marine mammals, including manatees, polar bears, sea otters, walruses, and dugongs. Section 7 of the ESA requires that federal agencies consult with USFWS to determine the potential of a federal action to affect federally listed rare, threatened, or endangered species.
Advisory Council on Historic Preservation (ACHP)	NHPA Section 106 Consultation	NHPA 16 U.S.C. § 470	36 CFR §§ 60, 800	Section 106 of the NHPA requires federal agencies to take into consideration the effects of their actions, including permit approvals, on cultural resources listed on, nominated to, and eligible for the National Register of Historic Places (NRHP). It also requires federal agencies to consult with the State Historic Preservation Office (SHPO) of the state in which federal actions are to take place, or with the Tribal Historic Preservation Office (THPO), as applicable.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
USCG, Sector Southeast New England, Sector New York, Sector Long Island Sound, and First District	Private Aids to Navigation (PATON) Local Notice to Mariners (LNM)	49 U.S.C. § 44718 33 U.S.C. § 1221	33 CFR § 66	The USCG has jurisdiction over marine traffic and national security out to 12 nm (22 km) from shore. As part of the USCG programs for overseeing boating safety, the USGC oversees the placement of PATONs, which are buoys, lights, or day beacons owned and maintained by any individual or organization other than the USCG. The USCG determines the type of aid, lighting, and marking for privately owned marine obstructions or other similar hazards to navigation. The USCG is also responsible for establishing any restricted zones around the facilities that may be desirable and for coordinating traffic during construction of the Project. The USCG has completed several port access route studies including the Massachusetts and Rhode Island Port Access Route Study (MARIPARS), the Northern New York Bight Port Access Route Study (NNYBPARS), and the Atlantic Coast Port Access Route Study (ACPARS) to determine future shipping lanes and port access routes. The USCG should be consulted regarding preferred buffer zones to Traffic Separation Schemes (TSS) and any final ACPARS routes, should any routes be delineated. Request for a LNM is appropriate prior to construction. The request is generally made about 2 weeks prior to commencement of activity.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
U.S. Department of Defense (DoD)	Consultation	Public Law 114-92, National Defense Authorization Act (NDAA) of 2016, Amendment to § 358, FY11 NDAA	32 CFR § 211	Consultation with the DoD regarding the proposed location of the offshore wind turbines and interconnection cables is anticipated to be required. Per DoD Instruction 4180.02 (March 31, 2016; updated August 31, 2018), the DoD will complete its planning assessments for renewable and conventional energy development projects on the OCS when requested by BOEM or on an as-needed basis within 50 days of receiving the request. The review will address any DoD stipulations that BOEM should include in its lease sale agreement with the project proponent. The DoD may review the proposed structures for potential obstruction and radar interference in coordination with the Federal Aviation Administration (FAA), although turbines are likely to be outside of the FAA's 12 nm (22.2 km) jurisdictional boundary. The DoD has a central Siting Clearinghouse to facilitate communication of offshore wind turbine and cable siting, and the Navy has a cable liaison official who also will provide guidance on the potential cable routes across sensitive military areas.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
EPA, Region 1 & Region 2, Air Programs Branch	OCS Air Quality Permit and General Conformity Determination	Clean Air Act 42 U.S.C. §§ 7401 et seq.	40 CFR § 60	Section 328(a) of the Clean Air Act requires that the EPA establish requirements to control air pollution from OCS sources located within 25 mi (40.2 km) of States' seaward boundaries that are the same as onshore requirements. Construction of a commercial wind park will most likely require submission of an OCS air permit. This determination is based on the likelihood that marine vessels or other equipment used to construct and/or operate the commercial wind farm will be considered an “OCS source” and the potential emissions from the OCS source (including emissions from vessels servicing the OCS source within a 25-mi [40.2-km] radius) would trigger Federal and/or State permitting rules as if the source were located onshore. Given ambiguities in the definition of “OCS source” and other past applicability determinations, detailed information on construction activities will need to be provided (i.e., with regard to anchoring or other activities that involve attaching to or resting on the sea floor) and the EPA and state agencies will need to be consulted on this issue.
EPA, Region 1	National Pollution Discharge Elimination System (NPDES) Individual Permit	Clean Water Act Section 316(b)	40 CFR § 122, 125, 33 U.S.C. §§1251 et seq.	EPA regulates point sources that discharge pollutants to waters of the United States pursuant to the CWA (Section 316(b), 40 CFR § 122, 125, 33 U.S.C § 1251 the EPA retains authority over point sources on the OCS. Cooling water intake systems associated with the offshore substation facilities will be located in federal waters and do not fall within any specific state’s jurisdiction. The offshore substation facilities will be considered new facilities and it is anticipated that an individual permit will be administered through EPA Region 1.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
New York				
New York State Public Service Commission	Certificate of Environmental Compatibility and Public Need under Article VII Environmental Management and Construction Plan	New York State Public Service Law, Article VII	16 NYCRR §§ 85-88	Siting of major utility transmission facilities with a design capacity between 100-kV and 125-kV and extending 10 mi (16 km) or more in length, or 125-kV and over and extending a distance of 1 mi (1.6 km) or more, is under the jurisdiction of the Public Service Commission. The Article VII process provides a single forum for approval of the project, and the Certificate issued by the Public Service Commission is the only non-federal approval required to construct a transmission line. For transmission lines extending offshore, only the portion of the line onshore and offshore out to 3 nm (5.6 km) is included in determining the distance of the line.
	CWA Section 401 Certification	CWA, Section 40 New York Environmental Conservation Law (ECL) Article 15, Title 5	6 NYCRR § 608	For federally-permitted activities that discharge to waters of the United States, states have a reasonable period of time, not to exceed one year, in which to review and certify compliance with applicable water quality standards. New York administers its Water Quality Certification under the Protection of Waters Regulatory Program.
New York State Office of General Services (OGS), Bureau of Land Management	Application for Use of State Submerged Land (easement for cables)	New York Public Lands Law Article 2, Section 3, Subdivision 2	9 NYCRR §§ 270 and 271	Structures located on State-owned lands underwater require a license, grant, or easement from the OGS. A permanent structure, including a transmission cable, requires an easement.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
New York State Department of State (NYSDOS), Division of Coastal Resources	Coastal Zone Management Program Federal Consistency Certification	CZMA 16 U.S.C. § 1451 State Executive Law Article 42	15 CFR §§ 923, 930 6 NYCRR § 617 19 NYCRR § 600	Section 307 of the CZMA requires that any applicant for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities in a coastal zone, shall provide the licensing or permitting agency a certification from the State. In New York, the enforceable coastal policies are those in the New York Coastal Management Program, Local Waterfront Revitalization Programs, and Long Island Sound Coastal Management Program. New York also requires consistency review for state actions, including issuance of permits such as the USACE Section 10/404 permits. NYSDOS review of the project would satisfy the requirements of both the federal and state consistency reviews.
	State Pollutant Discharge Elimination System (SPDES) Construction Stormwater Permit	CWA Section 402 ECL Article 17	6 NYCRR § 750-1.21	Before commencing construction activity that will involve soil disturbance of one or more acre, Beacon Wind must obtain coverage under the SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-20-001, effective January 29, 2010). The Article VII process provides a single forum for approval of the project, and the Certificate issued by the Public Service Commission is the only non-federal approval required to construct a transmission line.
New York State Department of Environmental Conservation (NYSDEC)	Protection of Waters Permit	Environmental Conservation Law (ECL) Article 15 Title 5 and Article 70; ECL Article 25	6 NYCRR PART 608	Excavation or placement of fill in navigable waters. The permit is covered by the Article VII process which provides a single forum for approval of the project.
	Tidal Wetlands Act Permit		6 NYCRR Part 661	Consult with NYSDEC and/or local jurisdictions to review wetland maps in project area. Adjacent areas extend 300 feet landward from wetland boundary. The permit is covered by the Article VII process which provides a single forum for approval of the project

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
	Environmental Review for Species of Special Concern	ECL Article 11, Title 5;	6 NYCRR Part 182	Consultation with Division of Fish, Wildlife, and Marine Resources – Bureau of Marine Resources on State Shellfish and Marine Fish Habitat; Rare, Threatened and Endangered Marine Species The permit is covered by the Article VII process which provides a single forum for approval of the project.
	Consultation under Section 106 of the NHPA, Section 14.09 of the New York State Historic Preservation Act of 1980, and Section 233 of the State Education Law (submerged archeological resources)	16 U.S.C. § 470	6 NYCRR § 617	Under the federal and state historic preservation statutes, consultation with the SHPO and appropriate THPOs will be required as part of the federal and state reviews of the project, to evaluate the potential to affect properties listed on or eligible for listing on the NRHP or to affect tribal interests. In New York, Article VII mandates consideration of impacts to cultural resources during project review.
New York City				
New York City Department of Building	New Building and/or Alterations Type 1-3	New York City Administrative Code	New York City Building Code §27-126	Construction or alteration of buildings associated with the onshore substation facilities.
Connecticut				
Connecticut Siting Council	CECPN	Regulations of Connecticut State Agencies (RCSA) Sections 16-50j-1, et seq	Public Utility Environmental Standards Act, CGS §16-50g, et seq.17	Onshore interconnection of the BW2 transmission line (required for lines 69 kV or more) and associated equipment.

[17] https://www.cga.ct.gov/current/pub/chap_277a.htm

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
Connecticut Department of Energy and Environmental Protection (CTDEEP) Land and Water Resources Division (LWRD)	Coastal Zone Consistency Determination	CGS Sections 22a-90 through 22a-112, as amended	Connecticut Coastal Management Act	BW1 and BW2 submarine export cables within Long Island Sound and BW2 submarine export cable within Connecticut State waters per review authorized for USACE permit. BW2 POI, landfall and onshore substation facility in Waterford, Connecticut will be subject to consistency review for building permits.
CTDEEP Land and Water Resources Division (LWRD)	Structures, Dredging and Fill Water Quality Certification	CGS Sections 22a-359 through 22a-363f	CGS Sections 22a-426	Activities in tidal, coastal or navigable waters – including transmission lines. BW2 submarine export cable within Connecticut State waters will require these permits.
CTDEEP Office of Planning and Program Development (OPPD)	Individual Permit	RCSA Sections 22a-30-1 through 22a-30-17	CGS Sections 22a-359 through 22a-363f	Activities that may affect Connecticut natural resources or environment.
CTDEEP Bureau of Natural Resources Wildlife Division	Natural Diversity Data Base (NDDB) State Listed Species Review	CGS Section 26-310 (a)	State Endangered Species Act	Activity located within an area identified as habitat for endangered, threatened, or special concern species within the Waterford landfall and onshore substation facility site.
Connecticut Department of Economic and Community Development – SHPO	Consultation under Section 106 of the NHPA; SHPO Environmental Review - Historic Resource Consultation	16 U.S.C. § 470	CGS 22a-14 to 22a-19 CGS 22a-1	Under the federal and state historic preservation statutes, consultation with the SHPO and appropriate THPOs will be required as part of the federal and state reviews of the project, to evaluate the potential to affect properties listed on or eligible for listing on the NRHP or to affect tribal interests.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
Massachusetts				
Massachusetts Office of Coastal Zone Management	Office of Coastal Zone Management Federal Consistency Certification	CZMA 16 U.S.C. § 1451	15 CFR §§ 923, 930 301 CMR 21.00	Section 307 of the CZMA requires that any applicant for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities in a coastal zone, shall provide the licensing or permitting agency a certification from the State. The state's CZMA enforceable policies are defined within the 2011 Massachusetts Office of Coastal Zone Management Policy Guide. The Beacon Wind Lease Area is located outside of the Massachusetts coastal zone and therefore is not subject to the state's federal consistency review; however, potential use of an existing O&M facility in New Bedford will be subject to consistency review.
Massachusetts Historical Commission	Consultation under Section 106 of the NHPA; SHPO State level review	16 U.S.C. § 470	950 CMR 70	Under the federal and state historic preservation statutes, consultation with the SHPO and appropriate THPOs will be required as part of the federal and state reviews of the project, to evaluate the potential to affect properties listed on or eligible for listing on the NRHP or to affect tribal interests. State SHPO review administered by the Massachusetts Historical Commission.

Regulatory Authority	Permit, Approval, or Consultation	Statutory Basis	Regulations	Applicability
Rhode Island				
Rhode Island Coastal Resources Management Council (RICRMC)	RICRMC Federal Consistency Certification	CZMA 16 U.S.C. § 1451	15 CFR §§ 923, 930 650-RICR-20-00-1	Section 307 of the CZMA requires that any applicant for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities in a coastal zone, shall provide the licensing or permitting agency a certification from the State. Per the RICRMC Federal Consistency Manual, the Beacon Wind Submarine Export Cable would qualify as a Federal License or Permit Activity under the 2011 Geographic Location Description (GLD) as it is an underwater cable that requires a Department of Interior right-of-way easement – this provides the nexus for Rhode Island consistency review. Therefore, Rhode Island's enforceable policies under the CZMA, which could apply to the Beacon Wind Project, include the Ocean SAMP's Section 11.10 and Areas of Particular Concern.

1.6 Agency and Public Outreach

Since execution of the Lease in 2019, Beacon Wind has been and continues to be engaged in extensive outreach with federal, state, tribal governments, and local officials; organizations; fishermen; and other important stakeholders to discuss the Project. At these meetings, Beacon Wind provides background information on the Project, including the scope, proposed environmental, social and technical surveys and evaluations, and the anticipated timing of the permit applications. Beacon Wind also receives feedback regarding survey plans, site design (i.e., export cable routes), and mitigation. The agency and stakeholder coordination and meetings conducted on behalf of the Project are summarized in **Appendix B Summary of External Engagement Activities**. Consistent with Lease stipulations, Beacon Wind continues to engage with Native American Tribes in concert with Empire Wind, including the Delaware Nation, Delaware Tribe of Indians, Narragansett Indian Tribe, Mashpee Wampanoag Tribe, Mohegan Tribe, Wampanoag Tribe of Gay Head-Aquinnah, Shinnecock Indian Nation, and the Mashantucket Pequot Tribal Nation to discuss activities specific to the Lease Area.

With regards to non-regulatory stakeholders, Beacon Wind has developed and continues to implement a dedicated public outreach program. Through this program, Beacon Wind is able to work with and address concerns from various interests, including local communities, environmental groups, fishing communities, maritime groups, and recreational boating groups. Beacon Wind has engaged in communications with these groups through various forums such as informational meetings, press releases, website promotion, social media, information gathering sessions, and workshop participation. Additional information regarding engagement with the maritime community, fishing community, and environmental nongovernmental organizations (ENGOs) is provided in **Section 8.8 Commercial and Recreational Fishing** and **Appendix B Summary of External Engagement Activities**.

Beacon Wind is committed to continued stakeholder communications and effective public outreach. The public outreach program includes the following:

- Continuing to identify and meet with local associations, citizen groups, environmental justice organizations, and other non-governmental organizations to inform them about the Project and address any issues that may be raised;
- Continuing to meet with key federal, state, tribal governments, and local agencies, elected officials, and other potentially interested stakeholders to identify issues;
- Participation in offshore wind events in partnership with NYSERDA, for example, the Offshore Wind Suppliers and Workforce Forum;
- Holding a series of public open houses and community workshops throughout New York, to provide information about Beacon Wind (most recently held virtually on December 15, 2021 and December 16, 2021 with a focus on Long Island residents); and
- Continuing to maintain Project-specific web sites with information on the status of the Project (www.beaconwind.com). Details available on the web site include:
    - A description of the Project;
    - News briefs;
    - Contacts for additional information;
    - Fisheries coexistence plans and notices;
    - Notices of surveys;
    - Survey data reports for download and/or links to relevant websites; and
    - Other appropriate Project-related information.

- Project updates via Twitter (@equinorwindus) https://twitter.com/equinorwindus

1.7 Company Overview

Beacon Wind is a direct, wholly-owned subsidiary of Beacon Offshore Wind Holdings LLC ("Beacon HoldCo"). Beacon HoldCo is jointly owned by (1) an indirect, wholly-owned subsidiary of Equinor ASA (collectively, "Equinor"); and (2) an indirect wholly-owned subsidiary of bp Wind Energy North America Inc. ("bp"). bp acquired ownership interest in Beacon HoldCo in a transaction that closed on January 29, 2021.

Lease OCS-A 0520 was assigned from Equinor Wind US LLC to Beacon Wind LLC on January 27, 2021. Equinor Wind US LLC is the Designated Operator for the Project through development, construction, operations, and decommissioning phases. The PSA was subsequently finalized in January 2022.

Equinor is an international energy company, headquartered in Norway, with operations in over 30 countries. Equinor has approximately 22,000 employees worldwide, is listed on the New York and Oslo stock exchanges (NYSE: EQNR, OSE: EQNR) and has a current market capital valuation in excess of $100 billion.[18] With an extensive portfolio of offshore wind, oil, and gas facilities developed over its 50-year history, Equinor has a proven track record of successfully developing large-scale energy projects in some of the most challenging ocean environments around the world.

With significant in-house capabilities and resources focused specifically on meeting the challenges of offshore energy development, backed by ample financial resources, Equinor is quickly becoming a leader in the development of offshore wind throughout the world:

- Equinor Wind US LLC and its strategic partner, bp, are developing the 2,076 MW Empire Wind (Empire Wind 1 and Empire Wind 2) project located in Lease OCS-A 0512 located off Long Island, New York.
- Equinor has developed, constructed, and operates two major bottom-fixed offshore wind farms in the United Kingdom: (1) the 317 MW Sheringham Shoal offshore wind farm and (2) the 402 MW Dudgeon offshore wind farm.
- Equinor also is the developer, owner, and operator of the 30 MW Hywind Scotland wind farm, the world's first floating offshore wind farm.
- Equinor is a partner in the Arkona Offshore Wind Project, an operational 385 MW wind farm located in the Baltic Sea approximately 22 mi (35 km) from the German coastline.
- Equinor also owns an interest in the Dogger Bank offshore wind farms, a series of projects in the United Kingdom which entered construction in January 2020 with a projected total nameplate capacity of 3.6 GW.

Equinor is a global energy producer with experience in safely developing and operating large-scale offshore assets and infrastructure, including offshore wind resources and electric transmission systems.

Since 2008, Equinor has been pursuing renewable energy opportunities on both the west and east coasts of the U.S., with Leases OCS-A 0512 and OCS-A 0520 representing its first significant U.S. offshore wind investments. Additional information on Equinor can be found on its website: www.equinor.com.

[18] As of March 2022.

1.8 Authorized Representative

Equinor Wind US LLC will be the operator. The contact information for the Authorized Representative is:

Scott Lundin
VP of Permitting and Community Affairs
Beacon Wind LLC
600 Washington Boulevard, Suite 800
Stamford, Connecticut 06901
Email: sclu@equinor.com

1.9 Certified Verification Agent

Pursuant to 30 CFR § 585.705, a CVA must be used to certify that the proposed facility is designed to withstand the environmental and functional load conditions for the intended life of the Project at its proposed location. The CVA will also review the relevant design standards and environmental loading for the structural design of the facilities.

In accordance with 30 CFR § 585.706, BOEM approved the qualified entity that Beacon Wind nominated to serve as the CVA on February 2, 2022 (see **Appendix C Certified Verification Agent**).

1.10 Financial Assurance

In accordance with 30 CFR § 585.516, Beacon Wind is required to provide BOEM a supplemental bond, a decommissioning bond, or other financial instrument to assure that lessee obligations can be fulfilled prior to approval of the COP and prior to authorization to commence construction. BOEM, however, has the authority to allow evidence of financial strength and reliability to meet financial assurance requirements, as detailed in 30 CFR § 585.527.

The parent companies of Beacon Wind have strong financial standing and a long history of undertaking, self-funding, or obtaining, the necessary financing for large infrastructure projects in a responsible manner. Beacon Wind is prepared to demonstrate its financial strength, as required by 30 CFR § 585.527 during the COP review process.

1.11 Design Standards

The CVA will review the site conditions assessment of the geotechnical and metocean conditions. The review also includes certifying the codes and standards hierarchy. These codes and standards will govern the design and development process for the proposed facilities. The final selection of Design Standards is not completed; however, Beacon Wind will establish a preliminary Hierarchy of Standards to be reviewed by the CVA.

1.12 References

TABLE 1.12-1. DATA SOURCES

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml

BOEM (Bureau of Ocean Energy Management). 2013. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhoede Island and Massachusetts. Revised Environmental Assessment. United States Department of the Interior Office of Renewable Energy Programs, Bureau of Ocean Energy Management. May 2013. Available online: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/BOEM%20RI_MA_Revised%20EA_22May2013.pdf/. Accessed October 15, 2019.

BOEM. 2017. *Phased Approaches to Offshore Wind Developments and Use of the Project Design Envelope, Final Technical Report.* U.S. Department of the Interior, Bureau of Ocean Energy Management Office of Renewable Energy Programs. OCS Study BOEM 2017-057. Available online: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/Phased-Approaches-to-Offshore-Wind-Developments-and-Use-of-Project-Design-Envelope.pdf. Accessed July 23, 2020.

BOEM. 2018. *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan.* U.S. Department of the Interior, Bureau of Ocean Energy Management Office of Renewable Energy Programs. January 12, 2018. Available online: https://www.boem.gov/sites/default/files/renewable-energy-program/Draft-Design-Envelope-Guidance.pdf. Accessed July 23, 2020.

BOEM. 2020. *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP).* United States Department of the Interior Office of Renewable Energy Programs, Bureau of Ocean Energy Management. May 2020. Available online: https://www.boem.gov/COP-Guidelines/. Accessed July 23, 2020.

2.0 Project Design Development

2.1 Project Siting

This section presents a description of the development of the PDE as conducted by Beacon Wind. The development of the PDE is informed by several factors, including desktop assessments, site-specific surveys, supply chain capacity, commercial availability, and engagement with regulators and stakeholders (a summary of stakeholder outreach and engagement is provided in **Appendix B Summary of External Engagement Activities**). Where existing public data was available, this was also used to inform the siting assessment. The siting assessment considered alternatives for the POIs, submarine export cable routes, onshore substation facilities, submarine cable landfalls, and onshore cable routes.

The following sections document the criteria used in evaluating various alternatives and refining the components that define the PDE. The siting of the MA WEA and Lease Area for the Project were previously discussed in **Section 1.0 Introduction**. Wind turbine sizing and spacing is addressed in **Section 3.0 Project Description**.

Beacon Wind is developing the Lease Area in accordance with the 1x1 nm (1.9x1.9 km) layout proposal as discussed in **Section 3.1 Regional Array for Fixed Structures**.

2.1.1 Selection of Beacon Wind Electrical Points of Interconnection

One of the requirements to qualify for the procurement of offshore wind renewable energy certificates (ORECs) issued by the State of New York under its Offshore Wind Standard, is that the energy generated by the offshore wind generation facility be delivered into the New York Control Area and incorporate a point of interconnection in NY ISO Zone J (New York City) or Zone K (Long Island). To meet this requirement for BW1, which was awarded ORECs from NYSERDA in January 2020 and finalized in January 2022, Beacon Wind conducted a series of technical, financial, and desktop environmental studies to identify potential POIs to existing electrical substations located within these NY ISO zones. A broad range of factors were considered during these studies leading up to the selection of possible POIs for BW1 in Queens, New York, which are also considered for BW2. These studies and selection criteria are discussed in this section.

Primary assessment and screening information used to select BW1 and BW2 POIs in Queens, New York:

- Identification of existing substations with available capacity to receive greater than 1,000 MW at 115 kV or above;
- HVAC versus HVDC technology options as limited by the distance between offshore substations(s) and the onshore POI;
- Power injection assessments to existing POIs including predicted system impacts;
- Identification of necessary NY ISO upgrades and modifications due to injection and estimated upgrade costs;
- Availability of an existing POI to allow for a commercial operation date to fulfill BW1's OREC obligations in consideration of its NY ISO interconnection queue and other offshore wind energy generators, solar energy projects, regional transmission projects vying for interconnection;
- Land availability for the onshore electrical infrastructure;

- Offshore and onshore routing opportunities to reach potential POIs, and the overall complexity and environmental impact associated with offshore and onshore routing combinations; and
- Potential and relative severity of community and environmental impacts associated with implementing POI solutions.

2.1.1.1 *BW1 and BW2 Queens, New York POI Selection*

The proposed location to connect BW1 and BW2 to the NY ISO transmission system is at the Astoria power complex in Queens, New York City, New York. A POI at this location provides BW1 a delivery point into NY ISO Zone J within the New York City Control Area and a favorable NY ISO interconnection queue position. The actual delivery point for BW1 is one of two, existing substations located within the Astoria power complex, which consists of power generation facilities, tank farms, electrical transmission and distribution infrastructure, and ancillary energy facilities. .

The Astoria power complex was selected over other possible POIs within the New York Control Area that were evaluated for technical and commercial feasibility as well as physical and environmental constraints. After a detailed screening process of dozens of POI options, nine POIs within Zones K and J were assessed in terms of power injection, estimated upgrade costs, land availability, onshore and offshore cable routing, and other factors that could serve the Project. The nine POIs given additional consideration are illustrated in **Figure 2.1-1** and include:

- Astoria Annex 345 kV Substation (Queens, Queens County, New York)
- Goethals 345 kV Substation (Staten Island, Richmond County, New York)
- Goethals 345 kV Tap (Staten Island, Richmond County, New York)
- Shore Road, 345 kV Substation (Oyster Bay, Nassau County, New York)
- Northport 138 kV Substation (Huntington, Suffolk County, New York)
- Astoria West 138 kV Substation (Queens, Queens County, New York)
- Astoria East 138 kV Substation (Queens, Queens County, New York)
- Shoreham 138 kV Substation (Brookhaven, Suffolk County, New York)
- Sills Road 138 kV (Brookhaven, Suffolk County, New York)

While all of these high-voltage substations offer the possibility of energy delivery into the NY ISO Zones J and K, all but the Astoria POI options were dismissed as technically or commercially infeasible because of the following conclusions drawn from the multiple, detailed assessments completed by Beacon Wind during the Project design development process:

- Lack of adequately sized and available land (for purchase or lease) to locate, construct, and operate the necessary onshore substation facility including the converter station equipment to interconnect BW1, while minimizing sensitive environmental and community resources;
- Length of submarine export cables and influence on export cable technology options – see **Section 2.2 Project Components and Technology**;
- Greater complexity of nearshore submarine export cable routing and cable landfall opportunities;
- Greater modeled transmission system impacts and higher estimated transmission system upgrade costs necessary to connect; and
- Limitations for onshore routing and underground duct-bank constraints and configurations.

Two possible POI substations, both owned and operated by Consolidated Edison and located in Queens, New York (i.e., Astoria East and Astoria West) were identified as optimal points to deliver energy from BW1. **Figure 2.1-2** depicts the overall Astoria power complex area that was further reviewed by Beacon Wind for siting of the onshore substation facility.

2.1.1.2 *BW2 Waterford, Connecticut POI Selection*

The findings from the various assessments conducted for identifying optimal POI options for BW1 have been leveraged toward identification of a POI for BW2, as Waterford, Connecticut was a POI location evaluated for the BW1 Project prior to receipt of the PSA with NYSERDA, as depicted in **Figure 2.1-1**. The POI for BW2 is being considered within New York or southern New England, including the potential for BW2 to also interconnect at Queens, New York, as discussed in **Section 2.1.1.1 BW1 and BW2 Queens, New York POI Selection**, or interconnect at the Eversource 345 kV POI within the Dominion Millstone Power Station at the Waterford power complex located in Waterford, Connecticut.

Figure 2.1-3 depicts the Waterford power complex that was further reviewed by Beacon Wind for siting of the onshore substation facility.

FIGURE 2.1-1. BW1 AND BW2 POI EVALUATION

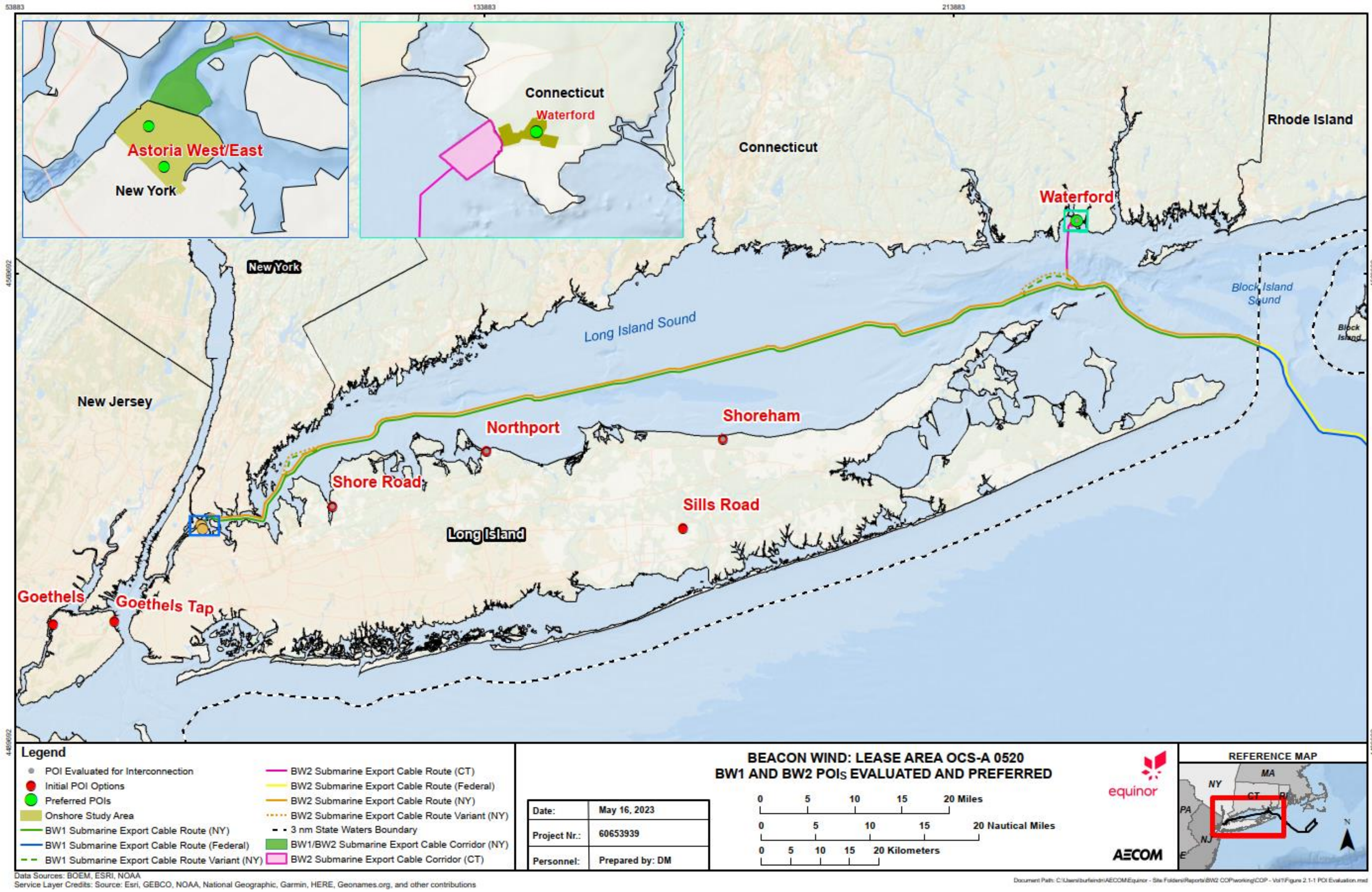


FIGURE 2.1-2. ASTORIA POWER COMPLEX IN QUEENS, NEW YORK

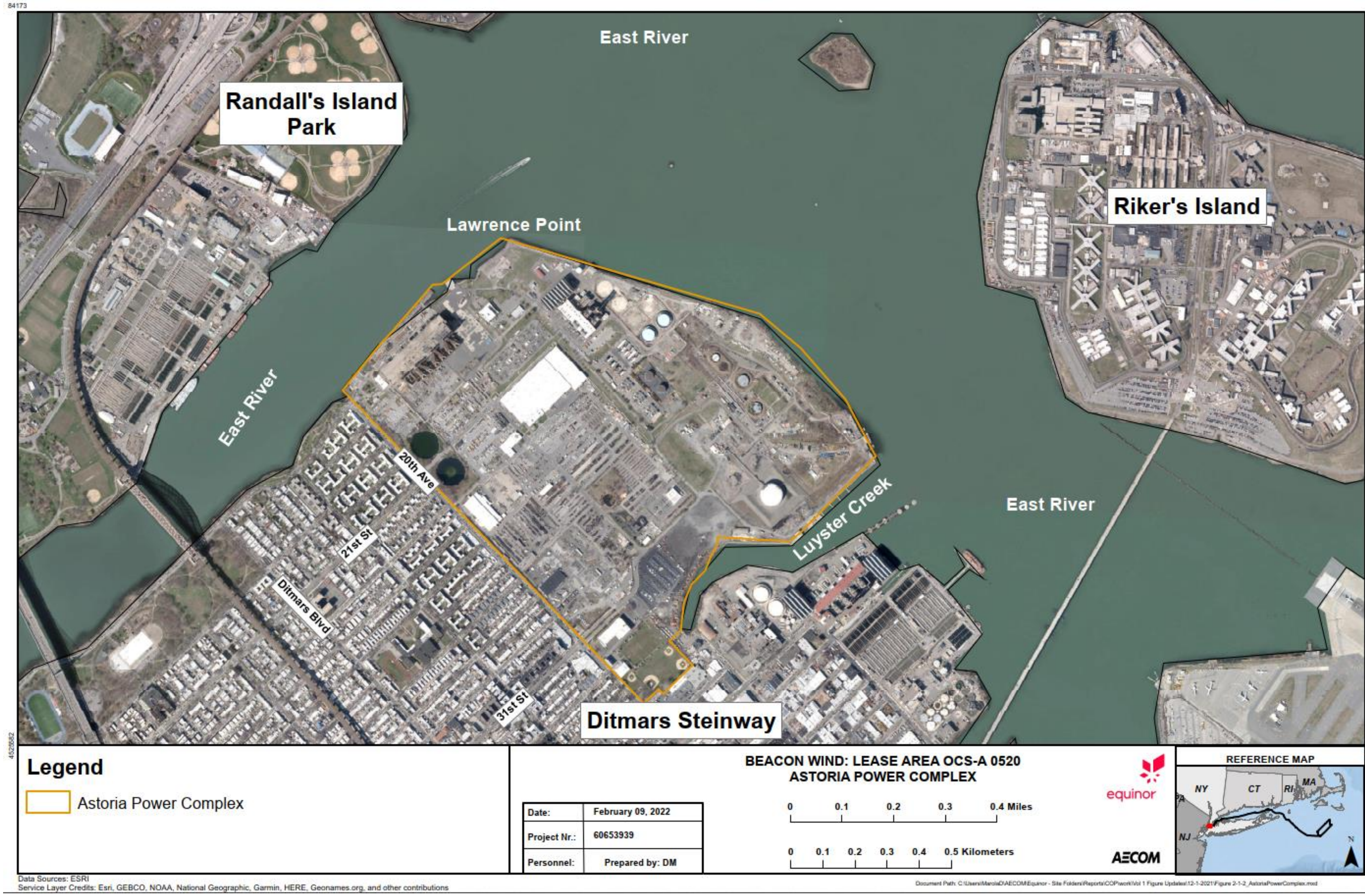
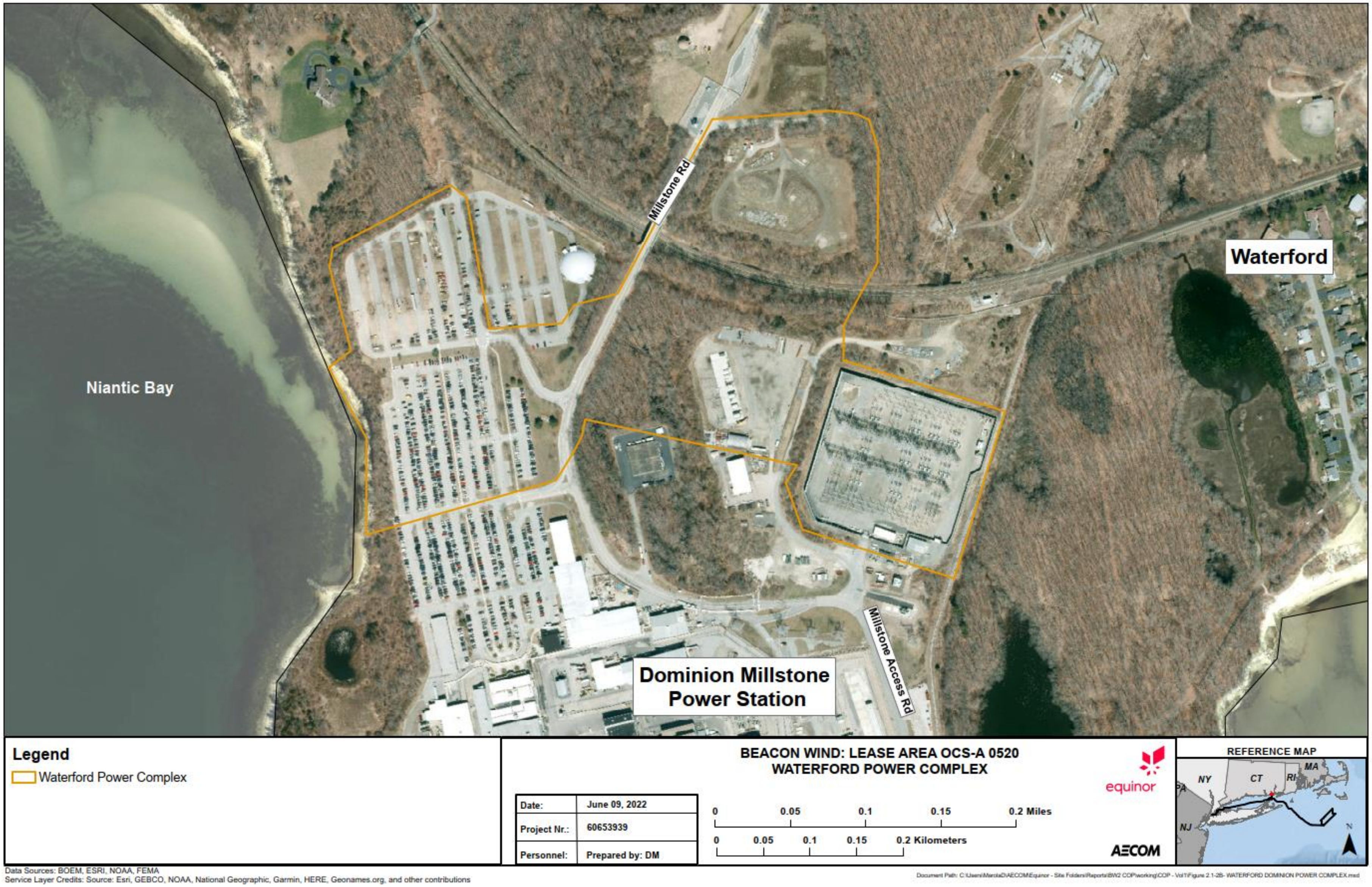


FIGURE 2.1-3. WATERFORD POWER COMPLEX IN WATERFORD, CONNECTICUT



2.1.2 BW1 and BW2 Siting Assessment Overview

The routing and siting assessment for BW1 is dictated by the selection of Queens, New York as the target POI. The POI is located at the Astoria power complex in Queens, New York (**Figure 2.1-2**). The routing and siting assessment for BW2 is dictated by the potential options for POIs in Queens, New York and Waterford, Connecticut.

The Queens, New York POI is a dense industrial energy complex bordered by residential development to the southwest and industrial/commercial development to the southeast. The complex is bordered by the East River and associated waters to the northwest and northeast. The shorelines of the Astoria power complex are mostly manmade with either riprap or bulkheads. There are two substations for potential interconnection in this area: the Astoria East Substation and the Astoria West Substation.

The Waterford, Connecticut POI is an existing power complex situated on a peninsula with Niantic Bay immediately to the west where the property edge is characterized by a rocky shoreline with small areas of sandy beach. To the east is a small area of forested land, which further beyond it is a small residential area situated along Jordan Cove. To the north is undeveloped forest and then pockets of residential development. There is one substation proposed for interconnection that is immediately adjacent to the onshore substation facility: Eversource Substation.

Section 2.1.3 BW1 Submarine Export Cable Routing discusses the offshore cable route alternatives considered between the Lease Area and Queens, New York. The selection of a suitable location for the submarine cable landfall to reach the onshore substation facility is discussed in **Section 2.1.4 BW1 Submarine Export Cable Landfall** and the selection of suitable locations for the onshore substation facility and onshore cable routes are discussed in **Section 2.1.4.1 BW1 Onshore Substation and Cable Routes**.

2.1.3 BW1 and BW2 Submarine Export Cable Routing

Identification of submarine cable route alternatives for BW1 and BW2 was an iterative process conducted over several years. Early cable routing efforts took a wide geographic scope to develop alternatives in parallel with efforts to identify and select POIs for the project. Mainly through desktop assessment relying on geographic information system (GIS) spatial analysis and NOAA nautical chart review, the scope of routing was narrowed as was the refinement of routing alternatives to those alternatives deemed conceptually viable. Once a selection of viable alternatives was made, routing focused more carefully on potential constraints within defined routing corridors. In turn, these routing corridors were elected for marine site characterization as a part of Beacon Wind's ongoing high resolution geophysical survey campaign. The information below explains some of the details about how export cable routing was conducted in support of the Project, including the following constraints:

- Geophysical/Oceanographic
- Physical, Biological, Ecological and Cultural
- Potential Hazards
- Regulated Areas

Completion of the initial desktop assessment aided in the planning of survey activities to further evaluate and characterize the marine environment along the submarine cable route. Data collected from survey campaigns conducted from August 2020 into January 2022 and currently ongoing will inform final micrositing of the route.

2.1.3.1 *Submarine Cable Routing Constraints*

Submarine cable routing was conducted following guidance contained in current industry-standard best practices and guidance published by the Institute of Electrical and Electronics Engineers (IEEE) Power Engineering Society (2004), Carbon Trust (2014), Det Norske Veritas/DNV (2014), and the International Cable Protection Committee (ICPC) (2015). The criteria used in determining the preliminary marine routes involved the use of publicly available information from NOAA, BOEM, Northeast Regional Ocean Council (NROC), and other sources. Criteria such as water depth, seafloor differences (unconsolidated vs. hard-bottom), topography, and sediment types, among others, were used as the basis for the routing assessment. The routes were sited to avoid additional resources/use areas including unexploded ordnance (UXO) areas, shipwrecks (and other submerged obstructions), artificial reefs, mapped protected habitats, anchorage areas, and historic sites. Other information such as the locations of existing utility lines, pipelines, and human use areas such as vessel traffic lanes, commercial/recreational fishing areas, aquaculture, and shellfish management areas informed the routing analysis, although these constraints are not considered critical flaws for the siting of a submarine cable and are largely unavoidable, particularly in the western portion of the study area near New York City. Nonetheless, fully understanding and accommodating these unavoidable constraints generally adds complexity and cost to the project design and cable installation. The following subsections outline the steps taken to evaluate cable routing options from the Lease Area to potential landfall locations and provide a brief description of the types of constraints and opportunities that were considered.

2.1.3.1.1 *Geophysical/Oceanographic*

Geophysical/Oceanographic features mapped by BOEM, NOAA, and U.S. Geological Survey (USGS) determine the feasibility and risks of installation of a submarine cable and include water depth, type of seafloor (e.g., soft sediment, hard bottom), thickness of surficial sediments, bathymetry, topography (e.g., slopes, elevation changes and mapped submarine features such as sand waves), and complex sea floor.[19]

2.1.3.1.2 *Biological and Ecological Resources*

Biological and ecological resources mapped by federal and state agencies include types of habitats or areas that support various aquatic species that have significant ecological or economic value. These types of resources include eelgrass beds, scallop biomass areas (assumed potential for shellfish harvesting), aquaculture, shellfish management areas, artificial reefs, commercial and recreational fishing areas, threatened and endangered species habitats, and wildlife/marine species management areas.

2.1.3.1.3 *Cultural Resources*

Cultural resources include archaeological sites, historic/architectural properties, or historic districts that have been listed in, or determined eligible for listing in, the NRHP as well as resources that are recorded by the New York SHPO on the New York State Register of Historic Places (NYSRHP) and the Connecticut SHPO on the State Register of Historic Places. Cultural and historic resources data were obtained from the NRHP, NYSRHP, and the Connecticut State Register of Historic Places. These sources consist of districts, sites, buildings, structures, and other objects of known or potential value

[19] Complex seafloor is a characterization of seabed ruggedness and complexity and provides a measure of seafloor variation.

to prehistory, history, upland and underwater archaeology, architecture, engineering, and culture of the United States, the State of New York, and/or the State of Connecticut.

2.1.3.1.4 *Physical Constraints and Potential Hazards*

Multiple marine and submarine constraints have been identified and mapped by NOAA, BOEM, USCG, USACE, NROC, New England Fishery Management Council, and others including:

- Shipwreck data;
- Commercial shipping lanes;
- Artificial reefs;
- Sediment/sea floor substrate classifications;
- Utility/telecommunication line locations;
- Pipeline locations;
- Munitions and explosives of concern (MECs)/UXOs;
- General submerged obstructions; and
- Vessel anchorage areas.

2.1.3.1.5 *Regulated Areas*

Establishing a submarine cable route presents many challenges with the physical constraints, environmental features, a potential use conflicts; however, another facet considered as part of this routing analysis is federal and state regulated areas that could impact a submarine cable route with additional approval requirements, restrictions, and/or impact analysis. These areas include:

- Limits of states' jurisdiction;
- USCG Homeland Safety zones;
- USCG speed zones;
- Rhode Island Special Area Management Plan (SAMP);
- New York State Significant Coastal Fish and Wildlife Habitats;
- Connecticut Long Island Sound Blue Plan Ecologically Significant Areas
- BOEM Lease Areas; and
- DoD Regulated Areas.

Areas that are regularly occupied by protected species (e.g., North Atlantic humpback whale) and designated habitat areas (e.g., Essential Fish Habitat) were considered in the cable planning process, especially with respect to regulatory risk and potential restrictions on construction (i.e., time of year restrictions).

2.1.3.2 *Preliminary Submarine Export Cable Routing Concepts*

2.1.3.2.1 *BW1 and BW2 Approach to Queens*

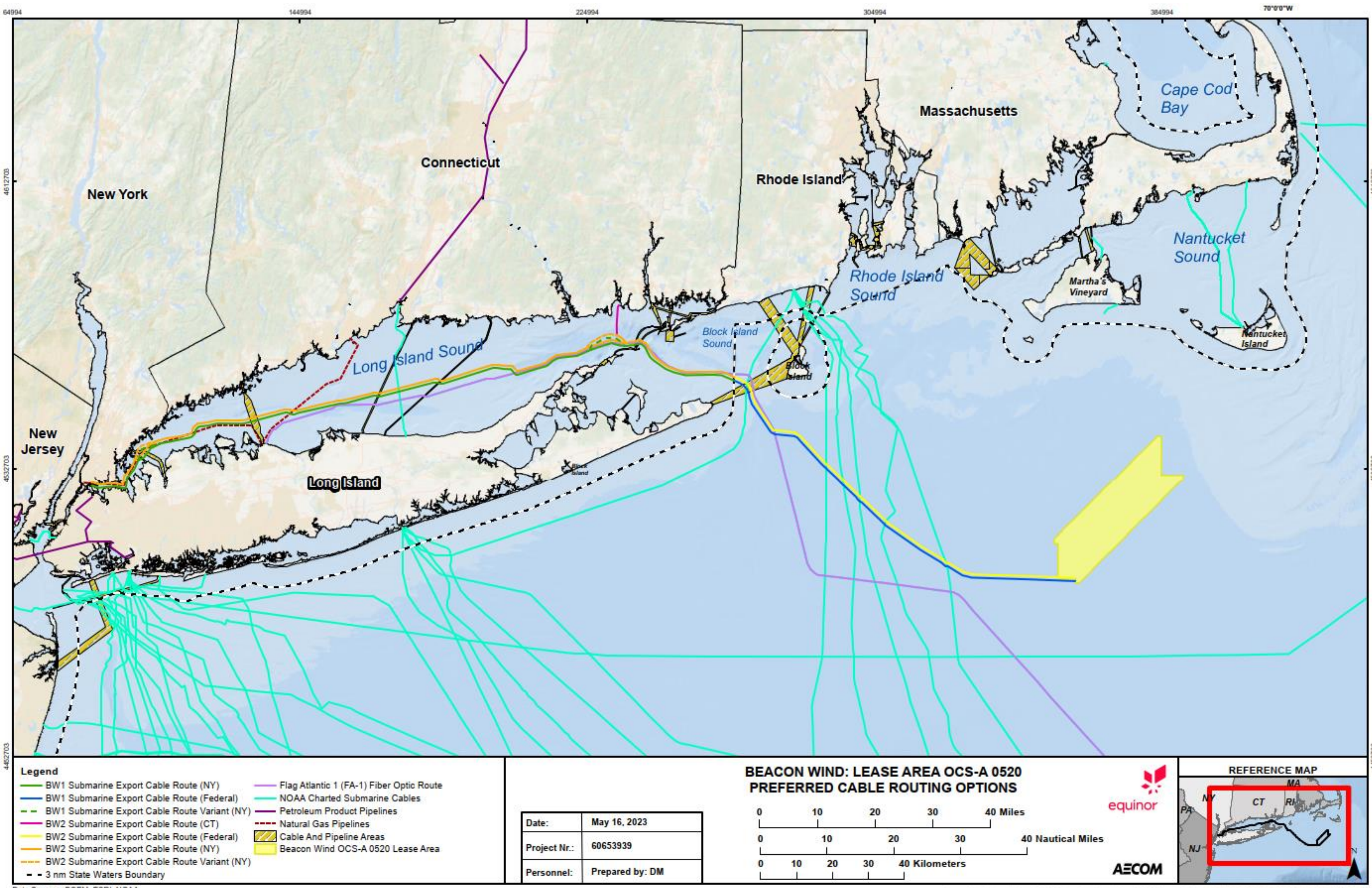
Three alternative concepts were considered between the Lease Area and Queens, New York, based on the preliminary constraints data described above.

- Submarine route through Long Island Sound (preferred);
- Submarine route through New York Harbor; and
- Submarine export cable route south of Long Island with land route across Queens.

The route into Long Island Sound (**Figure 2.1-4**) is a proven concept, as demonstrated by the FA-1 fiber-optic cable that was installed in 2000. The Long Island Sound Blue Plan establishes submarine cables as a compatible use of Long Island Sound considering the presence of several other existing linear utilities (CTDEEP 2019). Also, natural gas pipelines, telecommunications (fiber optic), and electrical transmission cables are installed within Long Island Sound, providing energy interconnections within New York and between New York and New England.

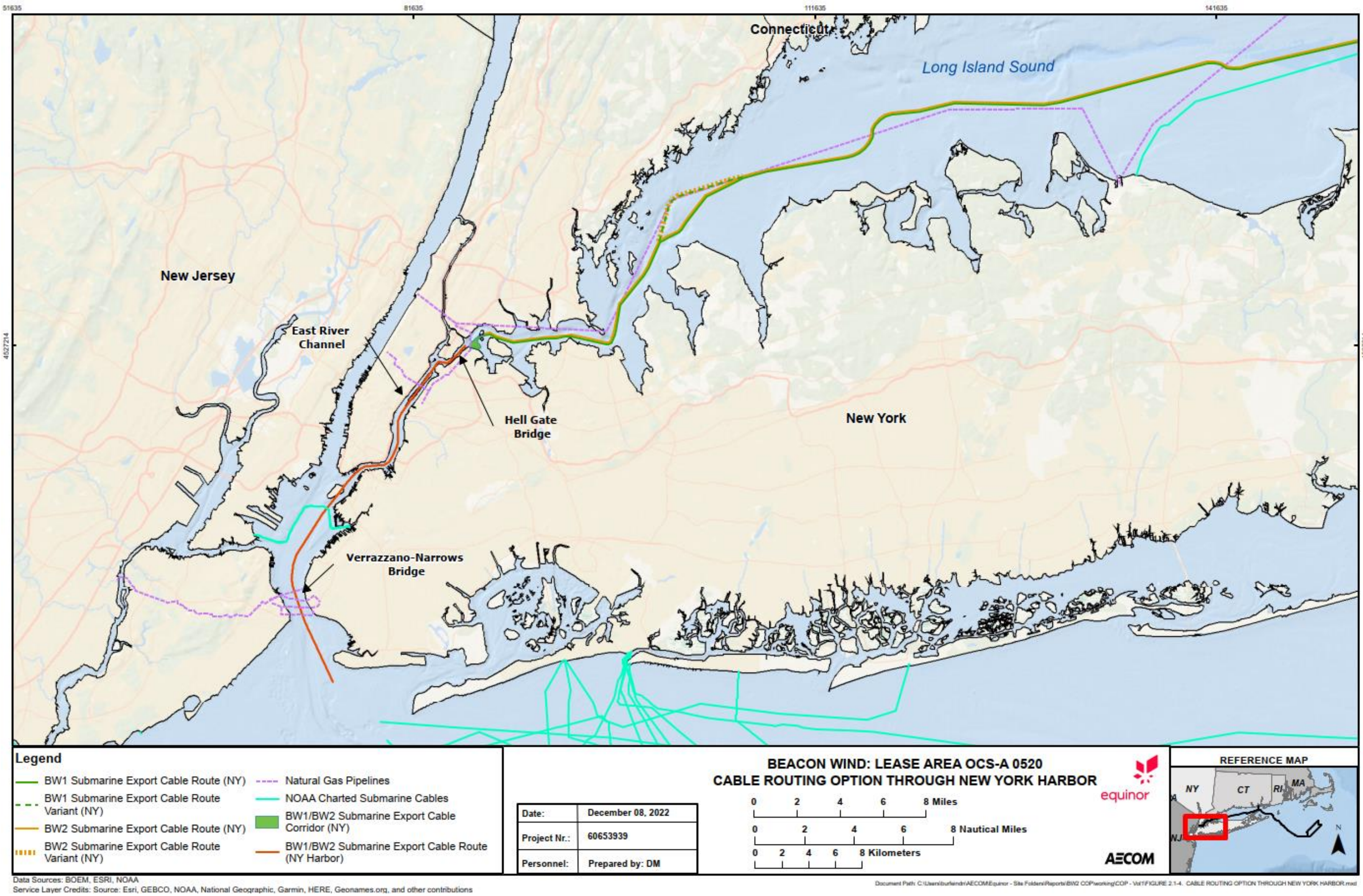
The submarine route through New York Harbor (**Figure 2.1-5**) would require encroachment along the federally maintained East River Channel. The route would require crossing beneath seven bridges between the Verrazzano-Narrows Bridge and Hell Gate Bridge. Furthermore, the geology of the East River in the vicinity of Hell Gate is known to be exposed bedrock due to the blasting that was performed by the U.S. Army Corps of Engineers in the late 1800s, which would therefore require surface laying the cable and adding cable protection. There was also consideration for the limited availability of routes through New York Harbor because of future offshore wind projects in the New York Bight likely needing to bring submarine cables into these waters. These construction challenges make the submarine route through New York Harbor impracticable for the Project.

FIGURE 2.1-4. PREFERRED CABLE ROUTING OPTIONS



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other

FIGURE 2.1-5. CABLE ROUTING OPTIONS THROUGH NEW YORK HARBOR



The submarine export cable route south of Long Island with land route across Queens would require extensive in-street work within densely developed areas of Queens and the use of public parkland or open space to partially avoid in-street work. Street corridors in Queens have significant existing utility congestion, including existing electric and telecommunication lines; pipelines; sewer and water mains; and transportation infrastructure such as subway and railroad crossings. The existing utility congestion constrains the available space for routing duct banks for the Project cables, and the number of infrastructure crossings along the roadway corridors adds significant cost and construction duration associated with the need for additional geotechnical work; cable splice and transition vaults; horizontal directional drilling (HDD), jack-and-bore, and other trenchless infrastructure crossings; utility relocations; and soil and water management, decontamination, and disposal.

Onshore, in-street, routing is likely to result in traffic impacts and road closures during cable installation, which may result in disruption to local business and residents. In-street routes also place construction in closer proximity to noise receptors such as residences, commercial areas, and noise-sensitive locations such as schools and hospitals. Use of parkland along the shoreline can avoid some in-street work, but still requires numerous infrastructure crossings. This routing would also result in temporary disruption to recreational use and potential parkland alienation for easement acquisition and would still be in closer proximity to noise receptors and result in greater street traffic disruption than offshore construction activities. The combination of challenging and costly construction and community impacts make the onshore route through Queens technically and commercially infeasible for construction of the Project.

The route into Long Island Sound (**Figure 2.1-4**) was selected as the preferred routing concept for the Project for several reasons. A submarine route was preferred over an onshore route because of the challenges associated with rights-of-way acquisition in densely settled areas, potential concerns voiced by residents and other stakeholders in the vicinity of the Project, the need to account for potential resource area impacts, including potential wetlands and waterbodies, and/or visual impacts from overhead transmission structures.

The route into Long Island Sound was selected and matured along with the overall Project. Other routes were evaluated and dismissed as infeasible because of one or more critical technical and environmental constraints. Of additional concern, the proposed route was chosen because routing and installing submarine cables into Long Island Sound is a proven concept, as demonstrated by the presence of several existing utilities present throughout Long Island Sound.

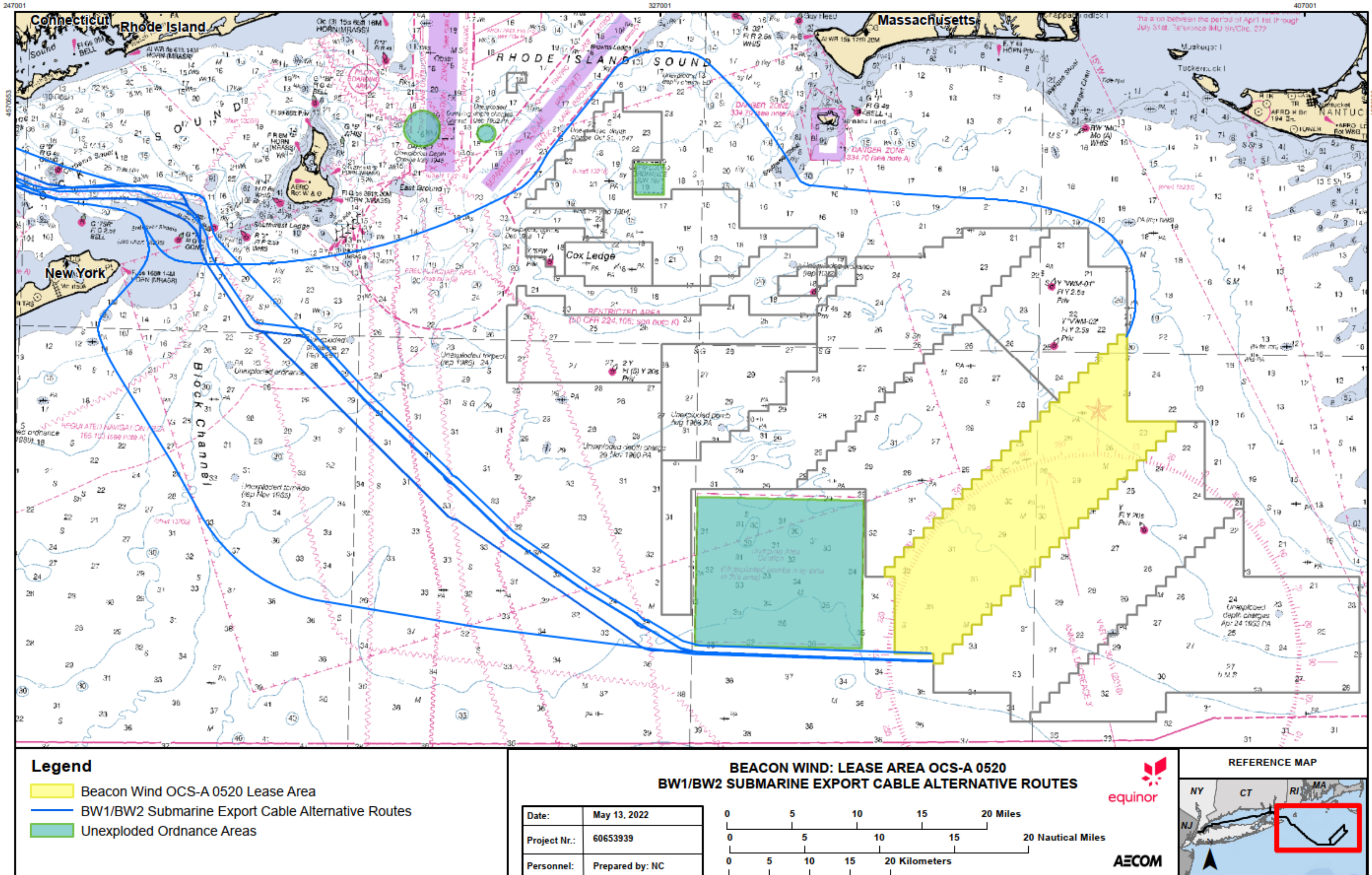
2.1.3.2.2 *BW1 and BW2 Approach to Long Island Sound*

Two alternative routes from the Lease Area to the entry to Long Island Sound were identified (**Figure 2.1-6**):

- Southern-exit Alternative (preferred); and
- Northern-exit Alternative.

The Northern-exit Alternative exits the northern portion of the Lease Area and travels in a northwest direction heading along the northern borders of BOEM’s Northeast lease blocks, turning southwest north of BOEM Lease Block OCS-A 0486 (Orsted’s Revolution Wind), traveling south of Block Island and west towards Montauk, New York. This segment is approximately 93 mi (150 km) and is comprised of deep-water open ocean area waters with relatively flat (no slopes greater than 20 percent) seafloor comprised mainly of sand. There are at least eight cable crossings - six telecom/fiberoptic and two proposed offshore wind cable systems (Vineyard Wind and Revolution Wind), although the total number of cables being proposed from the BOEM lease areas north of Beacon Wind are unknown at this time.

FIGURE 2.1-6. ALTERNATIVE BW1 AND BW2 ROUTES TO THE LEASE AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

Several variations of the Southern-exit Alternative exit the southern portion of the Lease Area and head due west before turning to the north towards Montauk, New York. The exit from the southwestern corner of the Lease Area is primarily driven by the location of a military disposal ground for MECs/UXOs due west of the Lease Area that must be avoided. This segment is approximately 75 mi (121 km) and is comprised of deep-water open ocean areas to the limit of the State of New York waters with a relatively flat (no slopes greater than 20 percent) seafloor comprised mainly of sand. The route avoids mapped MEC/UXO locations and dumping areas. It passes through vessel operation restriction zones for marine protected species, namely North Atlantic right whale. There are at least seven cable crossings - five telecom/fiberoptic and two proposed offshore wind cable systems (South Fork Wind and Sunrise Wind), although the total number of cables extending from the BOEM lease areas north of Beacon Wind are unknown at this time. The Southern-exit Alternative route travels north into Block Island Channel running parallel to the FA-1 fiber optic cable while skirting the eastern lobe of Endeavor Shoals.

The Southern-exit Alternative was established as the preferred route because it minimizes the total cable length by providing for an 18 mi (29 km) shorter route, thereby minimizing overall impacts, and minimizes anticipated cable crossings from proposed offshore wind projects north of Beacon Wind.

2.1.3.2.3 *BW1 and BW2 Entry into Long Island Sound*

Two alternative routes were considered at the entrance of Long Island Sound (**Figure 2.1-7**):

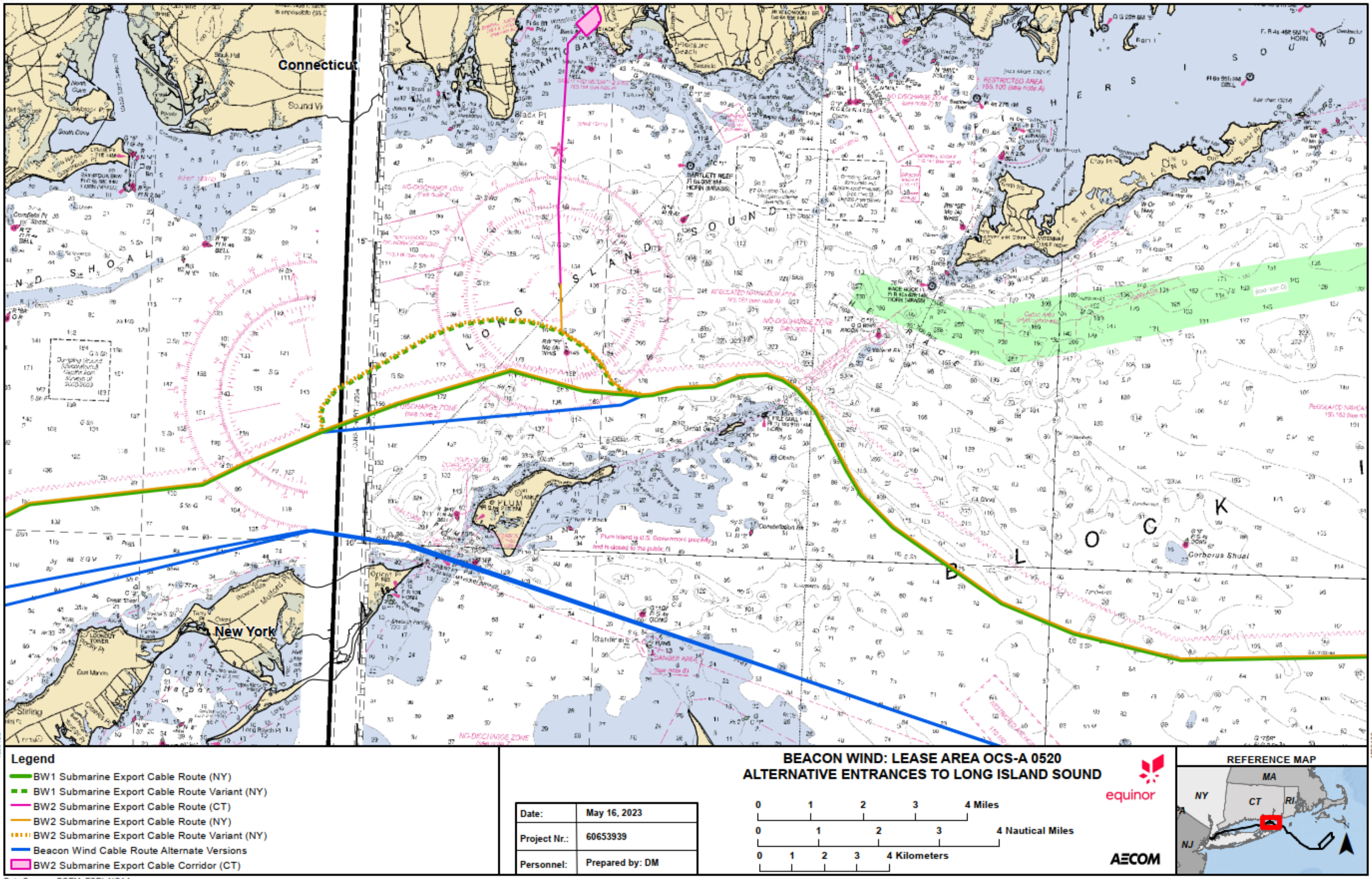
- The Race Alternative (preferred); and
- Plum Island Cut Alternative.

The Race Alternative continues from the State of New York waters to the Long Island Sound Entrance segment heading northwest into an area known as “The Race” north of Little Gull Island before turning southwest and heading into Long Island Sound. The Race is well-known for its waters with relatively high currents/tidal action and a hard, sloped, and complex seabed that creates cable installation challenges. This segment is approximately 21.7 mi (35 km) long and is comprised of deep-water (90 to 328 ft [30 to 100 m]). Shagwong Reef and Cerberus Reef are in the vicinity of this route segment but are avoided. This segment generally follows to the south of the NOAA mapped location of the FA-1 fiber optic cable.

The Plum Island Cut Alternative diverges at the same place as The Race Alternative but travels due west through Plum Gut, which is an approximately 0.93 mi (1.5 km) wide stretch of water between Orient Point (Long Island) and Plum Island. This segment is approximately 19.9 mi (32 km) long and is comprised of waters ranging in depth from 52.5 to 98.4 ft (16 to 30 m). Early desktop cable routing studies identified constraints associated with this segment including one pipeline/cable area crossed within Plum Gut, hard-complex seafloor, and the relatively narrow gap and existing navigation features. Charted fish trap areas, tidal rips, sand waves, aids to navigation, danger areas (Gardiners Point Military Area), and restricted anchorages also indicate the complexity of this area.

The Race Alternative is preferred due to deeper water depths, less challenging seabed, and the lack of other constraints present in the Plum Island Cut Alternative, including existing utilities and navigation features, charted fish trap areas, and danger areas. The area between Plum Island and Great Gull Island is shallower and was dismissed due to severe installation challenges in such shallow water depths. An HDD under Plum Island was dismissed as technically infeasible due to the length of HDD that would be required.

FIGURE 2.1-7. ALTERNATIVE ENTRANCES TO LONG ISLAND SOUND



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

2.1.3.2.4 *BW1 and BW2 Routing through Long Island Sound*

Submarine export cable routing alternatives to Queens, New York, and the other POIs along the north shore of Long Island, New York, were assessed in the Project development process by desktop routing studies. The preliminary results of these studies informed the overall selection of the Queens, New York, POIs over the other POI options. Also, the assessments led to the formulation of a preferred submarine export cable route across Long Island Sound to Queens, New York, including the BW1 submarine export cable route and the BW2 submarine export cable (New York).

The cable route across Long Island Sound has been developed to minimize the impact to sensitive environmental resources to the maximum extent practicable (**Figure 2.1-8**). Sediments along this segment transition from sands and gravels with hard and complex sea floor near the mouth of the Sound to higher concentrations of silt with fewer areas of complex sea floor as the cable corridor extends to the west, toward the East River. Water depths range from approximately 0.3 ft (0.1 m) lowest astronomical tide (LAT) up to 223 ft (68 m) LAT.

At the eastern end of the Sound, there are relatively few charted constraints or submarine asset crossings. Orient Shoal is a low water area marked by several aids to navigation and there is one anchorage area (Riverhead Anchorage) that occurs landward of the route segment. This route avoids Stratford Shoal (Middle Ground) Light and two other anchorage areas (i.e., Port Jefferson Anchorage and Northport Anchorage Ground). The route crosses six utilities in the Sound, including: Cross Sound Cable, FA-1 fiber optic cable, Long Island Reinforcement Cables (LIRC) cable area, Iroquois pipeline, and two unknown fiber optic cables. Near the entrance to Long Island Sound, northwest of Great Gull Island and near The Race, a route was assessed immediately south of the preferred alignment to allow flexibility in crossing an area of sand waves, however it was determined that seafloor topography posed limitationsand therefore was removed from consideration.

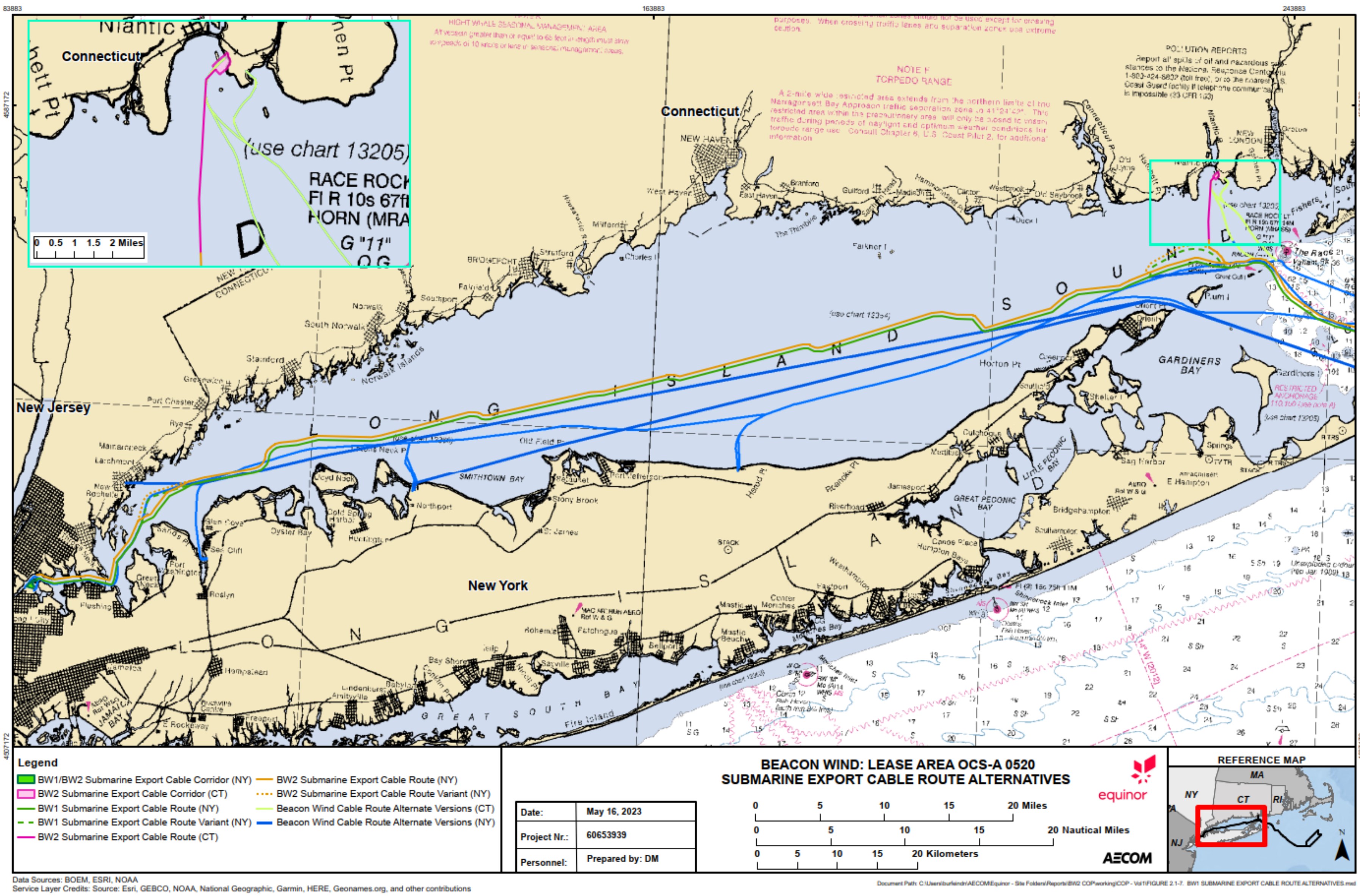
At the western end of Long Island Sound, the route seeks to avoid multiple charted features including: a dredge disposal area, Eatons Neck Point (and navigational aids), Fish Haven/Matinecock Point and other charted obstructions. The route crosses the LIRC cable area and the Eastchester Expansion (Iroquois pipeline) to then parallel this gas pipeline into the East River. A minimum setback distance of 328 ft (100 m) away from the Eastchester Expansion pipeline was applied to the proposed route to allow space for existing pipeline and future cable work corridors.

2.1.3.2.5 *BW1 and BW2 Route through East River*

The East River segment parallels the Eastchester Expansion pipeline at a minimum setback of 328 ft (100 m) heading south and west out of Long Island Sound and into the East River. The route is positioned outside of the East River Channel (federal navigation project) to the maximum extent practicable; however, there are areas where encroachment on the Channel is likely necessary. To avoid the Eastchester Expansion pipeline and other space restrictions on the northern side of the channel, the route travels westward along the outside of the charted southern edge of the channel until Rikers Island. This segment is approximately 16.2 nm (30 km) and is comprised of near-shore waters with approximately 64 percent of sediments being comprised of silt. Multiple cable and pipeline areas are crossed within this segment, including known New York Power Authority (NYPA) and Long Island Power Authority (LIPA) power cables and numerous unknown cables and mapped obstructions. In addition to these obstructions, there are also multiple navigational risks such as bridges (e.g., Throgs Neck Bridge, Bronx-Whitestone Bridge), navigation aids, and a U.S. Coast Guard security zone (i.e., New York Marine Inspection Zone and Captain of the Port Zone).[20]

[20] See 33 CFR 165.163: Navigation regulations are published in Chapter 2 of the U.S. Coast Pilot for this area. Restrictions include entry and speed restrictions.

FIGURE 2.1-8. BW1 AND BW2 SUBMARINE EXPORT CABLE ROUTE ALTERNATIVES



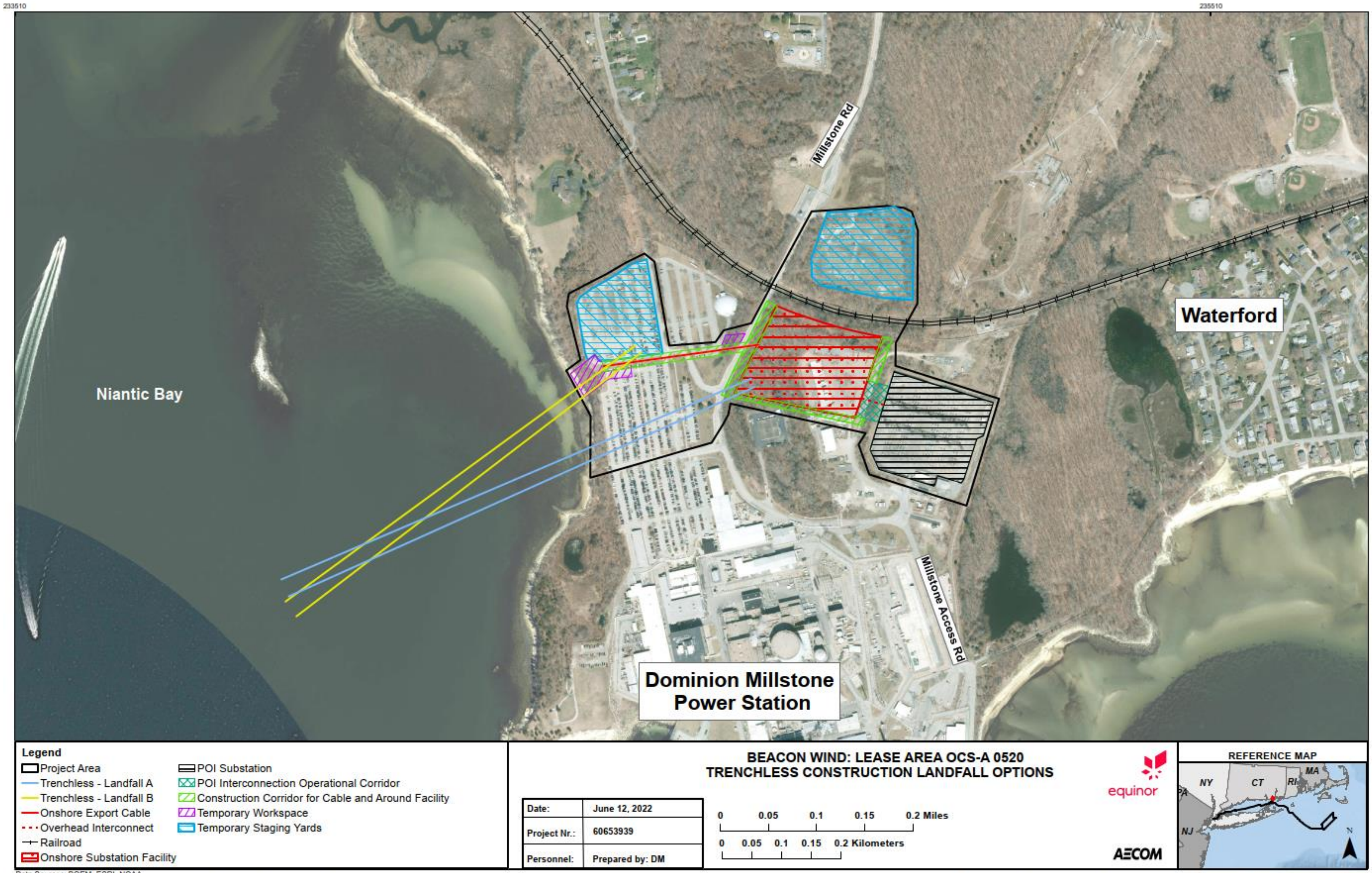
2.1.3.3 *BW2 Approach to Waterford, Connecticut*

At the BW2 submarine export cable landfall location in Waterford, Connecticut, Beacon Wind evaluated two trenchless alignments (see **Figure 2.1-9**). In the Trenchless Landfall A Alternative, the submarine export cable will connect directly into the onshore substation facility. The Trenchless Landfall B Alternative will require a short onshore export cable route from the landfall to the onshore substation facility situated within the same parcel, as shown in **Figure 2.1-9**. A description of the two export cable landfall locations under consideration are provided below:

- Trenchless Landfall A: The first trenchless landfall alternative consists of two separate HDDs, with the HDD entry location onshore within the southwest corner of the onshore substation facility. From there, the HDDs progress to the southwest, terminating in nearshore waters. The total HDD length is 2,800 ft (853 m).
- Trenchless Landfall B: The second trenchless landfall also consists of two separate HDDs. The HDD entry location is within the southeast corner of the northern parking lot within the existing Dominion Millstone Power Station. From there, the HDDs progress to the southwest, terminating in nearshore waters. The total HDD length is 2,375 ft (724 m).

A trenched landfall alternative was also evaluated, which would involve open-cut installation of the submarine export cables. The trenched landfall would follow a slightly modified path of the Trenchless Landfall B alignment, beginning in water at the approximate -22 ft (-7 m) contour at mean low water adjacent to the power station. Due to the higher potential impacts to inwater habitat, the shore, and nearshore environment, the trenched landfall alternative was removed from the PDE and is not carried forward.

FIGURE 2.1-9. BW2 SUBMARINE EXPORT CABLE TRENCHLESS LANDFALL OPTIONS, WATERFORD, CONNECTICUT



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

2.1.3.4 *BW1 and BW2 Submarine Export Cable Route Surveying*

An initial reconnaissance survey with Multibeam Echosounder (MBES) and Sub-bottom Profiler (SBP) was performed around the Astoria power complex in Queens, New York along the East River and into Long Island Sound to just north of Execution Rocks (**Figure 2.1-10**). The survey corridor was aligned with the route alternatives developed through the iterative cable routing process. The purpose of the survey was to confirm the feasibility of the route prior to performing a full survey in accordance with BOEM specifications. The main part of the reconnaissance survey was performed during the fall of 2020 with some additional survey near the Astoria power complex during the spring of 2021. The entire survey route was then surveyed in accordance with BOEM specifications between January 2021 and January 2022 comprising HRG survey, benthic, sediment and geotechnical sampling. The results of these survey efforts will be presented in a supplemental COP filing for **Appendix G Marine Site Investigation Report** and **Appendix U Marine Archaeological Resources Assessment**, while **Appendix S Benthic Resources Characterization Report** is provided herein with this filing.

2.1.3.4.1 *BW1 and BW2 Submarine Export Cable Route Variants*

As a result of the full route surveys, Beacon Wind identified two locations where further siting refinement was completed. The first is in the area of Execution Rocks in the Western Narrows (**Figure 2.1-11**), and the second is at the entrance to Long Island Sound near Block Island Sound and The Race (**Figure 2.1-12**). From the details of the survey, Beacon Wind developed two route variants in the area of Block Island Sound and two route variants in the area of Execution Rocks (**Figure 2.1-13**).

At Block Island Sound, Route Variant A and B are similar in length and were proposed to provide varying alignments to traverse sand wave features located northwest of Great Gull Island near The Race. Route A was determined to be the preferred alignment as it traversed the sand waves at the most desirable angle compared to Route Variant B; however, both variants are carried forward in the PDE.

At Execution Rock, Route Variant A and C represent two alignments similar in length that were assessed due to routing constraints. Route A was determined to be the preferred alignment as it provided the greatest distance from the adjacent natural gas pipeline in the area; however, both variants are carried forward in the PDE.

FIGURE 2.1-10. MULTIBEAM ECHOSOUNDER AND SUB-BOTTOM PROFILER RECONNAISSANCE SURVEY FROM EAST RIVER INTO LONG ISLAND SOUND

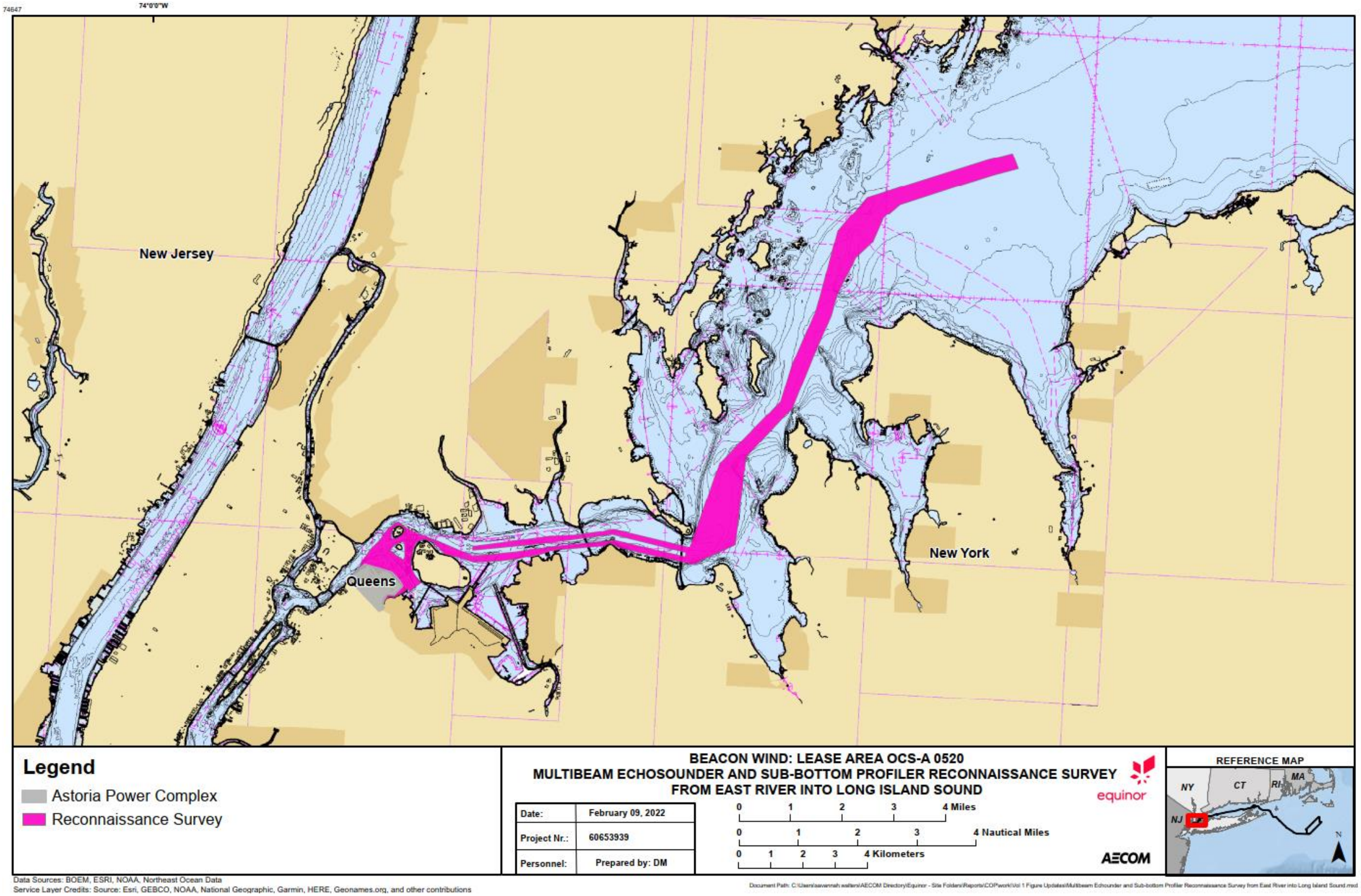


FIGURE 2.1-11. HIGH RESOLUTION GEOPHYSICAL SURVEY IN THE AREA OF EXECUTION ROCKS

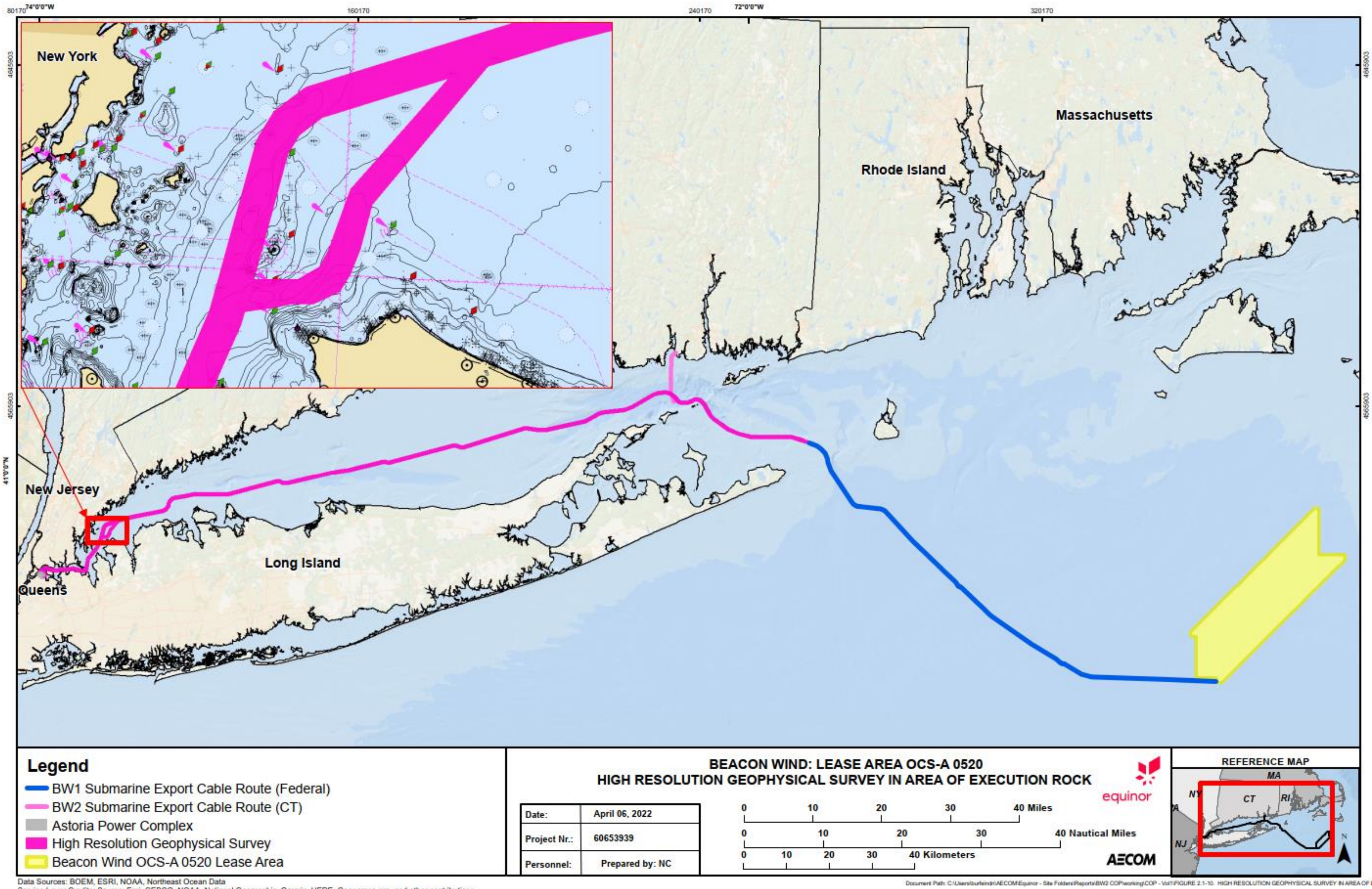


FIGURE 2.1-12. HIGH RESOLUTION GEOPHYSICAL SURVEY IN BLOCK ISLAND SOUND

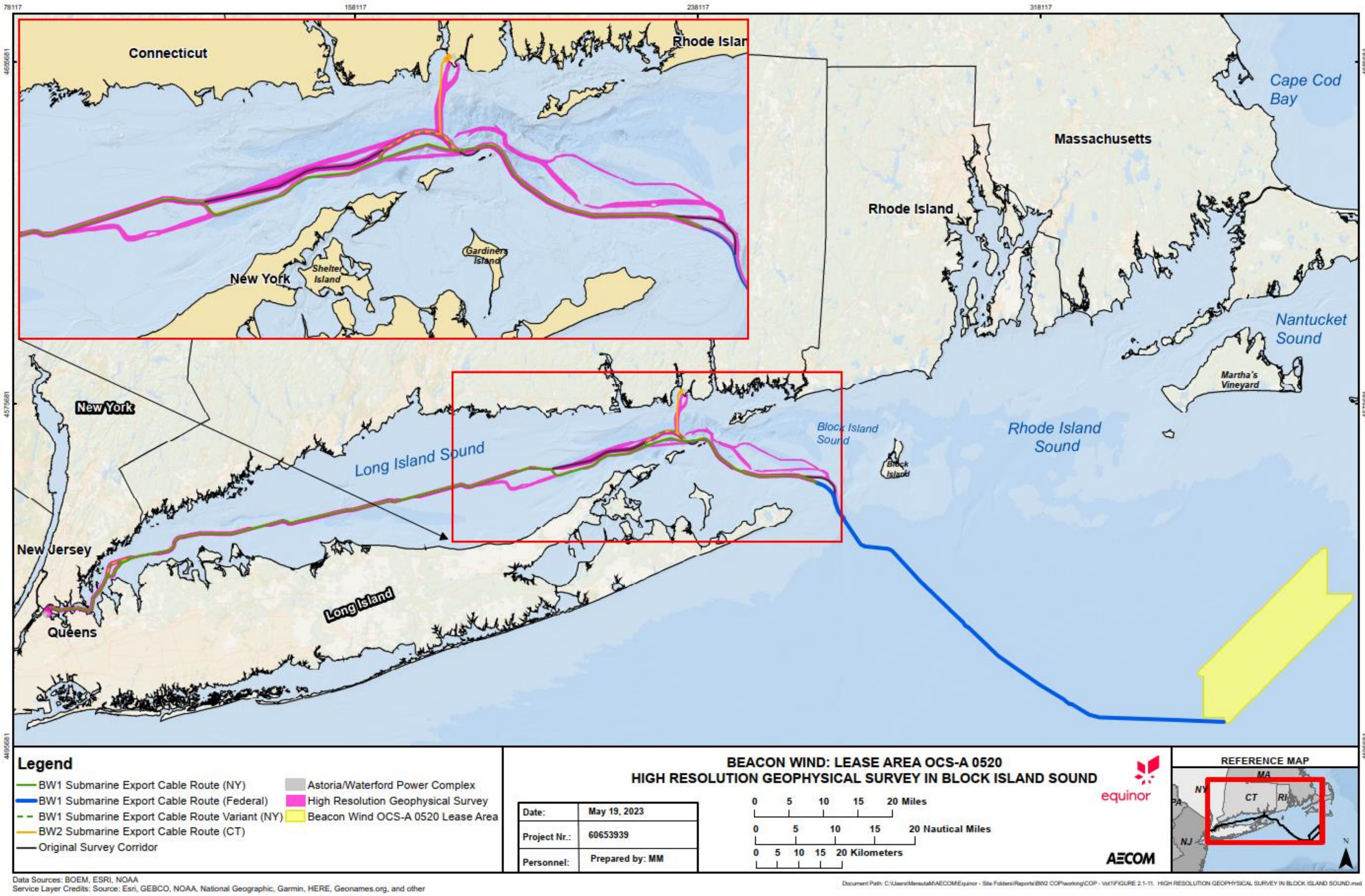
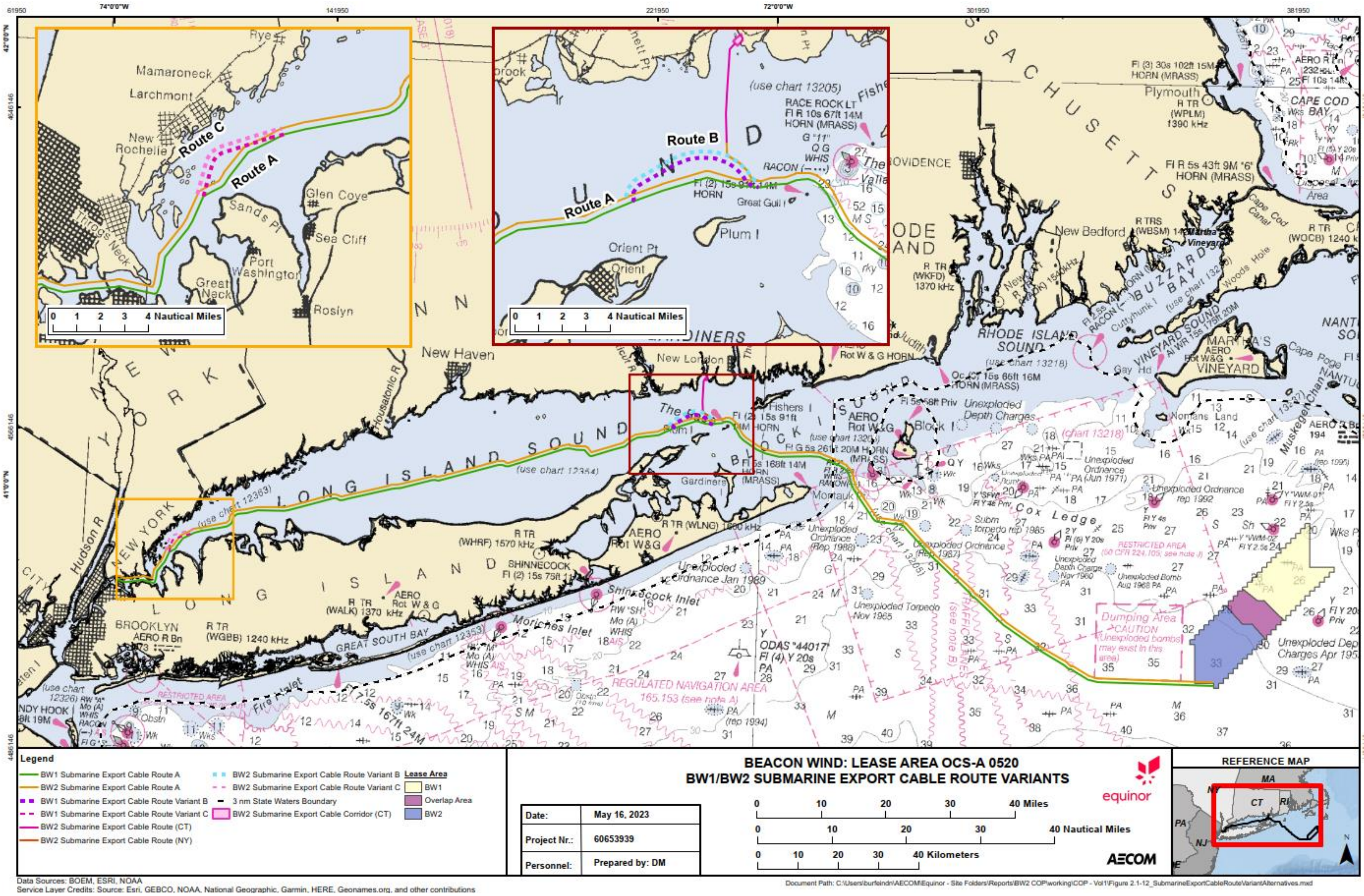


FIGURE 2.1-13. BW1 SUBMARINE EXPORT CABLE ROUTE VARIANTS



2.1.4 BW1 and BW2 Submarine Export Cable Routes, Landfalls, and Onshore Substations

The transition from submarine export cables to the onshore export cables will occur at the cable landfall locations. To identify the preferred landfall sites from those under consideration, Beacon Wind conducted a coastal and waterfront engineering analysis of the risks and benefits of potential cable landfall locations at sites in the vicinity of the preferred POIs. This analysis was informed based on selection of the preferred POIs included in the PDE (see **Section 2.1.1 Selection of Beacon Wind Electrical Points of Interconnection**) and the export cable routing analysis (see **Section 2.1.3 BW1 and BW2 Submarine Export Cable Routing**). The following criteria were used in evaluation of export cable landfall locations:

- Proximity to preferred POI (e.g., route length);
- Prior subsea cable landfall success in nearby areas;
- Staging area size/location/options (e.g., preferably land without permanent structures, with a minimum size to allow for adequate staging);
- Hydrodynamics and sediment dynamics (e.g., erosion);
- Man-made interferences (e.g., piers, fish trap area, pipelines, cables, dredging);
- Environmental and cultural considerations (e.g., land use, eelgrass, dunes, wetlands, buried and/or submerged cultural resources);
- Soil thermal resistivity; and
- Constructability complexities (e.g., workspace, long additional water crossings, vessel access).

In some cases, viable alternate landfall sites that are similar relative to the evaluation criteria have been retained within the PDE.

2.1.4.1 *BW1 and BW2 Onshore Substations and Cable Routes – Queens, New York*

2.1.4.1.1 *Onshore Substation Facilities*

The BW1 and BW2 onshore substation facilities each include the converter required to convert the HVDC current being delivered from the wind farm to HVAC current and an onshore substation facility so the offshore wind energy can be transmitted by the NY ISO grid. The preference was to use space available within or immediately adjacent to the existing POI substation to locate BW1 and BW2's onshore substation facilities, if possible, in order to minimize additional disturbance for installation of the onshore interconnection cables between the Project's substation and the existing POI, and to maintain consistency with existing land uses in the vicinity.

For the Astoria power complex POI, Beacon Wind assessed suitability of local parcels based on the following criteria:

- Availability (i.e., on the market for lease or sale);
- Distance from the target POI;
- Flood resistance design;
- Zoning;
- Setback requirements;
- Existing land use;
- Available space;
- Proximity to environmental and cultural resources;

- Constructability factors (e.g., extent of site grading needed, access, site specific soil condition); and
- Existing redevelopment plans.

These factors are associated with disturbance minimization, cost, constructability, design requirements, consistency with existing land use and zoning, and minimization of environmental and human impacts, and were used to identify the preferred site. Details of the evaluation of onshore substation facility site suitability for each of the POI locations are provided in this section. Viable substation facility parcel alternatives that are supported by the evaluation criteria have been retained within the PDE.

The Astoria power complex in Queens, New York is zoned M3-1 (Heavy Manufacturing District), which permits the use of buildings/structures associated with the generation, transmission, or distribution of electricity. The current landowners within this complex include:

- Eastern Power Generating Company (EasternGen; EG);
- NYPA;
- NRG;
- Consolidated Edison (ConEd); and
- Luyster Creek, LLC.

Based on the limited open or under-utilized land, Beacon Wind evaluated five potential sites for the onshore substation facility and submarine cable landfall (**Figure 2.1-14** and **Figure 2.1-15**).

- AGRE (preferred);
- NYPA (preferred);
- Luyster Creek;
- EG Tank Farm; and
- EG Power Station.

2.1.4.1.2 *AGRE*

The AGRE location would be divided up by an East and West allocation. The AGRE location is bounded to the west by the NYPA-operated Eugene W. Zeltman Power Project and to the north by the EG Tank Farm site. The available AGRE parcel is approximately 16 ac (6.5 ha), with AGRE East encompassing approximately 8.9 ac (6.4 ha) and AGRE West encompassing approximately 7.1 ac (2.9 ha). Both the AGRE East and AGRE West sites are large enough to accommodate the onshore substation facility for either BW1 and BW2 and peripheral equipment; together, AGRE East and AGRE West can accommodate both BW1 and BW2. The AGRE location includes an existing power plant that would be demolished prior to construction. The location itself has areas of topographical change within the site and ground preparation work would be required prior to construction. Additional space is available for laydown equipment and materials during the construction phase.

Land access is restricted by a security gate at the entrance of the current NRG plant. The 138 kV outgoing circuits from the converter station are base case for being installed overhead but could potentially be considered for installation underground. The overhead 138 kV total lengths for both BW1 and BW2 are approximately 2,952 ft (900 m).

Current land use and industrial development at the AGRE location is consistent with use for a new onshore substation facility, and therefore the location does not pose significant environmental, social, socioeconomic, visual or cultural resource concerns. This AGRE East and AGRE West sites are considered to be suitable based on space availability to accommodate BW1 and BW2 and proximity to the POI.

2.1.4.1.3 *NYPA*

The NYPA site is located at the northern edge of the Astoria power complex with just over 1,000 ft (305 m) of shoreline along the East River. This site is bound by a NYPA administration building to the southwest, NYPA electric plants to the southwest, and the riprap coastlines to the northwest and northeast. The available parcel is approximately 8 ac (3.2 ha) which is sufficient to accommodate the onshore substation facility and peripheral equipment. The existing site is relatively flat and minor ground preparation work would be required prior to construction. Additional space is available for laydown equipment and materials during the construction phase.

Land access to the existing site is restricted by a security gate at the entrance of the parcel, and an additional security gate is present at the adjacent NRG plant. A barge may be used to transport transformers due to the coastal location. The HVDC cable landfall would be located within the NYPA property. The 138 kV outgoing circuits from the converter station are base case for being installed underground but could potentially be considered for installation overhead and must avoid an existing overhead corridor and rights-of-way associated with the NRG plant. The underground 138 kV total lengths are approximately 6,500 ft (1,981 m).

The NYPA site was determined to be a suitable site based on space availability and proximity to the POI. Because the site is already developed for industrial use, no major environmental or cultural resource issues are anticipated.

2.1.4.1.4 *Luyster Creek*

The Luyster Creek site is located on the eastern side of the Astoria power complex along Luyster Creek which flows into the East River. The site is adjacent to a section of the Department of Public Works Yard and NYPA Garage property to the east, Amazon delivery van parking to the south, 31st Street to the west, and interior NYPA roads followed by NYPA property to the north. The available parcel is approximately 8 ac (3.2 ha) which is sufficient to accommodate the onshore substation facility and peripheral equipment. The existing site is relatively flat and minor ground preparation work would be required prior to construction. Additional space is available for laydown equipment and materials during the construction phase. Three 345 kV overhead transmission lines pass over the top of the property parallel to 34th Street and would require some setback clearances for installing the onshore substation facility.

A nearby loading dock could be used to transport transformers by barge but may require reinforcement prior to use. Up to four 138 kV outgoing circuits from the converter station is base case for underground installation but could potentially be considered for installation overhead to the POI at the Astoria West Substation and the Astoria East Substation. The 138 kV total cable lengths are approximately 5,800 ft (1,768 m). The proximity to energized 345 kV power lines poses a minor risk. The HVDC cable landfall poses a challenge with access either near the Luyster Creek waterway or passing through a third-party property with a distance to shore of approximately 1,500 ft (457 m). Due to marine construction challenges, the cable route through the Luyster Creek waterway was not retained as an option.

Current land use and industrial development of the site is consistent with use for a new onshore substation facility, and therefore the site does not pose significant environmental or cultural resource concerns. This site is considered suitable, but it poses additional challenges relative to the NYPA and AGRE sites due to the larger distance from shore and proximity to existing power lines as well as commercial challenges. Therefore, the Luyster Creek site is not carried forward in the PDE as a location for the onshore substation facility.

2.1.4.1.5 *EG Tank Farm*

The EG Tank Farm site is located within the northeastern portion of the Astoria power complex. The available parcel is approximately 8.07 ac (3.3 ha) which is sufficient to accommodate the onshore substation facility and peripheral equipment. Additional space is available for laydown equipment and materials during the construction phase. Demolition work and site remediation would be required prior to construction which would result in higher installation costs at the EG Tank Farm than at other locations under consideration.

Transformers transported by barge could use the nearby Luyster Creek loading dock. A transportation and rigging plan would be required to address the transport and offloading of the power transformers. The HVDC cable landfall would be approximately 250 ft (76.2 m) from the property line. The HVDC cable would cross the ConEd property and require an easement to route the HVDC onshore export cable segment. Both outgoing 138 kV circuits from the converter station would be routed underground. The underground line would connect to both Astoria East and Astoria West Substations via riser poles. The underground 138 kV total cable lengths are approximately 7,200 ft (2,195 m). The proximity to active fuel tanks poses a moderate risk.

Current land use and industrial development of the site is consistent with use for a new substation, and therefore the site does not pose significant environmental or cultural resource concerns. This site is considered suitable, but the ability to develop the site depends upon the decommissioning and associated demolition of the existing facility. The level of demolition requires added complexity and schedule implication; therefore, the EG Tank Farm site is not carried forward in the PDE as a location for the onshore substation facility.

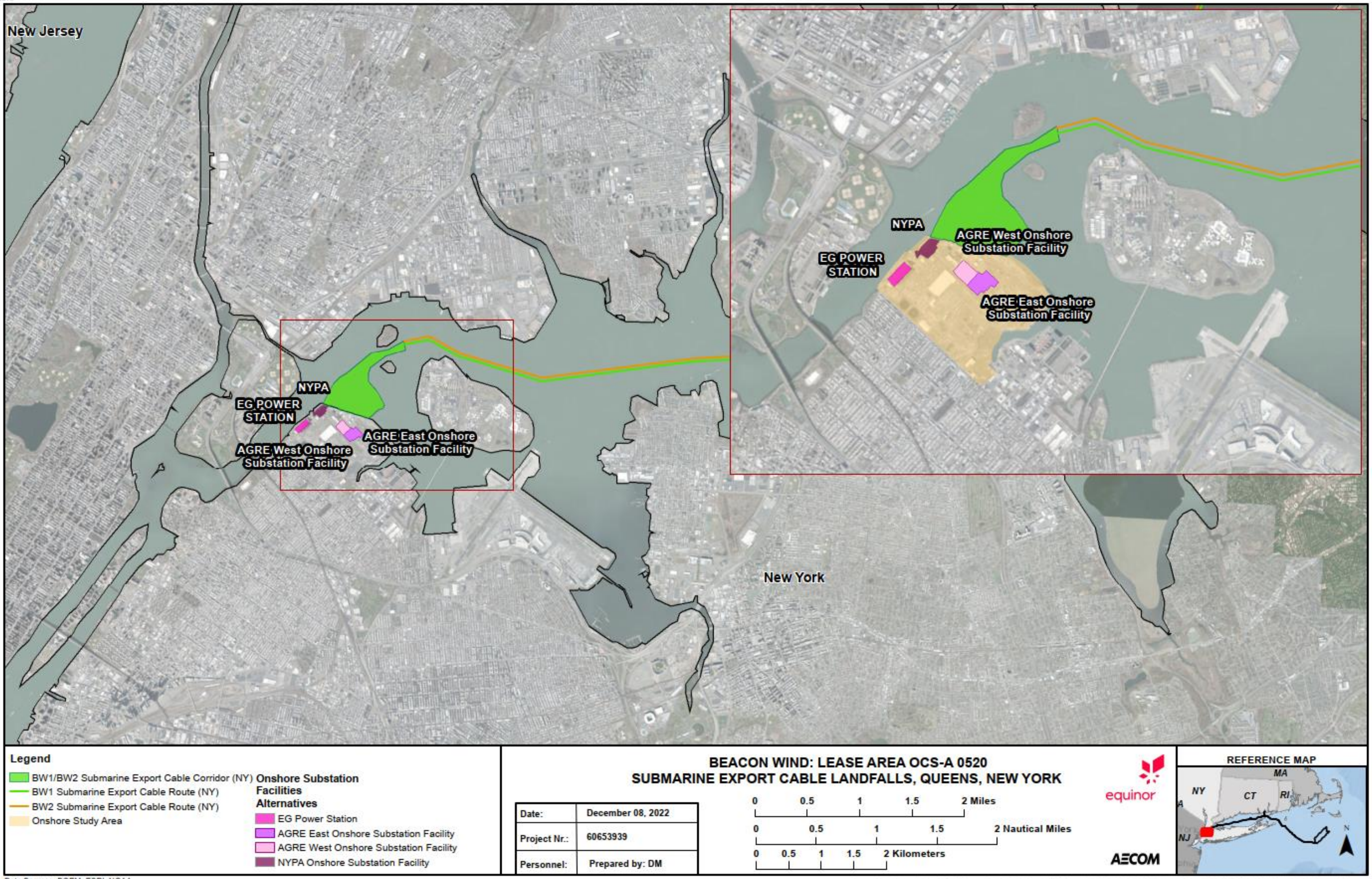
2.1.4.1.6 *EG Power Station*

The EG Power Station site is located on the western edge of the Astoria power complex along the East River. The onshore substation facility would be constructed on the portion of the power station containing retired Units 10 and 20; EG would continue to operate the remaining generators (Units 30, 40, and 50). The buildings containing Units 10 and 20 could be re-purposed or demolished prior to construction of the onshore substation facility.

One existing POI at the Astoria East 138 kV Substation is connected to the existing alternating current (AC) yard for Units 10 and 20 by hybrid underground and overhead feeders. The existing transmission line capacity is underrated for the needs of the converter station and would require upgrading.

The transportation and hauling of heavy loads such as the power transformer have significant constraints via both barge and land. This site is characterized by a limited area for construction that is surrounded by above-ground and below-grade utilities, many of which could not be moved or would be challenging to relocate. Based on the limitations of the site, the EG Power Station site is not carried forward in the PDE as a location for the onshore substation facility.

FIGURE 2.1-14. BW1 AND BW2 SUBMARINE EXPORT CABLE LANDFALLS, QUEENS, NEW YORK



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

Document Path: C:\Users\burfeindr\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\COP - Vol1\FIGURE 2.1-8. BW1 SUBMARINE EXPORT CABLE LANDFALL, QUEENS, NEW YORK.mxd

2.1.4.2 *Onshore Cable Routing*

Once the submarine export cables make landfall, they will travel from the landfall location(s) to the new onshore substation facilities. Interconnection cable lines (one each for BW1 and BW2) will leave the onshore substation facilities to deliver power to the POIs. The onshore cable routes refer to the complete route traversed by the onshore export and interconnection cables between the submarine cable landfalls and the POIs.

To identify the preferred onshore cable route, Beacon Wind conducted a comparative analysis to assess the benefits and risks of several route options. The analysis considered the following criteria:

- Route length;
- Land use;
- Constructability;
- Presence of utilities;
- Prioritizing use of existing rights-of-way;
- Easement acquisition
- Community impacts; and
- Environmental aspects such as wetlands and water bodies, historic and cultural resources, sensitive species habitat, and potential for contamination, among others.

Although onshore routing was evaluated to some extent for all assessed sites, only those alternatives associated with routes from the preferred landfalls were retained.

The power delivered by the onshore substation facilities for BW1 and BW2 will be exported to the existing 138 kV Air Insulated Substations (AIS), Astoria West Substation and/or Astoria East Substation.

Beacon Wind considered several routes for the onshore export cables from the potential landfall locations under consideration to the potential onshore substation facility sites and routes for the interconnection cables from the onshore substation facility to the Astoria power complex POI to identify the least impactful and most feasible onshore cable route solutions for BW1 and BW2.

Potential landfall locations along the waterfront of the Astoria power complex for the onshore substation facility sites under consideration, as well as their proposed cable landfall installation method where trenchless (HDD, jack and bore, or micro-tunneling) and trenched (open cut trench) methods are proposed, are identified in **Figure 2.1-15**. The cable routes from the landfall locations to the onshore substation facilities under consideration are shown on **Figure 2.1-16** for the NYPA site, and **Figure 2.1-17** for the AGRE site.

Major primary and alternative onshore routes, carried forward within the PDE, from the onshore substation facilities under consideration to the POIs that were considered are shown in **Figure 2.1-18**. As the base case scenarios, the proposed transmission line design is an underground duct bank for the NYPA site and aboveground electric transmission lines for AGRE East and AGRE West, with the Project considering the potential for an overhead option for all locations.

FIGURE 2.1-15. ASTORIA POWER COMPLEX LANDING SITES OVERVIEW

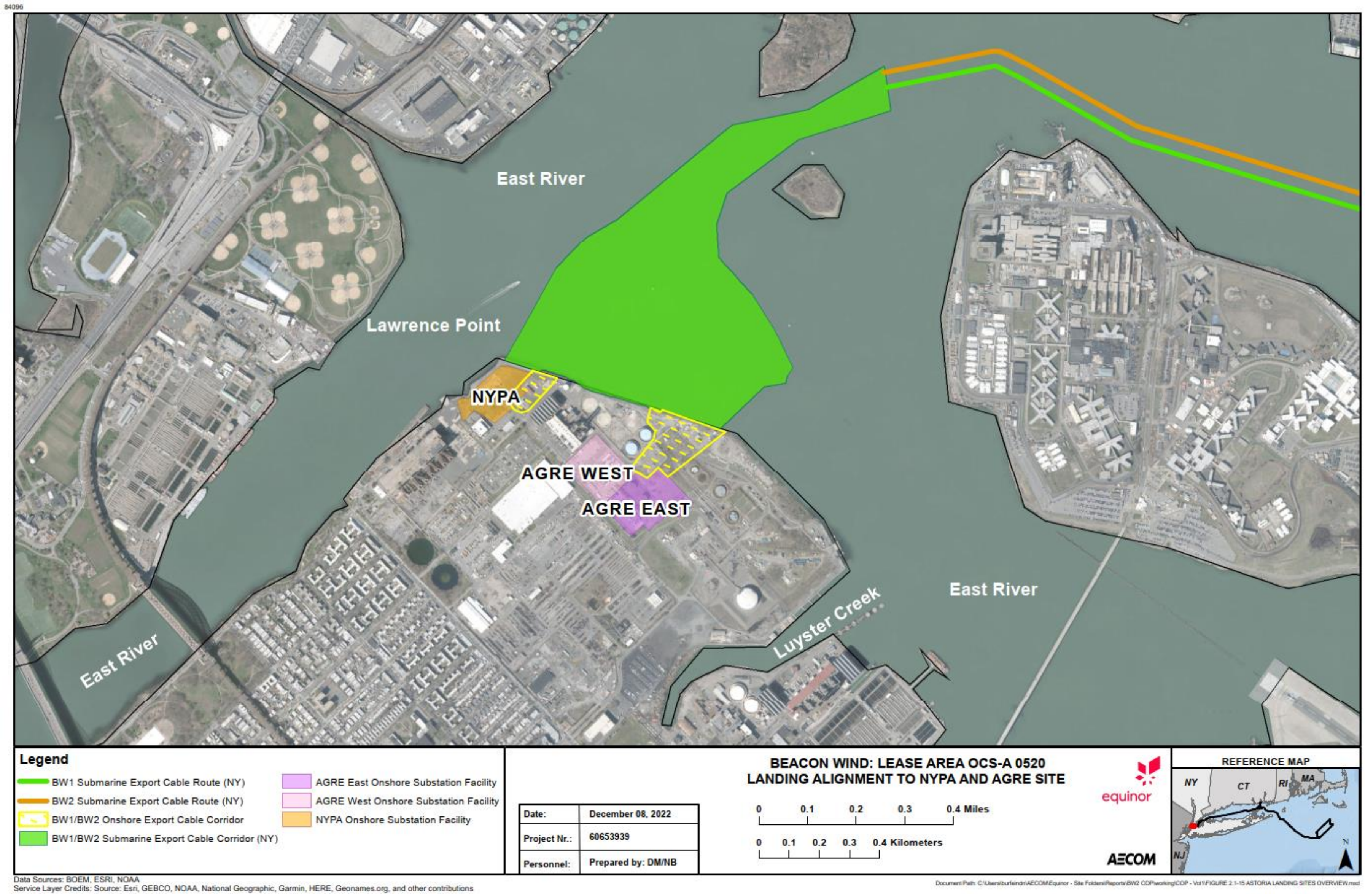


FIGURE 2.1-16. LANDING ALIGNMENT TO NYPA SITE

FIGURE 2.1-17. LANDING ALIGNMENT TO AGRE SITE

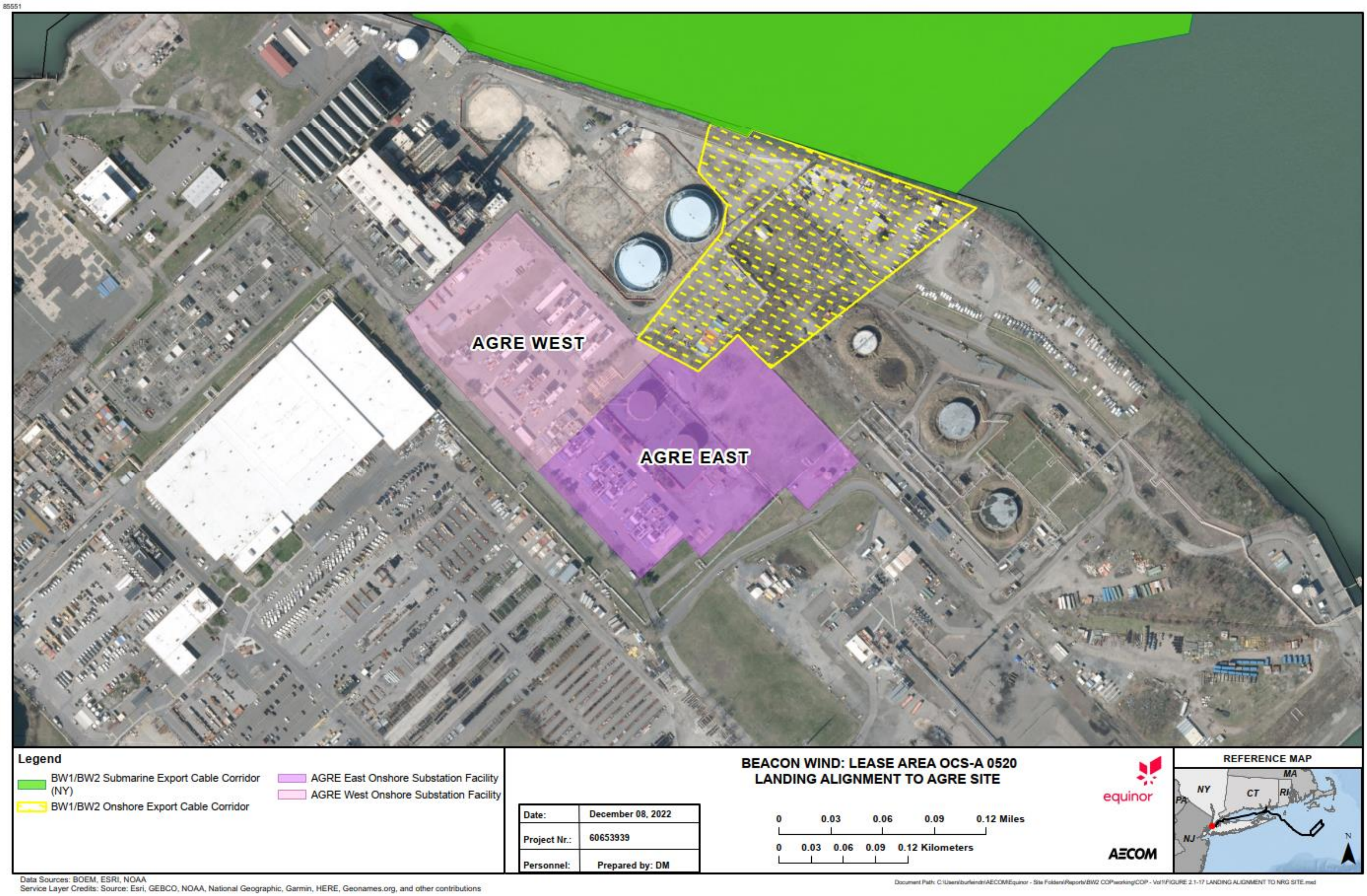
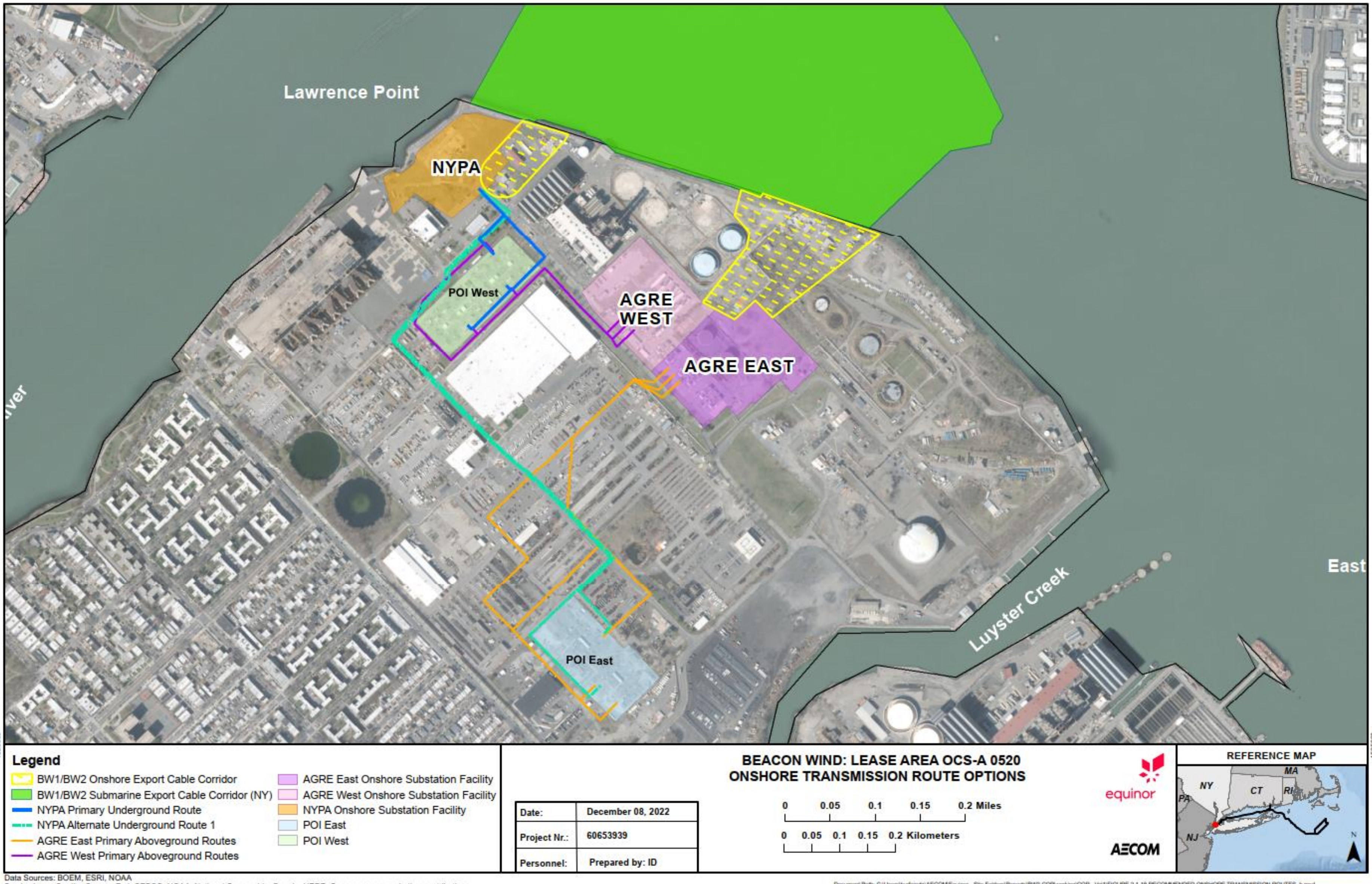


FIGURE 2.1-18. RECOMMENDED ONSHORE TRANSMISSION ROUTES



2.1.5 BW2 Submarine Export Cable Routes, Landfalls and Onshore Substation - Waterford, Connecticut

The transition from the submarine export cable to the onshore export cable will occur at the cable landfall location within Niantic Bay at the western edge of the peninsula containing the Waterford power complex. To identify the preferred landfall, Beacon Wind conducted a coastal and waterfront engineering analysis of the risks and benefits of a potential cable landfall location within both the offshore and the onshore corridors under assessment for the base case trenchless installation of the cable to the onshore substation facility and the POI. This analysis was informed based on selection of the preferred POI included in the PDE (see **Section 2.1.1 Selection of Beacon Wind Electrical Points of Interconnection**) and the submarine export cable routing analysis (see **Section 2.1.3 BW1 and BW2 Submarine Export Cable Routing**). The criteria as detailed in **Section 2.1.4** were used in evaluation of the submarine export cable landfall in Waterford, Connecticut.

2.1.5.1 *BW2 Onshore Substation and Cable Route – Waterford, Connecticut*

2.1.5.1.1 *Onshore Substation Facility*

The BW2 onshore substation facility will include the converter required to convert the HVDC current being delivered from the wind farm to HVAC current and an onshore substation facility so the offshore wind energy can be transmitted to the onshore grid. The preference was to use space available within or immediately adjacent to the existing Dominion Millstone Power Station for BW2's onshore substation facility, if possible, in order to minimize additional disturbance for installation of the onshore interconnection cables between the Project's onshore substation facility and the existing POI, and to maintain consistency with existing land uses in the vicinity (see **Figure 2.1-19**).

The available parcel is adequately sized to accommodate the 7.1 ac (2.9 ha) onshore substation facility and peripheral equipment. Additionally, there will be two temporary staging yards (5.5 ac [2.2 ha] and 4.3 ac [1.7 ha]). The design will require three single phase steel monopoles a maximum height of 80 ft (24.4 m) above existing ground level to connect the onshore substation facility to the adjacent POI. The site will require grading and placement of fill to build up the parcel to create a level area for construction.

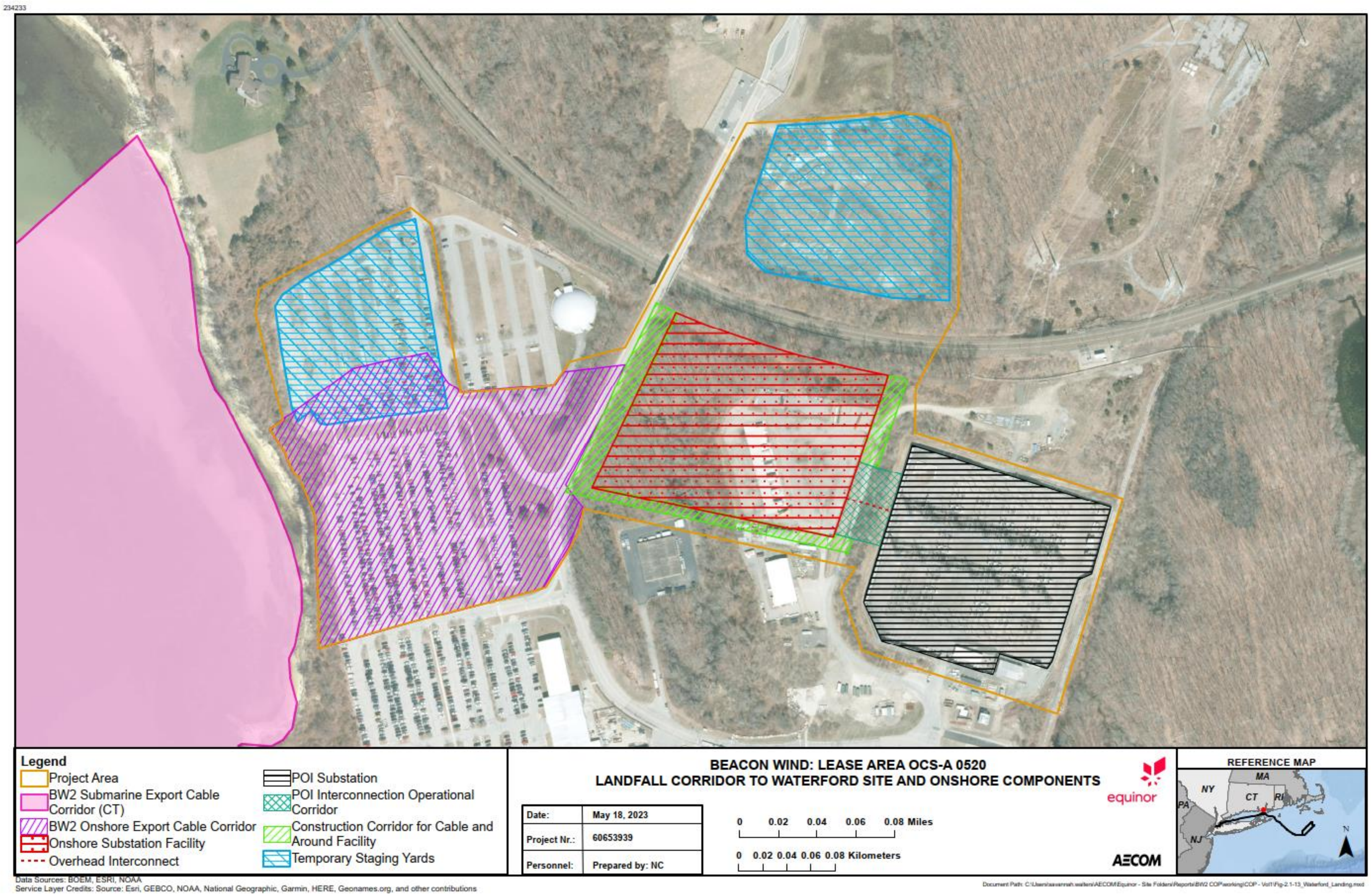
Current land use and industrial development of the site is consistent with use for a new substation facility. This site is considered a suitable site based on space availability and proximity to the POI and siting within an existing power complex.

2.1.5.2 *Onshore Cable Routing*

Once the submarine export cable makes landfall, it will travel from the western edge of the power station complex through the large area of existing parking lots, traversing over Millstone Access Road prior to entering into the parcel selected for the onshore substation facility.

Two trenchless (HDD, jack and bore, or micro-tunneling) landfall alignments are proposed (**Section 2.1.3.3**). An onshore and offshore corridor have been applied for micrositing to further occur within as the refined engineering is completed for the landfall alignment.

FIGURE 2.1-19. LANDING CORRIDOR TO WATERFORD SITE AND ONSHORE COMPONENTS



2.2 Project Components and Technology

A variety of components and technology have been considered for the PDE, including multiple foundation types and export cable types.

2.2.1 Foundations

Beacon Wind evaluated several potential types of foundations for supporting wind turbines: gravity base structure (GBS), monopile, piled jacket, suction bucket jacket, and floating foundations. Each foundation type was evaluated based on the following criteria:

- Subsurface conditions;
- Water depths;
- Wind turbine loads;
- Supply chain capacity; and
- Commercial availability.

Three wind turbine foundation types were deemed suitable against the criteria identified above: monopile, piled jacket, and suction bucket jacket. The following reasoning regarding suitability of monopile, piled jacket, and suction bucket jacket foundation types was determined:

- Monopiles are the most widely used foundation type with an established supply chain and suitable for the conditions characterizing Beacon Wind. Limitations in relation to site conditions, fabrication sizes and weights may, however, pose constraints for use of monopiles in the deeper parts of the Lease Area.
- Piled and suction bucket jackets can be designed for any relevant water depth and wind turbine size and are expected to be suitable for the entire Lease Area. The choice of piles or suction buckets mainly depends on the subsurface conditions.

Beacon Wind removed the GBS foundation type for wind turbines from consideration after a thorough assessment of suitability. GBS foundations are not commercially available in the U.S., and for Beacon Wind to establish a robust supply chain to provide such foundations would be challenging. In addition, utilization of the GBS foundation would require identification of and likely upgrade to a port facility suitable to fabricate GBS foundations. Beacon Wind identified few such sites, and all required substantial investments to render them suitable for fabricating and loading-out GBS foundations. In addition, GBSs are not suitable for long distance transport on heavy lift vessels due to the size and weight of the foundation. Additionally, they pose operational challenges associated with the boat landing, and accommodation of the crew transfer vessel. Accordingly, GBS foundations were ruled out based on supply chain evaluations, increased Project risk, increased costs, and lack of commercial availability.

Floating foundations were considered not suitable due to the combination of a relatively shallow water depth and harsh wave climate within the Lease Area.

GBS and floating foundations were eliminated from consideration for the offshore substations due to similar factors described above in the evaluation for wind turbines. Monopiles were also not deemed suitable for the offshore substation due to the size of the offshore substation topside. Beacon Wind is therefore evaluating the suitability of two types of foundations for the offshore substations: piled jacket and suction bucket jacket. The evaluation of the foundation alternatives under consideration is primarily driven by the assessment of the ground conditions.

The foundation types under evaluation area based on Beacon Wind's current understanding of the seabed and subsurface conditions. The Project PDE will continue to be developed as further analysis of the seabed and subsurface conditions is conducted. A short description of these foundation types is provided in **Table 2.2-1**.

TABLE 2.2-1. FOUNDATIONS WITHIN THE PDE

Foundation Type	Description
Monopile	A single vertical, broadly cylindrical steel pile driven into the seabed to support a wind turbine. A steel transition piece (TP), which may contain secondary structure components (i.e., boat landings and access platforms),[21] will be connected to the monopile. Alternatively, a TP-less design may be applied.
Piled Jacket	A vertical steel lattice structure consisting of three or four legs to support a wind turbine, or up to eight legs to support an offshore substation, secured into the ground with steel pile foundations. Jackets supporting wind turbines will be supported on pre-installed piles and connected to the turbine tower by a TP. The offshore substation jacket is expected to be temporarily supported on mud mats[22], with piles post-installed at the corner legs following jacket installation. Secondary structures (i.e., J-tubes, boat landings, and access platforms)[23] will be connected onto the jacket.
Suction Bucket Jacket	A vertical steel lattice structure consisting of three or four legs to support a wind turbine, or up to eight legs to support an offshore substation, with inverted bucket-like steel structures at the base. Jackets supporting wind turbines will be connected to the turbine tower by a TP. Secondary structures (i.e., J-tubes, boat landings, and access platforms)[24] will be connected onto the jacket.

2.2.2 Export Cables

Beacon Wind evaluated different transmission technologies for the submarine export cables against the following criteria:

- Technical feasibility;
- Transmission distances;
- Economic considerations; and
- Land required to support the onshore substation facility.

The submarine export cables are designed to use HVDC technology. HVDC, rather than HVAC, has been selected for Beacon Wind due to the large nameplate capacity of BW1 and BW2 (greater than 1,200 MW each) and export cable distance (up to 202 nm [375 km] for BW1, up to 202 nm [375 km] for BW2 to Queens, New York, and up to 113 nm [209 km] for BW2 to Waterford, Connecticut). Power losses in the HVDC transmission are significantly lower than HVAC, particularly over long distances, making HVDC a more efficient and economical selection for the Project. HVDC can use more narrow

[21] Beacon Wind is assessing a solution that would remove some of these secondary structures.

[22] Mudmats are part of the permanent jacket structure but perform a temporary function to provide temporary on-bottom stability for the substructure in the interim between jacket set-down and pile installation.

[23] Beacon Wind is assessing a solution that would remove some of these secondary structures.

[24] Beacon Wind is assessing a solution that would remove some of these secondary structures.

cable corridors than HVAC which may minimize the environmental impact associated with installation of the Project.

Equinor has extensive experience in both HVAC and HVDC transmission solutions as a result of the construction of its existing oil, gas, and offshore wind portfolios. In practice, the suitability of an HVAC or HVDC transmission solution depends on the amount of power to be exported and the distance between the generator and the interconnection point. For standard offshore wind capacity sizes, long distance HVAC transmission is better suited for transmission distances of up to approximately 80 mi (129 km). Beyond this point, the limitations of the submarine cable make longer HVAC transmission cables at higher capacities inefficient. For transmission distances longer than approximately 80 mi (129 km), an HVDC solution is preferred. Beacon Wind has a total export cable length of either approximately 202 mi (375 km) or 113 nm (209 km) per wind farm and export capacity of at least 2,400 MW total, therefore, Beacon Wind has selected a symmetrical monopole configuration HVDC solution. Beacon Wind's experience with HVDC design solutions has shown this qualified cable solution and application of industry technical standards is a good model for application to the Beacon Wind Project.

2.2.3 Cooling Water Intake System

Each offshore substation facility will include a cooling system to regulate the temperature of the electrical converter equipment. Beacon Wind has evaluated both closed-cycle and once-through cooling water systems using seawater for the Project. Closed-cycle cooling designs for use in offshore applications are not commercially mature, and based on evaluations up to this point, would not be technically or commercially feasible for the Project. Beacon Wind is conducting ongoing evaluations to determine potential future viability of closed-cycle systems. Once-through systems are carried forward as the maximum design scenario in the PDE.

Each offshore substation facility will include a cooling water intake system (CWIS) to regulate the temperature of the electrical converter equipment via once-through, non-contact cooling. Each CWIS will utilize a vertical intake attached to the offshore substation jacket foundation, between the jacket legs. Ocean water will be drawn in from the water column by raw seawater circulating pumps with intake caisson pipes attached to the jacket structure. After the water passes through the CWIS, water will be discharged back into the water column.

Beacon Wind also evaluated alternative cooling methods including air cooling and grey water cooling. The use of air cooling is not considered feasible as the air temperatures in the Lease Area are too warm for many months of the year to sufficiently cool the converter equipment, and grey water cooling is not feasible as adequate grey water supply does not exist. Beacon Wind additionally evaluated the use of variable frequency drives for CWIS pumps, which would minimize water flow during periods when the facility is not operating at full rated capacity or when ocean water temperatures are low enough to permit flow reduction without impacting converter equipment operations. Variable frequency drives are deemed feasible and practicable and are incorporated into the CWIS design.

The design, configuration, and operation of the offshore substation facilities' cooling systems continues to be finalized and will be permitted as part of an individual NPDES permit with EPA. Additional details on technologies evaluated for the CWIS are also presented in the NPDES permit application.

2.3 Summary of Siting and Technology Options Carried Forward in the PDE

As described in **Section 2.1.1 Selection of Beacon Wind Electrical Points of Interconnection**, Beacon Wind selected a POI in Queens, New York, to support BW1 and is assessing two potential POIs in Queens, New York, and Waterford, Connecticut, for BW2. Beacon Wind is assessing two submarine export cable route options for BW2 to Queens, New York, or to Waterford, Connecticut.

With regards to technological solutions, Beacon Wind will evaluate impacts associated with three foundation types (monopile, piled jacket, suction bucket jacket). Electrical transmission will be based on HVDC.

2.4 References

TABLE 2.4-1. DATA SOURCES

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	Sand Borrow Area	http://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/Federal-Sand-n-Gravel-Lease-Borrow-Areas_gdb.aspx	https://mmis.doi.gov/boemmmis/metadata/PlanningAndAdministration/LeaseAreas.xml
NOAA National Centers for Environmental Information (NCEI)	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
Mid-Atlantic Regional Ocean Council (MARCO)	Artificial Reef	http://portal.midatlanticocean.org/static/data_manager/data-download/Zip_Files/Fishing/ArtificialReefs2019.zip	http://portal.midatlanticocean.org/static/data_manager/metadata/html/ArtificialReefs2019.htm
NOAA	Ocean Disposal Area/Dredged Material Disposal Area	ftp://ftp.coast.noaa.gov/pub/MSP/OceanDisposalSites.zip	https://inport.nmfs.noaa.gov/inport/item/54193
NOAA	Cable/Pipeline Area	ftp://ftp.coast.noaa.gov/pub/MSP/ORT/PipelineArea.zip	https://inport.nmfs.noaa.gov/inport/item/54395
NOAA	Coastal Maintained Channel	http://encdirect.noaa.gov/theme_layers/data/coastal_maintained_channels/maintainedchannels.zip	https://inport.nmfs.noaa.gov/inport/item/39972

Source	Includes	Available at	Metadata Link
NOAA	Shipping: Speed Restrictions (Right Whales), Precautionary Area, Separation Zone, Traffic Lane/Fairway, Area to Be Avoided	http://encdirect.noaa.gov/theme_layers/data/shipping_lanes/shippinglanes.zip	https://inport.nmfs.noaa.gov/inport-metadata/NOAA/NOS/OCS/inport/xml/39986.xml
NOAA	Unexploded Ordnance	ftp://ftp.coast.noaa.gov/pub/MSP/ORT/UnexplodedOrdnance.zip	https://inport.nmfs.noaa.gov/inport/item/54407
NOAA	Anchorage Area	ftp://ftp.coast.noaa.gov/pub/MSP/AnchorageAreas.zip	https://inport.nmfs.noaa.gov/inport/item/48849
NOAA	Danger Zone/Restricted Area	ftp://ftp.coast.noaa.gov/pub/MSP/DangerZonesAndRestrictedAreas.zip	https://inport.nmfs.noaa.gov/inport/item/48876
NOAA NCEI	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastal/crm.html	N/A
Northeast Ocean Data	Safety & Security Regulated Area (165.169)	http://www.northeastoceandata.org/files/metadata/Themes/MarineTransportation.zip	https://www.northeastoceandata.org/files/metadata/Themes/MarineTransportation/SafetySecurityRegulatedAreas.pdf

CTDEEP. 2021. *Long Island Sound Blue Plan*. Available online: https://portal.ct.gov/DEEP/Coastal-Resources/LIS-Blue-Plan/Long-Island-Sound-Blue-Plan-Home. Accessed May 18, 2022.

3.0 Project Description

This section provides a Project description, which is comprised of components proposed as part of the PDE (see **Section 1.3 Project Design Envelope Approach**). Activities associated with the construction and installation, operation and maintenance, and decommissioning of the Project components are also discussed. A quick reference guide to the Project terms, components, and activities that will be referenced throughout the COP can be found in the Executive Summary. The information provided in this section is organized as follows:

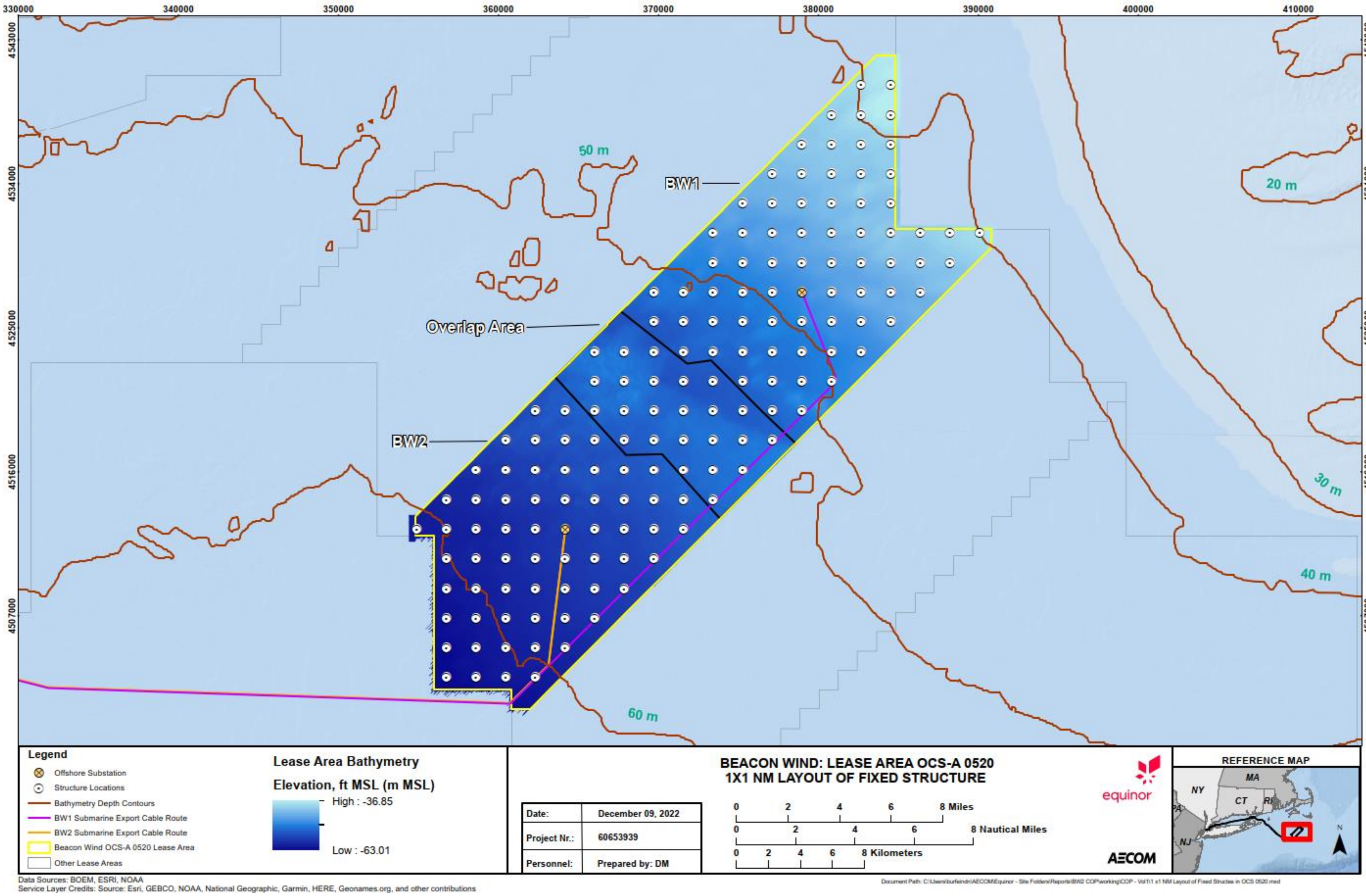
- A summary of the 1x1 nm (1.9x1.9 km) regional layout for fixed structures;
- A summary of the Lease Area development approach;
- A summary of both the offshore and onshore Project infrastructure, including the anticipated operational footprint associated with each component;
- A summary of both the offshore and onshore Project construction and installation activities, including the methodologies and anticipated short-term footprint associated with the installation of each component;
- A summary of both the offshore and onshore Project operations and maintenance (O&M) activities, including a summary of the offshore marking and lighting; and
- A summary of the decommissioning activities for the Project.

3.1 Regional Array for Fixed Structures

In 2019, the current New England offshore wind leaseholders proposed a collaborative regional layout for wind turbines across the area encompassing the seven leases south of Massachusetts and Rhode Island herein referred to as the MA/RI WEA. Under this proposal, each turbine would be spaced 1 nm (1.9 km) apart in fixed east-to-west rows and north-to-south columns to create the 1x1 nm (1.9x1.9 km) grid arrangement preferred by many stakeholders, including fishermen operating in the region. The 1x1 nm (1.9x1.9 km) layout was evaluated by the U.S. Coast Guard as part of the Areas Offshore Massachusetts and Rhode Island Port Access Route Study (Docket USCG-2019-01). USCG concluded that the adoption of a standard and uniform grid pattern will likely eliminate the need for formal or informal routing measures within the MA/RI WEA. BOEM has subsequently established the 1x1 nm (1.9x1.9 km) layout configuration as the preferred alternative in the Final Environmental Impact Statement for the Vineyard Wind project (BOEM 2021a) and its Record of Decision for the COP (BOEM 2021b). The Vineyard Wind project will be located in Lease OCS-A 0501, which is adjacent to Beacon Wind's Lease Area.

Beacon Wind is developing the Lease Area in accordance with the 1x1 nm (1.9x1.9 km) layout proposal. A total of up to 155 wind turbines and up to two offshore substation facilities, using up to 157 foundations (encompassing both BW1 and BW2) are established within the Lease Area as illustrated in **Figure 3.1-1** and the coordinates for these locations are provided in **Appendix G Marine Site Investigation Report**.

FIGURE 3.1-1. 1X1 NM LAYOUT OF FIXED STRUCTURES IN OCS-A 0520



3.2 Lease Area Development

Beacon Wind is proposing the full build out of the Lease Area which is approximately 128,811 ac (52,128 ha) in two wind farms in accordance with 30 CFR 585.629. BW1 and BW2, being electrically isolated and independent from each other, will each be connected to their own POIs via individual submarine export cable routes. However, if BW1 and BW2 both interconnect with the New York Independent System Operator (NY ISO), the Project will assess the possibility of cable linkage between BW1 and BW2. BW1 was selected as a winning bidder in State of New York's 2020 competitive solicitation for Offshore Wind Renewable Energy Credits. BW2 is being developed to support future wind energy solicitations and help the State of New York and the New England states achieve renewable energy goals. Beacon Wind is assessing two submarine export cable route options for BW2 to Queens, New York, or to Waterford, Connecticut.

The Lease Area is being assessed and included as part of this COP submission. BW1 is located in the northern 56,535 ac (22,879 ha) of the Lease Area and BW2 is located in the southern 51,611 ac (20,886 ha) of the Lease Area, with a 20,665 ac (8,363 ha) Overlap Area that could be included in either BW1 or BW2.

As discussed in **Section 1.0 Introduction**, in order to assess impacts to resources using the design envelope approach, the maximum design scenario is defined as the full build out of the Lease Area. The options in the PDE apply for all of the Lease Area and for both BW1 and BW2. Beacon Wind has surveyed and/or assessed resources and effects for the entire Lease Area and the construction and operation activities for the BW1 submarine export cable route and landfall to Queens, New York, and the BW2 submarine export cable routes and landfalls to Queens, New York, or Waterford, Connecticut.

3.3 Project Infrastructure Overview

Beacon Wind is proposing a variety of both offshore and onshore infrastructure as part of the PDE as illustrated in **Figure 3.3-1**, which also includes the approximate boundaries of federal, state, and local jurisdictions. **Section 3.3.1 Offshore Infrastructure** describes the offshore infrastructure and the components proposed in the PDE. **Section 3.3.2 Onshore Infrastructure** describes the onshore infrastructure and the components proposed in the PDE. The conceptual project design drawings are provided for reference as **Appendix D Conceptual Project Design Drawings**.

3.3.1 Offshore Infrastructure

The offshore infrastructure will consist of wind turbines, foundations, offshore substations, interarray cables, and submarine export cables. The following sections describe each component and the associated parameters that define the PDE.

As discussed in **Section 1.3 Project Design Envelope Approach** and **Volume 2 Site Characterization and Assessment of Impact-Producing Factors**, selection of PDE parameters is informed by extensive site-specific surveys, stakeholder engagement, and commercial availability of technical components.

3.3.1.1 *Wind Turbines*

The wind turbines installed for the Project will be three bladed, horizontal-axis machines. The rotor will be attached to a nacelle containing the electrical generator and other equipment. The nacelle will sit on top of a tubular support tower. Wind energy causes the blades on a wind turbine to rotate, which turns a generator in order to transform the kinetic energy of the air into electricity.

The maximum sized wind turbine in the PDE is based on models that are anticipated to be commercially available within the proposed development timescale of the Project. Nameplate capacity for turbines is excluded from the PDE because turbine suppliers have demonstrated an ability to modify generating capacity without changing physical dimensions. The make, model, and generating capacity of the wind turbine will be selected during the procurement process and is expected to be the most technologically advanced and efficient model available at that time. The turbines will comply with and hold valid certification to the International Electrotechnical Commission (IEC) 61400 or the IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications (IECRE) OD501 standards. The selected turbine model and nameplate capacity will ultimately determine the number of turbines. **Table 3.3-1** details the parameters for the wind turbines proposed in the PDE.

FIGURE 3.3-1. REPRESENTATIVE OVERVIEW OF THE PROJECT OFFSHORE AND ONSHORE INFRASTRUCTURE

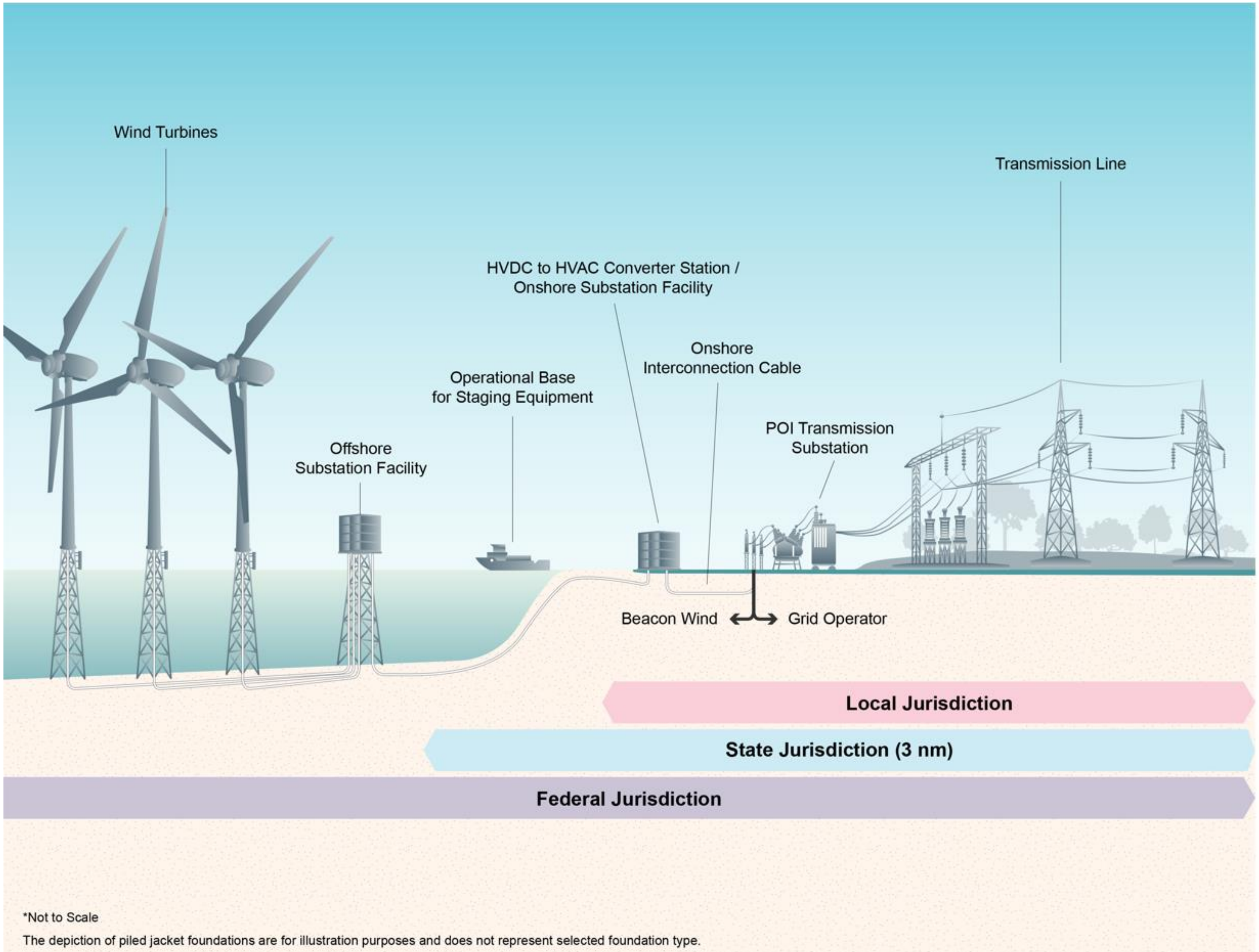


TABLE 3.3-1. SUMMARY OF WIND TURBINE MAXIMUM PDE PARAMETERS

Parameter	BW1	BW2
Number of Wind Turbines a/	61 – 94	61 – 94
Rotor Diameter	984 ft (300 m)	
Hub Height above Highest Astronomical Tide (HAT)	591 ft (180 m)	
Upper Blade Tip above HAT	1,083 ft (330 m)	
Lower Blade Tip above HAT	85 - 125 ft (26 - 38 m)	

Note:
a/ The number of wind turbines for the Project will not exceed 155. Both BW1 and BW2 will include between 61 and 94 wind turbines with the Overlap Area accounting for 33 wind turbines that could be incorporated into either BW1 or BW2.

The wind turbines for this Project will consist of the following components:

- **Tower:** Steel tubular section which supports the rotor and nacelle, in addition to providing the required height. The tower is the piece connected to the foundation and typically holds cables, some control and electrical cabinets within or at the base while also providing access to the nacelle for servicing.
- **Nacelle:** Box-like structure at the top of the tower which houses the electro-mechanical components of the wind turbine. The nacelle may contain equipment such as generator, transformers, converters, yaw system, and gearbox.
- **Rotor:** Consists of the three blades and the hub (where the blades connect). The rotor is responsible for the extraction of wind energy which is then converted into electricity by the generator. Blades can range in length depending on wind turbine size and can be pitched to control thrust force and rotor speed.

Figure 3.3-2 shows an indicative wind turbine.

Each wind turbine will contain oils, greases, and fuels used for lubrication, cooling, and hydraulic transmission. The precise volumes required will vary depending on the size and type of the machine selected. The wind turbine will be designed to minimize the potential for spills through containment measures. These materials will have an operational life at the end of which they, or the components which contain them, will be disposed of in accordance with industry guidelines and regulatory requirements. **Table 3.3-2** provides details on the oils, greases, and fuels proposed in the PDE. After use, these products will be brought to designated ports and disposed of according to applicable regulations and guidelines unless otherwise authorized.

TABLE 3.3-2. SUMMARY PER WIND TURBINE FOR OIL/GREASE/FUEL MAXIMUM PDE PARAMETERS

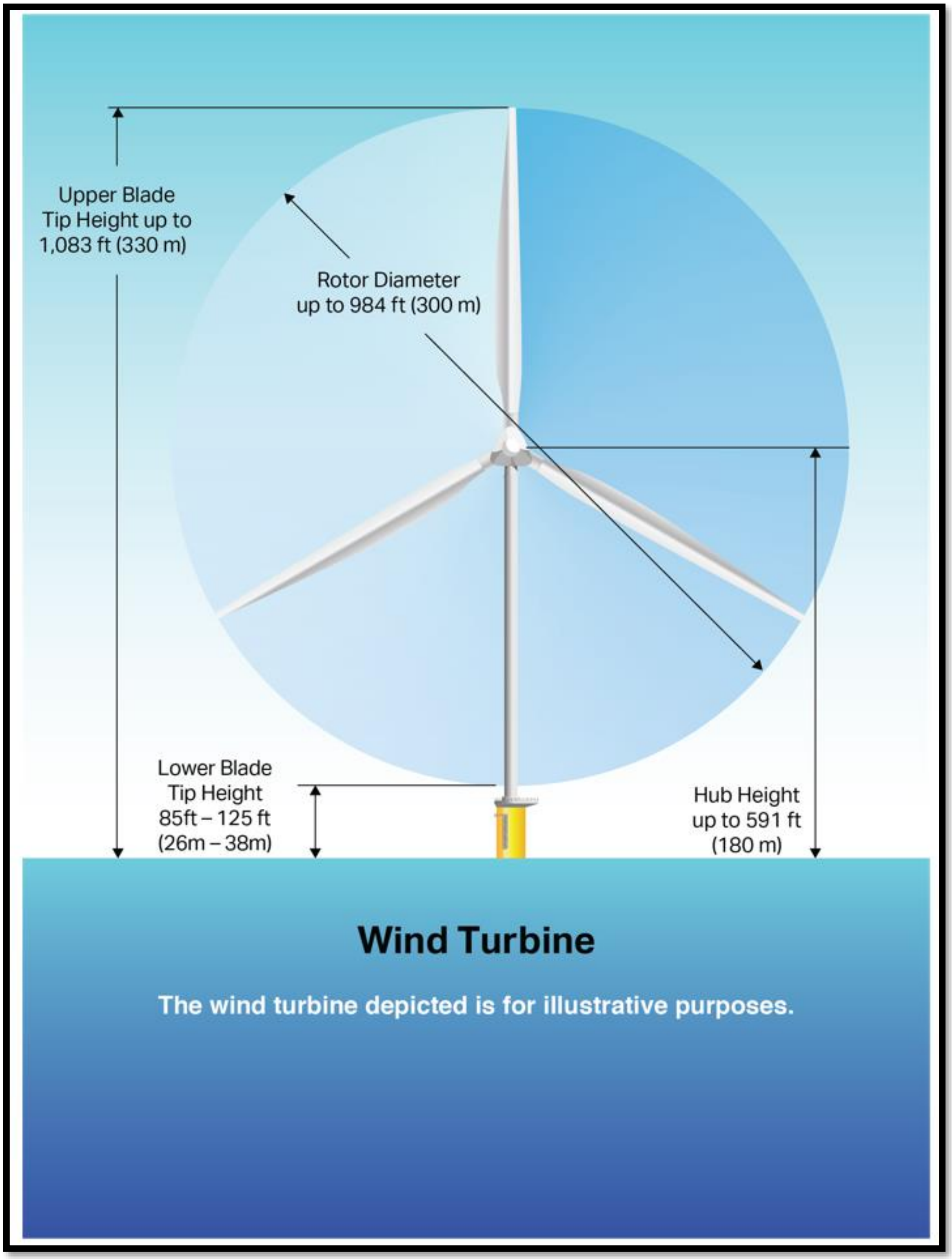
Oil/Grease/Fuel	Wind Turbine System/Component	BW1 and BW2
Ester Oil	Transformer	2,378 gallons (gal) (9,000 liters [l])
Grease	Bearings, yaw and pitch pinions	343 gal (1,300 l)
Gear Oil	Drive train gearbox, yaw and pitch drive gearbox	1,170 gal (4,430 l)
Hydraulic Oil	Crane (if not electrical), hydraulic pumping unit, hydraulic pitch actuators, hydraulic pitch accumulators	528 gal (2,000 l)
Cooling (Water/Glycol)	Tower damper, cooling system	872 gal (3,300 l)
Nitrogen	Blades and generator (pitch system) hydraulic accumulators	17,171 gal (65,000 l)
Diesel Fuel	Emergency generator	793 gal (3,000 l)
Sulfur Hexafluoride (SF_6 Gas)	Switchgear	287 pounds (130 kilograms [kg])

The wind turbines will contain a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system acts as an interface for a number of sensors and controls throughout the wind farm, allowing the status and performance to be monitored, and for systems to be controlled remotely, where required. Each wind turbine will have its own control system which will ensure that the turbine runs in a controlled manner by aligning the turbine with the wind and performing a ramp down in high wind speeds. The turbines can also be controlled manually from within the tower base or nacelle.

The wind turbines selected will also contain safety and access measures for the crew during operations. Further, they will include marking and lighting in accordance with USCG and Federal Aviation Administration (FAA) guidelines and regulations (see **Section 3.5.3 Offshore Marking and Lighting** for additional information).

In addition to the marking and lighting measures described in **Section 3.5.3 Offshore Marking and Lighting**, Beacon Wind is considering the use of agency-approved Aircraft Detection Lighting System (ADLS; or similar system) to turn the aviation obstruction lights on and off in response to detection of a nearby aircraft and is actively completing an evaluation to determine the impacts of the implementation of this system. This commitment as a mitigation is subject to final Project evaluation and agency approval (see **Section 8.6 Aviation** for additional details).

FIGURE 3.3-2. MAXIMUM WIND TURBINE DIMENSIONS



3.3.1.1.1 *Offshore Substation Facilities*

The offshore substations will collect power from the wind turbines via the interarray cable systems (**Section 3.3.1.4 Interarray Cables**) and convert it from alternating current to direct current for transmission. Transformers will be located on the offshore substations to increase the voltage of the power received from the wind turbines so that the electricity can be efficiently transmitted onshore. Beacon Wind proposes to install up to two offshore substations: one for BW1 and a second for BW2. The details and parameters provided in this section refer to the topside of the offshore substations; the foundation is discussed in **Section 3.3.1.2 Foundations**. **Table 3.3-3** details the parameters for the offshore substation facilities.

TABLE 3.3-3. SUMMARY OF OFFSHORE SUBSTATION FACILITY MAXIMUM PDE PARAMETERS

Offshore Substation Facility Parameter	BW1 and BW2
Voltage	Up to 400 kV a/
Number	2
Width	278 ft (85 m)
Length	459 ft (140 m)
Height above HAT b/ (including crane)	492 ft (150 m)
Base height above HAT (air gap)	105 ft (32 m)

Note:
a/ 320 kV is the larger EMF impact and is assessed in Appendix CC Offshore Electric and Magnetic Field Assessment.
b/ HAT - Highest Astronomical Tide

As with the wind turbines, oils, greases, and fuels will be required for lubrication, cooling, and hydraulic transmission within the offshore substations. The precise volumes required will vary depending on the selected topside. The offshore substation facilities will be designed to minimize the potential for spills through containment measures. These materials will have an operational life at the end of which they, or the components which contain them, will be disposed of in accordance with best practice guidelines and regulatory requirements. **Table 3.3-4** provides details on the oils, greases, and fuels proposed in the PDE. After use, these products will be brought to designated ports and disposed of according to applicable regulations and guidelines unless otherwise authorized.

TABLE 3.3-4. SUMMARY PER OFFSHORE SUBSTATION FOR OIL/GAS/COOLING MEDIUM/LUBRICANT MAXIMUM PDE PARAMETERS

Oil/Grease/Fuel	Offshore Substation System/Component	BW1 and BW2	Transport
Mineral Oil	Transformer	260 metric tons (260,000 kg)	Transformer filled with oil prior to transport.
SF6 gas	Gas insulated switchgear / gas insulated bushing / bushings	14 metric tons (14,000 kg)	GIS is filled prior to transport, however pressurization to operation level is conducted offshore.

Oil/Grease/Fuel	Offshore Substation System/Component	BW1 and BW2	Transport
Diesel fuel	Back-up generator	35,663 gal (135,000 l)	Base case onboard, but may be used as a back-up post installed.
---	UPS batteries	50 metric tons (50,000 kg)	Onboard
Hypochlorite	Seawater chlorination system	2,641 gal (9,997 l)	NA
De-ionized water	Cooling system	28 28 metric tons (28,000 kg)	System is partly filled and fully filled offshore.
Foam	Firefighting system	660 gal (2,500 l)	Onboard
Nitrogen	Inert gas firefighting system	925 gal (3,500 l)	Onboard
Argon	Inert gas firefighting system	925 gal (3,500 l)	Onboard
Nitrogen	Expansion vessel blanket system	2,642 gal (10,000 l)	Onboard
Barrier fluid	Seawater lift pump	1,321 gal (5,000 l)	Post installed
Ethylene glycol mix or similar	Cooling medium system	13,208 gal (50,000 l)	Onboard
Oily water	Drain system	126,802 gal (479,997 l)	NA
AdBlue/DEF urea solution	Diesel generator exhaust system	2,642 gal (10,000 l)	Base case onboard, but may be used as a back-up post installed.
Hydraulic oil	Cranes	66 gal (2,500 l)	Onboard
Lube oil	Backup diesel generator	79 gal (300 l)	Onboard
Refrigerant	Chiller	1 metric ton (1,000 kg)	Onboard

The offshore substations will include converters, transformers, switchgears, and reactors to control the power flow, and reactors to optimize the power capture from the interarray cables and flow through the export cables. The topside also will include auxiliary equipment and uninterruptible power supplies, power quality measuring units, SCADA equipment, telecommunication systems, and numerous monitoring systems, together with facilities, safety, and rescue equipment for personnel.

Each offshore substation will include a CWIS to regulate temperature of the electrical converter equipment, that will utilize up to 10.6 million gallons per day (mgd) of once-through non-contact cooling water. Ocean water will be drawn in from the water column, approximately 49-131 ft (15-40 m) below the water surface. The CWIS will discharge heated, treated seawater below the platform jacket approximately 66-112 ft (20-34 m) below the water surface. Discharged water temperature will be approximately 87.8°F (31°C) when the seawater inlet temperature is 68°F (20°C), though for much of the year the seawater will be cooler and the discharge temperature will accordingly be lower.

Discharged water will not exceed 96.8°F (36°C), and this maximum temperature would correlate to a CWIS operating at a much smaller discharge volume than the maximum.

The offshore substations will consist of multiple deck levels, which will include the cables, equipment, and utilities. The offshore substations will also be compatible with a gangway system for boat landings, and at this time the Project is currently considering the use of helicopters and helicopter winch decks (see **Section 3.3.1.2 Foundations** for additional information). Beacon Wind is continuing to evaluate logistics for helicopter use, and the relevant impact assessments will be updated pending the final decision. The layout of the offshore substations will also consider pull-in and hook-up of interarray and export cables using J-tubes. While the offshore substations will be unmanned, the design will also incorporate space for emergency sheltering situations and will be focused on health, safety, and material handling during fabrication, installation, operation, and maintenance of the substations (see **Section 3.4 Construction and Installation Activities** and **Section 3.5 Operations and Maintenance Activities** for additional information on operations). **Figure 3.3-3** shows an example of an offshore substation facility (including the offshore substation and converter station).

FIGURE 3.3-3. REPRESENTATIVE OFFSHORE SUBSTATION FACILITY CONCEPT

3.3.1.2 *Foundations*

Foundations are required to secure the wind turbines and offshore substation facilities vertically while withstanding loads from wind and the marine environment. Foundations also provide a means of safe access for maintenance activities.

The PDE includes options of up to three types of foundations to support the wind turbines and up to two for the offshore substation facilities. Descriptions of the foundation types proposed are:

- **Monopile**: A single vertical, broadly cylindrical steel pile driven into the seabed to support a wind turbine. A steel TP, which may contain secondary structure components (i.e., boat landings and access platforms),[25] will be connected to the monopile. Alternatively, a TP-less design may be applied.
- **Piled Jacket**: A vertical steel lattice structure consisting of three or four legs to support a wind turbine, or up to eight legs to support an offshore substation facility, secured into the ground with steel pile foundations. Jackets supporting wind turbines will be secured by pre-installed piles and connected to the turbine tower by a TP. The offshore substation jacket is expected to be temporarily supported on mud mats, with piles post-installed at the corner legs following jacket installation. Secondary structures (i.e., J-tubes, boat landings and access platforms)[26] will be connected onto the jacket.
- **Suction Bucket Jacket**: A vertical steel lattice structure consisting of three or four legs to support a wind turbine, or up to eight legs to support an offshore substation, with inverted bucket-like steel structures at the base. Jackets supporting wind turbines will be connected to the turbine tower by a TP. Secondary structures (i.e., J-tubes, boat landings and access platforms)[27] will be connected onto the jacket.

An illustration of the foundation types included in the wind turbine foundation PDE is presented in **Figure 3.3-4**. A summary of parameters from the wind turbine foundation PDE is included in **Table 3.3-5.**

The final number and selection of foundation type for wind turbines is dependent on several factors such as the selected wind turbine size, ground conditions, water depth, metocean conditions (wind, wave, current, and tidal regime), other relevant loads (such as vessel impact loads), supply chain, and economic factors at the time of design and construction. The PDE for the wind turbine foundation includes monopile, piled jacket, and suction bucket jacket. Selection of foundation type for the offshore substation primarily depends on the ground conditions. The PDE for the offshore substation facility foundations include suction bucket jacket and piled jacket.

Selection and allocation of the remaining foundation types in the PDE will depend on the final assessment of the site-specific soil conditions at each structure location (see **Appendix G Marine Site Investigation Report** for additional information). Beacon Wind is in the process of collecting and reviewing additional site-specific data to support the FDR/FIR. This additional data, combined with other studies (e.g., tank testing for erosion and scour design, driveability, and pile capacity checks) will help determine the final foundations. Beacon Wind may ultimately determine that multiple foundation types will be incorporated in the final design of the Project; for example, monopiles could be the preferred foundation type in shallow water, while water depths may require the use of jacket

[25] Beacon Wind is assessing a solution that would remove some of these secondary structures.
[26] Beacon Wind is assessing a solution that would remove some of these secondary structures.
[27] Beacon Wind is assessing a solution that would remove some of these secondary structures.

foundations in deeper water. Furthermore, the geologic conditions may be appropriate for suction bucket jackets in one portion of the Lease Area while piled jackets are required in another. Beacon Wind still maintains a requirement for flexibility to be able to select foundation types from the PDE based on commercial and technical reasons.

FIGURE 3.3-4. WIND TURBINE FOUNDATION TYPES

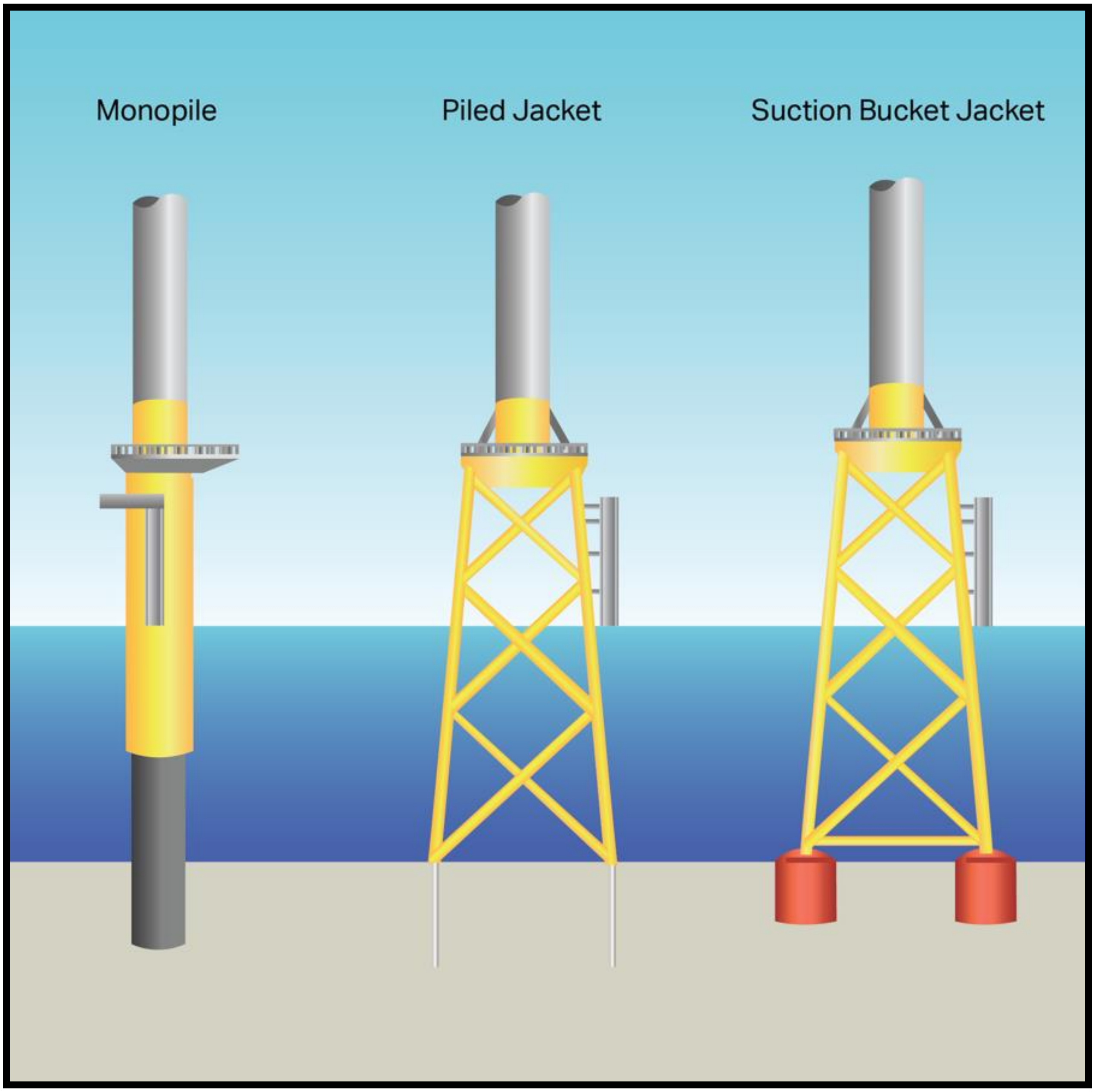


TABLE 3.3-5. SUMMARY OF WIND TURBINE FOUNDATION PDE PARAMETERS

Foundation Parameter	BW1 and BW2
Monopile	
Base diameter	43 ft (13 m)
Seabed penetration	180 ft (55 m)
Seabed footprint (without scour protection) a/	0.033 ac (0.013 ha)
Seabed footprint (with scour protection) b/	1.24 ac (0.50 ha)
Diameter at MSL	43 ft (13 m)
Piled Jacket	
Leg spacing at seabed	164 ft (50 m)
Piled diameter on seabed	14.8 ft (4.5 m)
Seabed penetration	229.6 ft (70 m)
Seabed footprint (without scour protection) a/	0.016 ac (0.0064 ha)
Seabed footprint (with scour protection) b/	1.5 ac (0.61 ha)
Leg spacing at MSL	112 ft (34 m)
Suction Bucket Jacket	
Leg spacing at seabed	164 ft (50 m)
Suction bucket diameter	66 ft (20 m)
Seabed penetration	66 ft (20 m)
Seabed footprint (without scour protection) c/	0.31 ac (0.13 ha)
Seabed footprint (with scour protection) b/	3.0 ac (1.2 ha)
Leg spacing at MSL	115 ft (35 m)

Notes:
a/ Per foundation, representative of maximum diameter with four piles.
b/ Per foundation if scour protection is required. The scour protection also protects the exposed portions of the interarray cables exiting the J-tubes.
c/ Per foundation, representative of maximum diameter of four buckets.

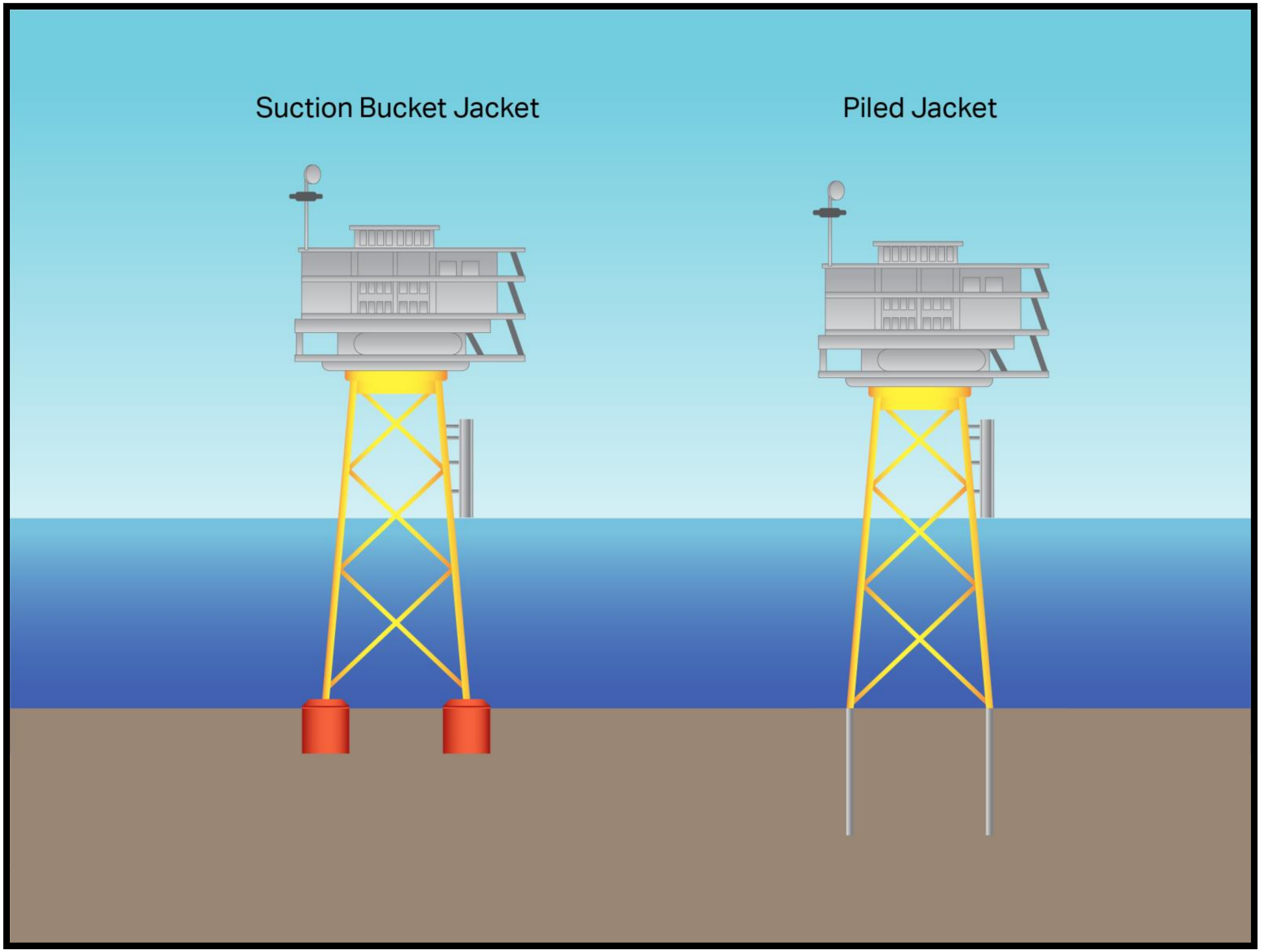
An illustration of the foundation types included in the offshore substation foundation PDE is presented in **Figure 3.3-5**. A summary of parameters from the offshore substation foundation PDE are included in **Table 3.3-6**. For the purposes of the assessments presented in this COP, the Project has assumed the maximum parameters for up to two offshore substation facilities.

TABLE 3.3-6. SUMMARY OF OFFSHORE SUBSTATION FOUNDATION MAXIMUM PDE PARAMETERS

Foundation Parameter	BW1	BW2
Piled Jacket a/		
Leg spacing at the seabed (corner legs)	230 ft (70 m)	
Piled diameter on seabed (per pile)	9.8 ft (3 m)	
Seabed penetration	328 ft (100 m) b/	118 ft (36 m) c/
Seabed footprint (without scour protection) d/	0.3 ac (0.1 ha)	
Seabed footprint (with scour protection) e/	4.0 ac (1.6 ha)	
Leg spacing at MSL	230 ft (70 m)	
Suction Bucket Jacket f/		
Leg spacing at seabed	230 ft (70 m)	
Suction bucket diameter	65 ft (20 m)	
Seabed penetration	59 ft (18 m)	
Seabed footprint (without scour protection) d/	0.3 ac (0.1 ha)	
Seabed footprint (with scour protection) e/	5.2 ac (2.1 ha)	
Leg spacing at MSL	230 ft (70 m)	

Notes:
a/ For piled jackets designed with up to 8 legs, and up to 6 piles per jacket corner leg.
b/ Up to 3 piles per jacket corner leg (12 total piles).
c/ Up to 6 piles per jacket corner leg (24 total piles).
d/ Per foundation, including mud mats at each leg/pile cluster. Note that seabed preparation prior to foundation installation may involve pre-dredging across the entire jacket and scour protection footprint,
e/ Per foundation if scour protection is required. The scour protection also protects the exposed portions of the submarine cables entering/exiting the J-tubes.
f/ For suction bucket jackets designed with 4 buckets per jacket.

FIGURE 3.3-5. REPRESENTATIVE OFFSHORE SUBSTATION FACILITY FOUNDATION TYPES



3.3.1.3 *Submarine Export Cables*

The wind turbines are connected with HVAC interarray cables to an HVDC converter installed on offshore substations within the Lease Area. The HVDC power is then transmitted through the submarine export cable systems. Given the export cable distances between the Lease Area and the onshore substation facilities, HVDC is the chosen technology due to the ability to reliably and effectively transmit with minimal losses. The HVDC transmission systems for BW1 and BW2 will each require two cables (+ and -) between the offshore substation facility and onshore substation facility to create the direct current (DC)-circuit needed. These two HVDC cables can be provided as a bundled solution or as two separate cables (unbundled), due to technical considerations and the capabilities of installation vessels. A separate fiber optic cable will be utilized for each wind farm for the automation, control, and communication signal transfer between the onshore control center and the offshore substation facility. The conceptual design utilizes a stranded conductor made of annealed copper and the interstices between wires are filled with a water-tight compound to prevent longitudinal water penetration if exposed to water due to damage. A representative conductor insulation could consist of three sublayers including a semiconductive screen, a main layer of crosslinked polyethylene (XLPE), and a semiconductive insulation screen. A longitudinal sheath made of water swelling tape provides a water barrier. A lead sheath acts both as a conductor for the highest anticipated earth fault current and as a mechanical barrier to prevent water ingress into the insulation system. The armor is made of one layer of galvanized steel and the outer protection sheath is made of polyethylene (PE).

Beacon Wind is currently assessing two solutions for the BW1 and BW2 transmission systems, each containing one fiber optic cable and two single core cables that will transmit power between each offshore/onshore substation facility: 1) unbundled cables and 2) a combination of bundled and unbundled cables along the submarine export cable routes. At the landfall, with the current base case the cables will be guided to shore through an HDD solution (starting from approximately 1,640-3,281 ft [500-1,000 m] from shore). The Project is also assessing other trenchless and trenched landfall solutions (see **Section 3.4.3.1 Onshore Export Cable and Interconnection Cable Routes**). The fiber optic will go bundled together with the HVDC cable through the HDD.

The current base case for the route to Queens, New York, is unbundled from landfall to kilometer point (KP) 12 (measured from shoreline at Queens, New York) due to limitations in shallow waters and bundled from KP12 to Lease Area. An example of a bundled and unbundled submarine export cable is found in **Figure 3.3-6** and **Figure 3.3-7**.

FIGURE 3.3-6. REPRESENTATIVE CROSS-SECTION OF A BUNDLED SUBMARINE EXPORT CABLE

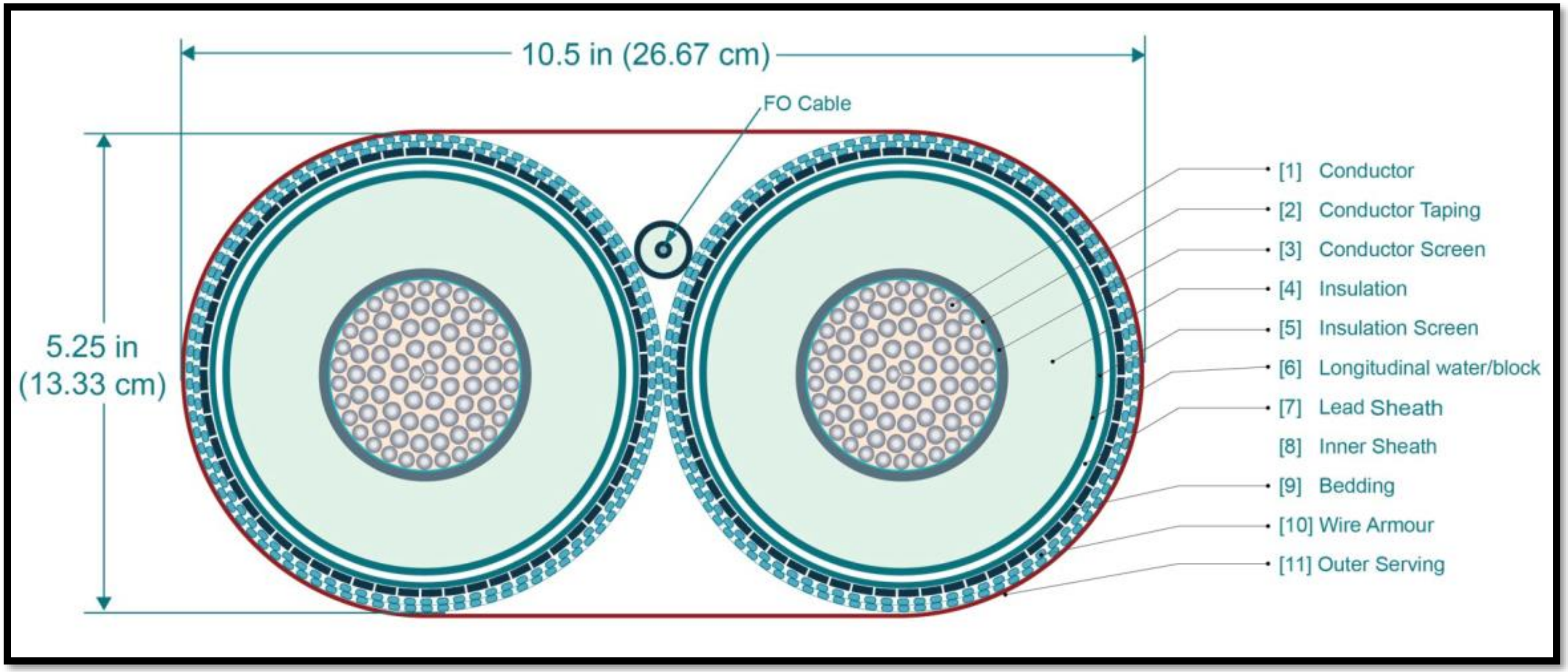
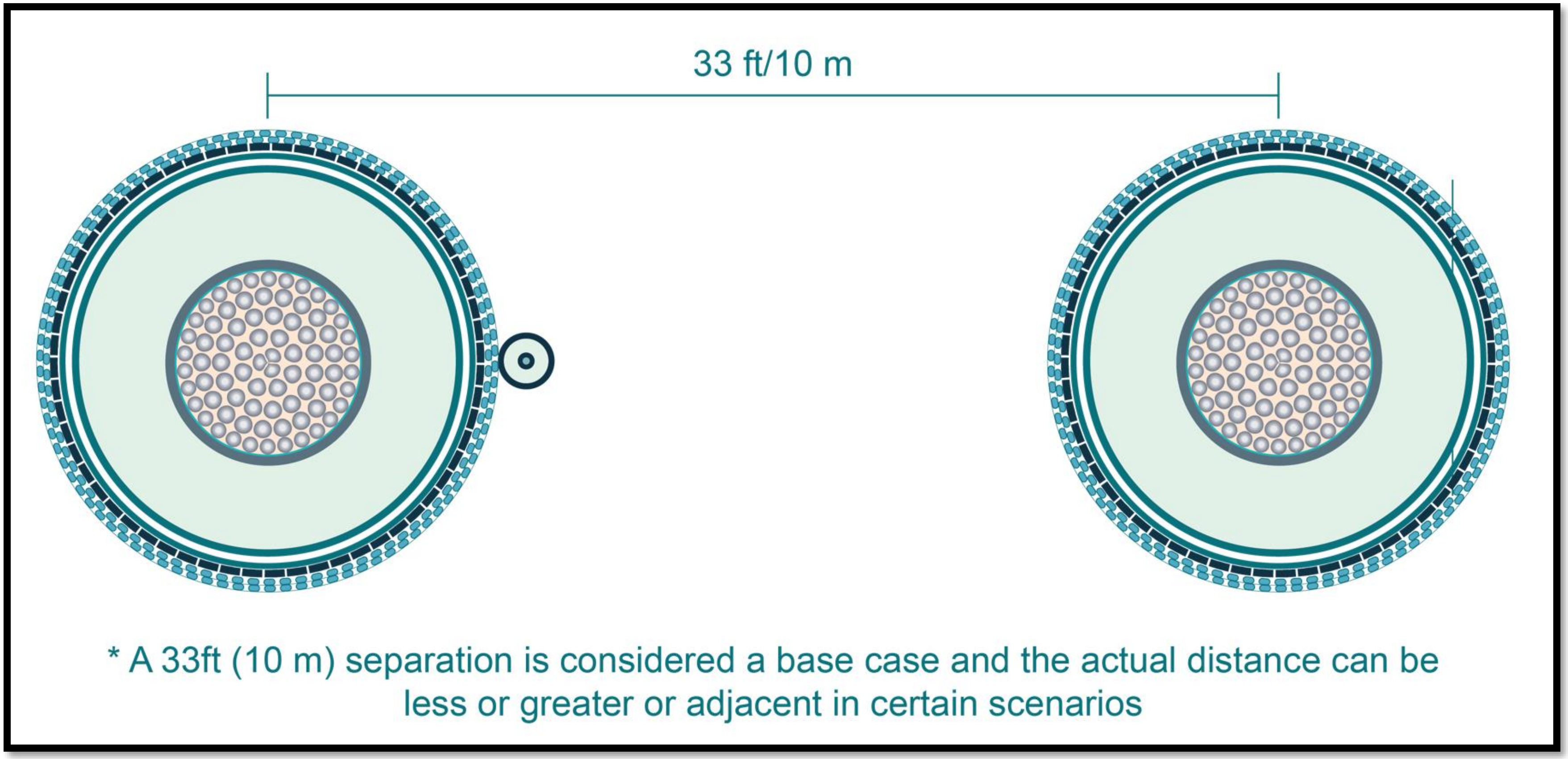


FIGURE 3.3-7. REPRESENTATIVE CROSS-SECTION OF AN UNBUNDLED SUBMARINE EXPORT CABLE



The submarine export cables will be buried to a target burial depth of 3-6 ft (0.9-1.8 m) below the seabed outside of federally maintained (e.g., anchorages and shipping channels) areas. Unless otherwise confirmed with USACE, Beacon Wind shall install the submarine export cables to a minimum target burial depth of 15 ft (4.6m) below the existing seabed or below the authorized depth in federally authorized channels, and anchorages, whichever is deeper, and where determined by the cable burial risk assessment (CBRA).[28]

In areas where the target burial depth cannot be achieved due to existing seabed conditions or the presence of existing utilities (cables and/or pipeline) that must be crossed, it is anticipated that protection measures will be required (see **Section 3.3.1.6 Cable Protection** for additional information on rock installation protection and other protection measures). Use of blasting to address seabed conditions in areas such as at landfall locations is anticipated to be necessary in portions of the East River where hard substrates may limit the use of traditional dredging methods. Final engineering assessment and landfall design, as well as the collection of additional data through cone penetration testing, will further confirm seabed conditions at the landfalls.

Other factors that determine minimum target burial depth will be considered during the CBRAs, such as non-regulated anchoring activity and seabed-impacting fishing (e.g., hydraulic clam dredging). For example, in areas of hydraulic clam dredging, a target burial depth of at least 6 ft (1.8 m) may be appropriate pending results of the CBRA (see **Section 8.8 Commercial and Recreational Fisheries**). **Table 3.3-7** details the PDE parameters for the submarine export cables.

TABLE 3.3-7. SUMMARY OF SUBMARINE EXPORT CABLE MAXIMUM PDE PARAMETERS

Submarine Export Cable Parameters	BW1	BW2
Number of Route Options	1	2 a/
Number of Circuits	1	1
Number of HVDC Conductors Per Circuit	2	
Number of Fiber Optic Cables per Circuit	1	
Total Length b/	202 nm (375 km)	202 nm (375 km) Queens, NY 113 nm (209 km) Waterford, CT
Voltage	Up to 400 kV	
Dimension of Cable Bundle	10.5in x 5.25 in (266.7 mm x 133.5 mm)	
Target Burial Depth c/	3-6 ft (0.9-1.8 m) 15 ft (4.6 m) d/	
Target Trench Depth	8 ft (2.4 m) d/	
Trench Width e/	18 ft (5.5 m)	
Width of Seabed Footprint Impact	33 ft (10 m)	

[28] Beacon Wind is in coordination with the USACE as it relates to future plans associated with these USACE-managed areas, and the potential for an increase in the authorized depths. Final burial depth will be based upon the CBRA and is subject to regulatory approval.

Submarine Export Cable Parameters	BW1	BW2
Anchor Corridor Width f/	3,000 ft (914 m)	
Siting Corridor Width g/	1,640 ft (500 m)	
Permanent Easement Width h/	200 ft (60 m)	
Pre-sweeping Sediment Dredge Volume	325,131 yd^3 (248,581 m^3)	325,131 yd^3 (248,581 m^3)

Notes:

a/ There will be two landfall options assessed for BW2 at Queens, New York and Waterford Connecticut which allows for a shared backbone concept of the design for BW1 and BW2 to utilize a shared corridor, as possible.

b/ The approximate distance along the centerline of the surveyed submarine export cable siting corridor from the edge of the Lease Area to the submarine export cable landfall. Actual length of cable may increase as a result of micrositing and final location of the offshore substation. Final installation will be within the surveyed corridor assessed.

c/ Burial depths to be based on CBRA and/or site-specific conditions and may be greater than values listed here.

d/ In locations where the submarine export cables will cross federally maintained areas, the depth may vary and will be determined based upon the current or future authorized depth or the existing water depths, whichever is greater; therefore, minimum burial could be greater.

e/ The width at the top of the trench is defined here as the subsurface width and will vary based upon the final installation method selected. Typical installation width is anticipated to be 1.5ft (0.50 m) for the jet trencher.

f/ The area in which a submarine export cable installation vessel may anchor in support of installation activities; distance measured from the edge of the siting corridor. Corridor width may increase or decrease where site constraints exist. The extent of the anchor corridor will be limited to the area of survey coverage that has been cleared of constraints. Impacts from Project-related vessel anchoring are expected to be up to 269 square feet (ft^2) (25 square meters [m^2]) in area, with a maximum penetration depth of 49 ft (15 m), in up to 1,400 locations.

g/ The area that has been surveyed, where the submarine export cable could be installed, and seabed impacts may occur. If export cables for BW1 and BW2 follow the same route, BW1 and BW2 may be installed in separate trenches within the same installation corridor. Corridor width may increase or decrease where site constraints exist, and survey coverage allows.

h/ Distance from centerline for the cable. If a field joint is required, a wider easement may be required at the location of the joint.

3.3.1.4 *Interarray Cables*

The interarray cables will be HVAC cables. These cables connect the wind turbines in "strings" and then connect the "strings" of wind turbines to the offshore substation facilities. **Table 3.3-8** details the PDE parameters for the interarray cables. An example of an interarray cable is found in **Figure 3.3-8**.

TABLE 3.3-8. SUMMARY OF INTERARRAY CABLE MAXIMUM PDE PARAMETERS

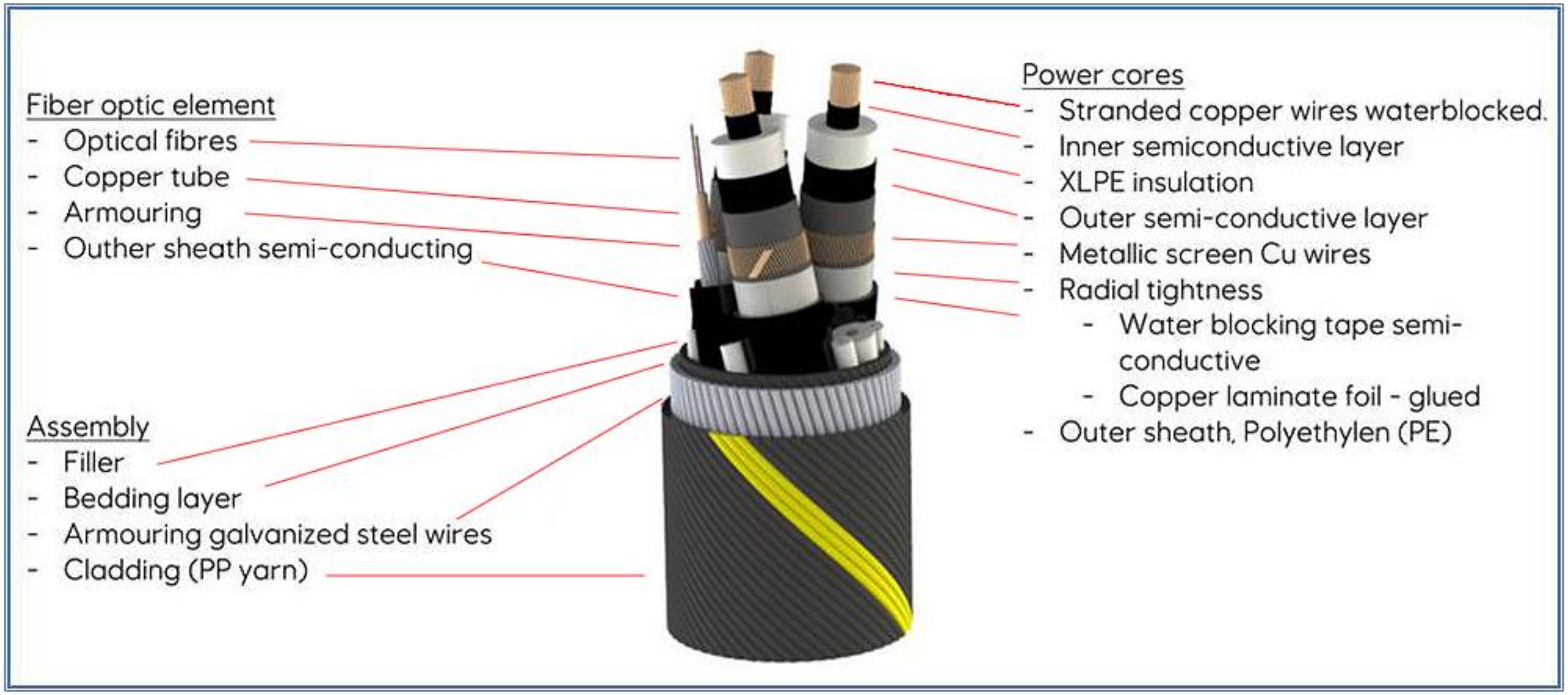
Interarray Cable Parameters	BW1	BW2
Total Length	162 nm (300 km)	162 nm (300 km)
Voltage	150 kV	
External Diameter (3 core cable)	10 in (250 mm)	
Target Burial Depth of Cable a/	3-6 ft (0.9-1.8 m)	
Maximum Trench Depth	8 ft (2.4 m)	
Trench Width b/	5 ft (1.5 m)	
Seabed Footprint	113 ac (45.7 ha)	

Note:

a/ Burial depths to be based on CBRA and/or site-specific conditions and may be greater than values listed here.

b/ The width at the top of the trench is defined here as the subsurface width and will vary based upon the final installation method selected.

FIGURE 3.3-8. REPRESENTATIVE INTERARRAY CABLE



The final design, wind turbines per string, and interarray cable arrangement will depend on a variety of factors including environmental conditions, detailed electrical design, seabed conditions, and micrositing requirements. In the event that a portion of the interarray cables does not achieve adequate burial depth, cable protection measures will be assessed and applied as appropriate (see **Section 3.3.1.6 Cable Protection** for additional information on scour protection and other protection measures).

3.3.1.5 *Scour Protection*

Scour protection is likely to be required around the base of wind turbines and offshore substation facilities to prevent scouring of seabed material, depending on the selected foundation type. The locations, the type of protection, and the amount placed around each foundation will be based on a variety of factors, including foundation type, water flow, and substrate type, and will be informed by hydrodynamic scour modeling. Descriptions of potential scour protection types are:

- Rock: the installation of crushed rock or boulders around a structure;
- Rock Bags: pre-filled bags containing crushed rock to be placed around a structure;
- Mattresses: the installation of purpose built mattresses around a structure; and
- Continued evaluation of new scour protection systems under development.

Table 3.3-9 details the parameters for the proposed scour protection measures. These measures as well as a summary of bedform locations and seabed mobility rates, are further detailed within **Appendix EE Scour Analysis**.

TABLE 3.3-9. SUMMARY OF SCOUR PROTECTION MAXIMUM PDE PARAMETERS

Scour Protection Parameters	BW1 and BW2
Scour Protection (Wind Turbine Foundations)	
Monopile	
Depth of scour protection	9.8 ft (3 m)
Diameter of scour protection (including foundation)	295 ft (90 m)
Total volume of scour protection for each monopile	9,156 cubic yards (yd^3) (7,000 cubic meters [m^3])
Piled Jacket a/	
Depth of scour protection	9.8 ft (3 m)
Diameter of scour protection (per leg [4] including foundation)	164 ft (50 m)
Total volume of scour protection material for each piled jacket	10,464 yd^3 (8,000 m^3)
Suction Bucket Jacket	
Depth of scour protection	9.8 ft (3 m)
Diameter of scour protection (per leg [4] including foundation)	262 ft (80 m)
Total volume of scour protection material for each suction bucket jacket	14,387 yd^3 (11,000 m^3)
Scour Protection (Offshore Substation Facility Foundations)	
Piled Jacket a/	
Depth of scour protection	11.5 ft (3.5 m)
Diameter of scour protection (per secured leg [4] including foundation) b/	262 ft (80 m)
Total volume of scour protection material for each piled jacket	58,860 yd^3 (45,000 m^3)
Suction Bucket Jacket	
Depth of scour protection	11.5 ft (3.5 m)

Scour Protection Parameters	BW1 and BW2
Diameter of scour protection (per secured leg [4], including foundation)	262 ft (80 m)
Total volume of scour protection material for each suction bucket jacket	58,860 yd^3 (45,000 m^3)

Note:
a/ The parameters for suction bucket jacket scour protection are conservatively assumed to apply to piled jackets.
b/ Secured legs refer to jacket legs supported directly on piles or suction buckets. In the case of a jacket with more than 4 legs, it is expected that the corner legs would be secured.

3.3.1.6 *Cable Protection*

Cable protection is proposed to be installed along portions of the submarine export cables and interarray cables, in the event target burial depths cannot be achieved or where other subsea assets have to be crossed (e.g., cables and pipelines). The locations requiring protection, the type of protection selected, and the amount placed around each submarine export and interarray cable will be based on a variety of factors, including water flow and substrate type (hydrodynamic scour modeling) and locations of other ocean uses (i.e., commercial fishing). Descriptions of the cable protection types proposed are:

- Rock: the installation of crushed boulders over a cable;
- Rock Bags: pre-filled bags containing crushed rock to be placed over a cable;
- Concrete Mattresses: concrete blocks, or mats, connected via rope or cable; and
- Cast iron shells: developed to protect fiber optic cables, power cables from abrasion and impact.

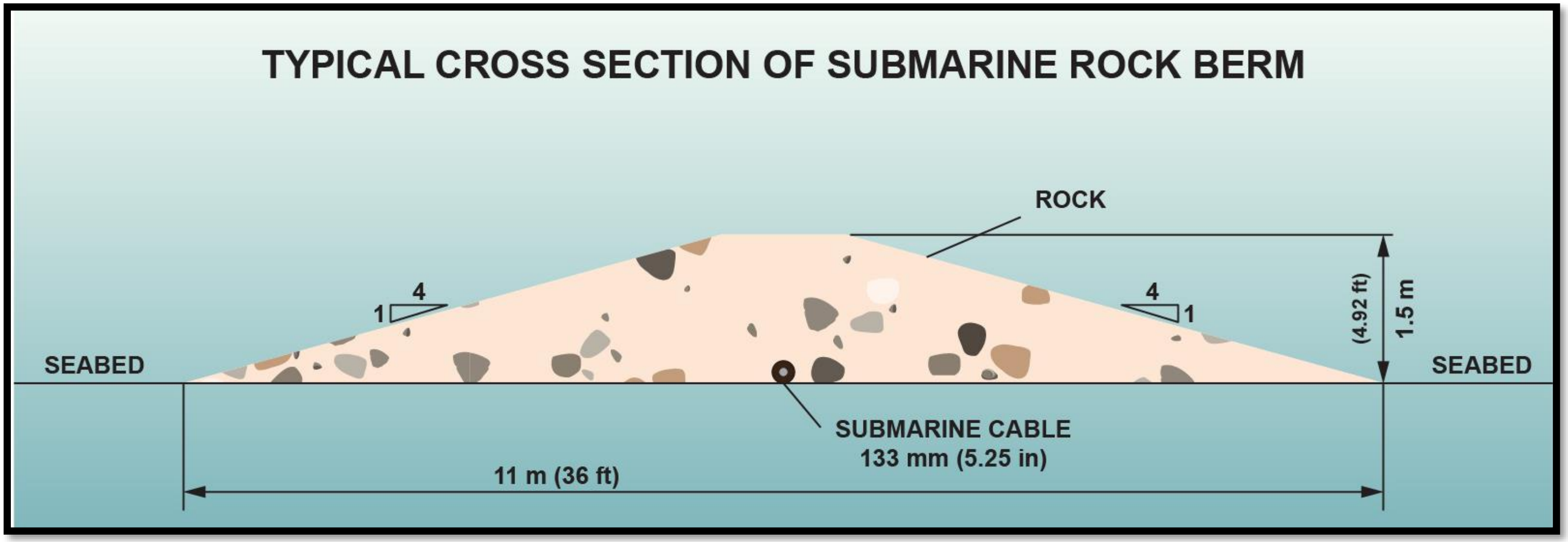
In addition, at cable and pipeline crossings, tubular sections, consisting of larger pipe sections to house the cable, may be installed on the submarine export cables as a protection layer prior to the placement of the cable protection measures described above. Cable protection may also be placed around appropriate sections of exposed or at-risk cables, where the amount and type is dependent on the cable type and position, residual burial depth (if partially buried) and subject to the results of the geophysical and geotechnical surveys, hydrodynamic modeling, and the CBRA. Beacon Wind notes that surficial use of concrete mattresses is not a preferred method of cable protection; therefore, this approach will be utilized to the least extent practicable. It is estimated that up to 10 percent of the length of the submarine export cables and up to 10 percent of the length of the interarray cables will require remedial surface cable protection.[29] **Table 3.3-10** details the parameters for the proposed cable protection measures. Representative images of certain cable protection types are found in **Figure 3.3-9**.

[29] Actual extent of cable protection will be refined including completion of the CBRA and maturity of BW1 and BW2 but shall not exceed 10 percent.

TABLE 3.3-10. SUMMARY OF CABLE PROTECTION MAXIMUM PDE PARAMETERS

Cable Protection Parameters	BW1 a/ and BW2 a/
Submarine Export Cables	
Width at Base	36 ft (11 m)
Width at Top	5 ft (1.5 m)
Depth	5 ft (1.5 m)
Interarray Cables	
Width at Base	36 ft (11 m)
Width at Top	5 ft (1.5 m)
Depth	5 ft (1.5 m)
Cable and Pipeline Crossings	
Width at Base	118 ft (36 m)
Width at Top	8.2 ft (2.5 m)
Depth of Protection between Asset Crossed and Cable	1.5 ft (0.5m)
Note: a/ Provided per cable within each installation corridor.	

FIGURE 3.3-9. EXAMPLE OF CABLE PROTECTION: ROCK DUMPING, FOR USE IN AREAS WHERE BURIAL DEPTHS CANNOT BE ACHIEVED



3.3.2 Onshore Infrastructure

3.3.2.1 *BW1 and BW2 Queens, New York, Export Cable Landfalls*

At the BW1 and BW2 submarine export cable landfall locations in Queens, New York, the submarine export cables will most likely connect directly into the onshore substation facilities, as the onshore substation facility locations under consideration are proposed to be located proximate to the landfall locations.

A brief description of the two export cable landfall locations under consideration are provided below and shown in **Figure 2.1-15:**

- **NYPA**: The NYPA landfall will occur at the northern edge of the Astoria power complex located at the East River shoreline. From the landfall, the submarine export cable will travel a short distance to the onshore substation facility situated within the same parcel.
- **AGRE**: The AGRE landfalls will occur at the northeastern edge of the Astoria power complex extending via HDD, as the base case installation method if selected, approximately 2,150 ft (655 m) from the East River to the AGRE East site and/or the AGRE West site.

From either landfall under consideration, the submarine export cables will connect directly into the onshore substation facility. A representative example of submarine export cable transition components is provided in **Appendix D Conceptual Project Design Drawings**.

3.3.2.2 *BW2 Waterford, Connecticut, Export Cable Landfall*

At the BW2 submarine export cable landfall location in Waterford, Connecticut, upon coming onshore the submarine export cable be required to traverse across the Dominion Millstone Power Station property to terminate at the onshore substation facility which is immediately adjacent to the POI.

A brief description of the export cable landfall location is provided below and shown in **Figure 2.1-19**:

- The landfall will occur at the western edge of the Dominion Millstone Power Station extending via HDD, as the base case installation method if selected, of approximately 2,000 ft (600 m) from Niantic Bay into the Dominion property.

The submarine export cable will connect directly into the onshore substation facility. A representative example of submarine export cable transition components is provided in **Appendix D Conceptual Project Design Drawings**.

3.3.2.3 *Onshore HVDC Export Cables*

Should a trenchless solution be utilized for any of the BW1 or BW2 landfalls, the submarine HVDC cable will be pulled through the HDD or other trenchless solution and connected directly to the onshore substation. Fiber optic cables are joined to give a continuous path from the offshore platform through the submarine export cable system and export land cable to the onshore substation facility. These fiber optic cables are required for communication between the HVDC converters, to provide command and control SCADA to the wind farms and may optionally be used for temperature sensing and acoustic sensing of the marine cable systems and surroundings for system health monitoring and fault detection. The PDE parameters for onshore export cables are found in **Table 3.3-11**.

Table 3.3-11. Summary of Onshore Segment of HVDC Export Cable Maximum PDE Parameters

Onshore Export Cable Parameters	BW1	BW2
Voltage	Up to 400 kV	
Number of HVDC Conductors per Circuit	2	
Diameter per Cable	5.25 in (133 mm)	5.25 in (133 mm)
Route Length	2,000 ft (600 m)	2,000 ft (600 m)
Temporary (construction) Easement Width	75 ft (22.9 m)	
Permanent Easement Width	20 ft (6.1 m)	
Construction Corridor Width	75 ft (22.9 m)	
Operational Corridor Width	20 ft (6.1 m)	

3.3.2.4 *Onshore Substation Facilities*

An onshore substation facility will be constructed and installed in support of each wind farm (BW1 and BW2) to transform and convert the power received by the submarine export cables from HVDC to HVAC for connection to the POI. Each onshore substation facility will contain enclosed buildings and/or walled structures which will contain various equipment, such as switchgears, control equipment, batteries, and a designated outside area to house outdoor equipment like reactive compensation equipment and harmonic filters, transformers and reactors. These facilities will be designed to comply with applicable state building codes, fire codes, electrical standards, occupational safety and health standards, and environmental conditions to the greatest extent practicable.

The BW1 onshore substation facility will be located at one of two locations: NYPA or AGRE (which includes the AGRE East and AGRE West sites). The final selection of the location will depend upon the ability for Beacon Wind to acquire land access agreements and other site considerations. As of January 2023, Beacon Wind Land LLC an affiliate of Beacon Wind and NRG were given NY PSC approval for sale of the AGRE parcel to Beacon Wind Land LLC. The Queens, New York onshore substation facility sites that are not used (NYPA, AGRE East, or AGRE West) for BW1 will remain under consideration, in addition to the Waterford, Connecticut site, for the single proposed BW2 onshore substation facility.

The essential components of each onshore substation facility in Queens, New York for BW1 and BW2 are as follows:

- Buildings (control, storage and valve hall);
- DC Yard (Up to 400 kV HVDC);
- Transformer Area;
- AC Yard (400 kV/138 kV); and
- Miscellaneous Components.

The essential components of an onshore substation facility in Waterford, Connecticut for BW2 are as follows:

- Buildings (control, storage and valve hall);
- DC Yard (Up to 400 kV HVDC);
- Transformer Area;
- AC Yard (400 kV/345 kV); and
- Miscellaneous Components.

3.3.2.5 *Onshore Interconnection Cables*

The Queens, New York underground HVAC interconnection cables will consist of nine cables per circuit with a total of three circuits each for BW1 and BW2. For BW2 in Waterford, Connecticut, the aboveground installation will consist of one circuit with two uninsulated conductors per phase. The alternative belowground installation would consist of two circuits, one XLPE-insulated conductor per phase. The copper or aluminum conductors will be enclosed in XLPE insulation, designed for voltage levels corresponding to the voltage of the POIs. Fiber optic cables for communication and temperature measurements will also be installed alongside the interconnection cables. An example of an onshore interconnection cable is found in **Figure 3.3-10**. **Table 3.3-12** details the PDE parameters for the interconnection cables.

At Queens, New York the interconnection cables will be installed underground (see **Section 3.4.3 Construction and Installation: Onshore Infrastructure**). Underground installation would involve duct banks buried to a target depth beneath the surface along the onshore cable routes (see **Appendix D Conceptual Project Design Drawings** for anticipated duct bank layouts). Joint pits (manholes) would be installed to provide access to the interconnection cables, and the spacing between joint pits will vary due to site-specific and cable installation constraints. At Waterford, Connecticut the interconnection cables will be installed aboveground on three steel towers.

FIGURE 3.3-10. REPRESENTATIVE CROSS-SECTION OF ONSHORE INTERCONNECTION CABLE

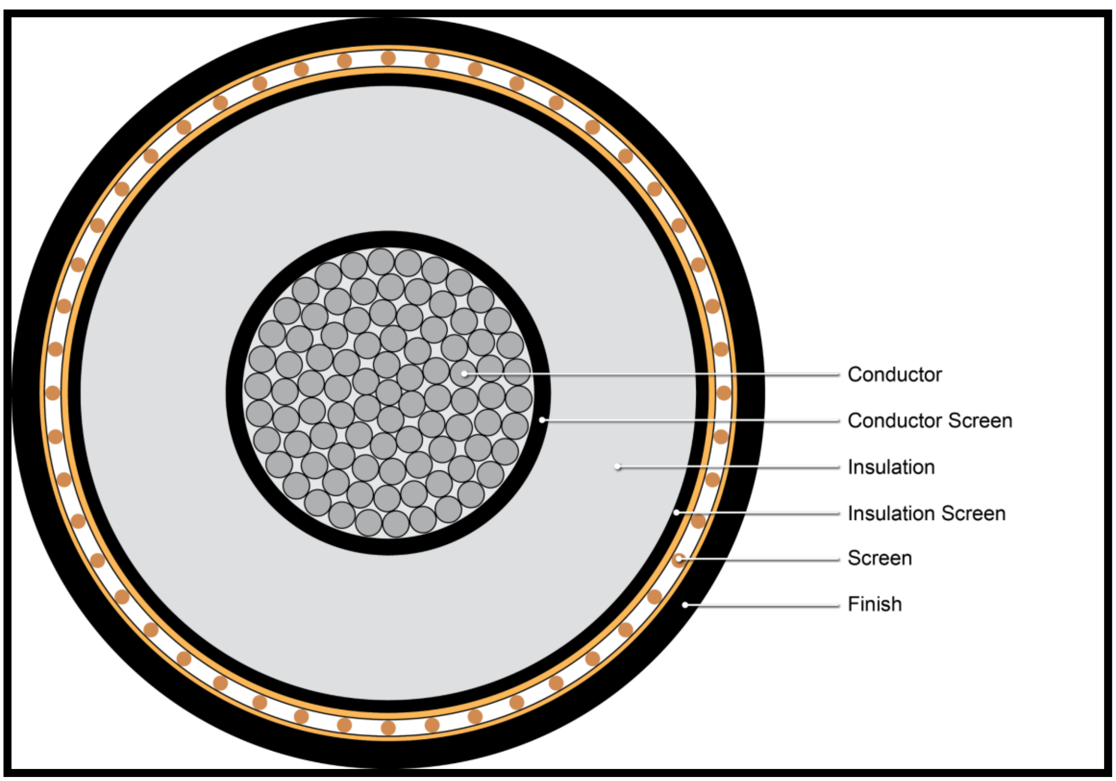


TABLE 3.3-12. SUMMARY OF INTERCONNECTION CABLE MAXIMUM PDE PARAMETERS

Interconnection Cable Parameters	BW1 (Queens, New York)	BW2 (Queens, New York)	BW2 (Waterford, Connecticut)
Onshore Interconnection Cable			
Number of Cables/Conductors per Route	27 + 3 fiber optic cables	27 + 3 fiber optic cables	6 Conductors (one circuit) + 2 fiber optic cables a/
Voltage at Interconnecting Substation (POI)	138 kV	138 kV	345 kV
Route Length	4,921 ft (1,500 m)	4,921 ft (1,500 m)	2000 ft (600 m)
External Diameter (including cable protection)	5.5 in (140 mm)	5.5 in (140 mm)	1.5 in (39 mm) b/
Construction Corridor Width (open cut)	75 ft (22.9 m)	75 ft (22.9 m)	N/A b/
Construction Corridor Width (overhead)	100 ft (30.4 m)	100 ft (30.4 m)	100 ft (30.4 m)
Operational Corridor Width (open cut)	20 ft (6.1 m)	20 ft (6.1 m)	N/A b/
Operational Corridor Width (overhead) c/	75 ft (22.9 m)	75 ft (22.9 m)	75 ft (22.9 m)

Note:
N/A – Not applicable
a/ The number of conductors represent an underground interconnection and would reflect the maximum potential. Overhead is the base case and would consist of 1 circuit with 2 conductors per phase.
b/ Based upon overhead alternative.
c/ For overhead based on onshore cable conduits being installed side-by-side in a single corridor; however, conduits may also be split or stacked depending on site conditions; therefore, this width may vary in certain locations.

3.4 Construction and Installation Activities

3.4.1 Ports and Equipment

Beacon Wind is evaluating the use of multiple port facilities to support construction and installation activities. The final staging and construction port selection will be determined based upon whether the ports are able to accommodate Beacon Wind's schedule, workforce, and equipment needs. Some components may be delivered directly from suppliers to the Lease Area and forgo local staging.

Beacon Wind will not be responsible for permitting or improving these facilities. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using the facilities.

During construction, Beacon Wind will receive equipment and materials to be staged and loaded onto installation vessels at one or more existing third-party port facilities. Beacon Wind has not yet finalized the selection of facilities. The Port of New Bedford, Massachusetts, and SBMT have been provided as ports under consideration for the Project. The additional ports listed in **Table 3.4-1** are provided as being under assessment for consideration.

As part of the PDE, the offshore infrastructure will consist of foundations, wind turbines, offshore substation facilities, interarray cables, submarine export cables, and scour protection. It is estimated that the Project will require approximately 40 vessels for construction of BW1 and approximately 40 vessels for construction of BW2. **Table 3.4-2** summarizes the types and number of offshore vessels to be used during construction.

Helicopters are currently being considered to support the Project during the construction phase. While a final decision has not been made, preliminary considerations of helicopter use have been considered in the air emissions calculations in **Appendix J Air Emission Calculations and Methodology**.

TABLE 3.4-1. POTENTIAL PORT FACILITIES

State	Port	City/Town, County	Staging and Load Out for Wind Turbine Tower, Nacelle, and Blades	Construction Management/ Vessel Services	O&M Activities
New York	South Brooklyn Marine Terminal	Brooklyn, Kings County	X	X	X
	Arthur Kill Terminal	Staten Island, Richmond County	X	X	
Massachusetts	Port of New Bedford	New Bedford, Bristol County		X	X
Rhode Island	Port of Providence	Providence, Providence County			X
Connecticut	Port of New London	New London, New London County		X	
	Port of Bridgeport	Bridgeport, Fairfield County		X	
	Port of New Haven	New Haven, New Haven County		X	

Beacon Wind is also proposing to temporarily moor a metocean buoy within the Lease Area during construction and installation operations to provide real-time weather conditions. This buoy is expected to be the same or smaller than those installed in November 2021, which were approved under the SAP. The buoy will be attached to the seafloor by means of a U-shaped mooring design which is comprised of a chain, rope, and floats, which connect the buoy to both a primary and secondary clump anchor on the sea floor. The primary and secondary clump weights would weigh up to 2,646 pounds (1,200 kilograms) and 661 pounds (300 kilograms), respectively, and will rest on the seafloor for an area of approximately 21.5 ft^2 (2 m^2) per clump weight. The chain would be attached to the underside of the buoy hull. Due to the mooring design, which includes a rubber cord section, there will be no anchor chain sweep associated with the operation of the buoy. Total area of mooring resting on the seafloor, inclusive of both clump weights, chains and wire ropes, would be approximately 62.4 ft^2 (5.8 m^2). Vertical penetration of the primary and secondary anchor chain into the seabed is anticipated to be approximately 1.5 ft and 0.5 ft (0.5 m to 0.2 m), respectively.

The buoy and mooring system will be deployed from a single workboat. The specific location proposed for deployment has not yet been determined, but will be cleared by the Qualified Marine Archaeologist (QMA) and sited to avoid sensitive benthic habitat. Following completion of construction and installation activities in the Lease Area, the metocean buoy and mooring system will be recovered by using a crane or A-frame to lift they buoy and mooring system to the decommissioning work vessel. Seafloor conditions are expected to return to previous baseline conditions shortly thereafter.

TABLE 3.4-2. PRELIMINARY SUMMARY OF OFFSHORE VESSELS FOR CONSTRUCTION

Vessel	Description	Foundations			Wind Turbines	Offshore Substation Topside & Foundation	Submarine Export Cables	Interarray Cables	Scour Protection
		Monopile	Piled Jacket	Suction Jacket					
Heavy Transport Vessel	Vessel for transport of foundations/wind turbines (0-14 knots [kts])	X	X	X	X				
Heavy Lift Vessel	Vessel for installation of foundations (0-14 kts)	X	X	X		X			
Wind Turbine Installation Vessel	Vessel for installation of wind turbine components (0-10 kts)				X				
Wind Turbine Supply Vessel / Barge	Vessel / Barge for transport of wind turbine components (0-10 kts)				X				
Heavy Transport Vessel / Barge	Vessel / Barge for transport of offshore substation topside/jacket (0-14 kts)					X			
Cable Lay Vessel / Barge	Vessel for installation of submarine export cable (0-14 kts)						X	X	
Cable Lay Support Vessel	Support vessel for cable lay operations (0-14 kts)						X	X	
Route Preparation / Trenching Support Vessel	Vessel for seabed clearance along cable routes (0-12 kts)						X	X	

Vessel	Description	Foundations: Monopile	Foundations: Piled Jacket	Foundations: Suction Jacket	Wind Turbines	Offshore Substation Topside & Foundation	Submarine Export Cables	Interarray Cables	Scour Protection
Fall Pipe Vessel	Vessel for installation of scour protection (0-12 kts)								X
Crew Transfer Vessel	Vessel for transporting workers to and from shore (0-30 kts)	X	X	X	X	X	X	X	
Construction Support Vessel	Vessel for general construction support (0-12 kts)	X	X	X	X	X	X	X	
Tugboat	Vessel for transporting and maneuvering barges (0-8 kts)	X	X	X	X	X	X	X	
Barge	Vessel for transport of construction materials (0-8 kts)	X	X	X	X	X	X	X	
Safety Vessel	Vessel for protection of construction areas (0-12 kts)	X	X	X	X	X	X	X	X

3.4.2 Construction and Installation: Offshore Infrastructure

3.4.2.1 *Wind Turbines*

The wind turbine components will be transported on barges to the installation vessel at the offshore foundation location. The installation methodology will generally be as follows:

1. Following installation of the foundation, the wind turbine components are transported to the foundation location (see **Table 3.4-2** for information of the types of vessels proposed);
2. The tower, typically consisting of up to four sections, is mounted vertically and secured to the foundation TP;
3. The nacelle is placed on top of the tower and secured; and
4. The blades will be joined to the nacelle hub.

The final installation sequence will be provided during the FDR/FIR stage and approved by the CVA prior to commencement of construction and installation activities. Following wind turbine installation, the wind turbine will be connected to the installed interarray cable, and a process of testing and commissioning will be completed prior to the wind turbine becoming operational. Temporary seafloor disturbance may arise from wind turbine installation in the form of jack-up vessel footings or anchors from construction vessels. **Table 3.4-3** summarizes the wind turbine installation parameters proposed as part of the PDE.

TABLE 3.4-3. SUMMARY OF WIND TURBINE INSTALLATION PARAMETERS

Parameter	BW1 and BW2
Seafloor footprint of wind turbine installation vessels a/ b/	0.5 ac (0.2 ha)
Estimated time per component (hours/wind turbine) c/	48 hours (hr)/wind turbine

Notes:
a/ Accounts for jack-up installation vessels
b/ Seafloor footprint will be the short-term impacts associated with construction and installation activities; **Section 3.3.1.3 Foundations** contains seafloor footprint for installed foundations.
c/ Duration of installation does not account for downtime as a result of weather conditions.

3.4.2.2 *Foundations*

The installation methodology utilized for the foundation PDE described in **Section 3.3.1.2 Foundations** will depend upon the foundation type selected. The installation methodologies under consideration as part of the PDE are described below. The maximum estimated seabed footprint during the operational term resulting from the installation of the foundations is detailed in **Table 3.3-5**. A preliminary list of the vessels proposed to be utilized during construction and installation can be found in **Table 3.4-2**.

A typical securement sequence for each foundation type proposed is described below.

3.4.2.2.1 *Monopile*

Once the installation vessel is in place, the steel pile is lifted into a vertical position, grabbed either by pile-gripper or placed into a subsea piling frame and lowered onto the seabed. A scenario where the pile is vibrated into a stable and vertical position free standing before replacing with a hydraulic impact hammer is also under evaluation. The steel pile is then driven into the seabed. Pile driving is conducted with the use of a large crane-mounted hydraulic impact hammer being dropped, or driven, onto the top of a foundation pile, driving it into the ground (see **Table 3.4-2** for information of the types of vessels proposed). Other methodologies such as using vibratory hammer technology and jetting are under evaluation. The hammer energy and duration are dependent on geological soil conditions, pile type, diameter, and most suitable technology. Should the pile reach a point of refusal, drilling or dredging out some of the sediment inside the pile may be required to reduce piling resistance and achieve the desired penetration depth. All spoil generated through pile drilling or dredging will be deposited near the foundation location. Parameters proposed as part of the monopile PDE are summarized in **Table 3.4-4**. Following pile driving, the TP and secondary ancillary equipment are installed onto the steel pile.

TABLE 3.4-4. SUMMARY OF MONOPILE FOUNDATION PARAMETERS

Parameter	BW1 and BW2
Pile hammer rated energy	6,600 kilojoule (kJ) a/
Maximum blows per minute per pile at maximum energy setting	45 a/
Maximum piling time per pile	4.8 hr
Estimated duration of installation (hours/foundation)	24 hr b/ c/

Notes:
a/ For purposes of underwater acoustic modeling, the driveability was based on an IHC S-5500 hammer extrapolated to a higher rated energy, as hammers with a higher rated energy do not yet exist at the time of COP submittal. For the 43 ft (13 m) diameter monopile the rated energy was scaled up to 6,600 kJ. While the theoretical rated hammer energy of 6,600 kJ was assumed for the 43 ft (13 m) diameter monopile, the anticipated effective energy would not exceed 6,208 kJ (see **Appendix L Underwater Acoustic Assessment**).
b/ Only one foundation is proposed to be installed via pile driving at a given time.
c/ Duration of installation is not limited to pile driving; however, it does not account for downtime as a result of weather conditions.

3.4.2.2.2 *Piled Jacket (Pre-Piled)*

The wind turbine jacket piles are to be pre-installed before jacket installation. This is performed by an installation vessel using a pre-installing jacket frame that holds three piles and helps maintain pile steering, footprint tolerances and verticality for the jacket piles. The piling locations will have very specific pile-stick-out levels to ensure level tops of the piles for a level jacket installation. The piles will be driven using the same methodology as described for monopiles. Other methodologies such as using vibratory hammer technology and jetting are under evaluation.

Once the installation vessel is in place, the jacket structure is lifted by the vessel crane and lowered onto and into the pre-installed piles. Parameters proposed as part of the piled jacket PDE are summarized in **Table 3.4-5**. Following the jacket installation, the jacket structure is secured to the driven piles. Optionally, the TP and/or secondary ancillary equipment may be installed on the jacket foundation as separate lifts.

The substation facility may also use a piled foundation concept, with the jacket lift installed and temporarily supported on mud mats for on-bottom stability. Piles will be installed and grouted to the pile sleeves following jacket installation (i.e., post-piling). Alternatively, for a suction bucket concept, the jacket will be lift installed and the foundation penetrates the seabed using the principles of suction.

TABLE 3.4-5. SUMMARY OF PILED JACKET FOUNDATION PARAMETERS

Parameter	BW1 and BW2
Pile hammer rated energy	2,300 kJ a/
Maximum blows per minute per pile	45 a/
Maximum piling time per pile	6.1 hr
Estimated duration of installation (hours/foundation)	60 hr b/ c/ d/

Notes:
a/ For the purposes of underwater acoustic modeling, a 2,300 kJ hammer size was used, however the maximum effective hammer energy expected to be required is 2,168 kJ (see **Appendix L Underwater Acoustic Assessment**).
b/ Only one foundation is proposed to be installed via pile driving at a given time.
c/ Duration of installation is not limited to pile driving; however, it does not account for downtime as a result of weather conditions.
d/ Includes time for pre-piling and jacket installation.

3.4.2.2.3 *Suction Bucket Jacket*

There are two possible approaches to the suction bucket jacket installation; either installing the jacket with attached suction buckets or by pre-installation of suction buckets. In the case with attached suction buckets, the jacket is lifted with the vessel crane and lowered onto the seabed once the installation vessel is in place. The suction buckets will naturally sink into the seabed before suction is applied to the suction buckets to pull them further down and into the seabed. In the case of pre-installation, the buckets may be installed individually or a pre-installation frame may be used to install the suction buckets for each individual jacket at the same time. Suction will be applied to pull the buckets down into the seabed before the jacket is installed by similar approach as for the pre-piled jacket.

Optionally in both approaches, the TP and/or secondary ancillary equipment may be installed on the jacket foundation as separate lifts. Parameters proposed as part of the suction bucket PDE are summarized in **Table 3.4-6**.

TABLE 3.4-6. SUMMARY OF SUCTION BUCKET JACKET FOUNDATION PARAMETERS

Parameter	BW1 and BW2
Estimated duration of installation (hours/foundation)	24 hr a/

Note:
a/ Duration of installation does not account for downtime as a result of weather conditions.

3.4.2.3 *Offshore Substation Facilities*

The offshore substation facility topside will be pre-assembled at a port location and then transported to the foundation location, most likely as one complete topside module. The installation methodology will consist of the following sequence:

1. Following the foundation installation, the offshore substation topside is transported to the foundation location (see **Table 3.4-2** for information of the types of vessels proposed); and

2. The topside is lifted onto the foundation using a heavy lift crane and secured to the foundation.

Following offshore substation topside installation, the interarray and submarine export cables will be connected, and a process of testing and commissioning will be completed prior to becoming operational.

3.4.2.4 *Submarine Export Cables*

The submarine export cables will be installed from specialized installation vessels/barges which will install the cable from a turntable on the lay vessel/barge. One or several vessels might be used for the installation of the cable depending on a number of factors, such as seabed depth, distance to shore, and cable protection method to be used.

There are several cable installation and burial methods being considered. Some activities will be performed before the installation of the cable, some during the installation of the cable, and some after the installation of the cable. Cable pre-lay activities may include pre-installation grapnel run, route clearance and boulder relocation, pre-sweeping, dredging, and pre-trenching. The cable burial methods being considered as part of the PDE are plowing, jetting, trenching, and drill and expand. The final cable burial method(s) will be selected prior to the FDR/FIR. The equipment selected will depend on seabed conditions and the required burial depths, as well as the results of various cable burial studies; more than one installation and burial method may be selected per route. The maximum estimated dredging volumes resulting from the installation methods of the submarine export cables are detailed in this section, and the footprint in the operational term is detailed in **Table 3.3-7**. Details on the vessels required for installation of the submarine export cables can be found in **Table 3.4-2**.

The typical key stages of submarine cable installation are as follows:

- MEC/UXO clearance and pre-installation activities;[30]
- Pre-sweeping, and pre-trenching activities (if needed);
- Cable lay and burial, including cable and pipeline crossings;
- Post-installation survey; and
- Post-crossing or remedial cable protection (if needed).

Burial of the submarine export cables will terminate before the offshore substations and J-tubes will be installed to protect the remaining portion of the cable. Depending on the final construction and installation schedule, it is possible that up to 3,000 ft (914 m) of the submarine export cables will need to be wet stored where it would be stored 820 ft (250 m) from the offshore substation locations, potentially up to a 6-month timeframe. This wet storage concept would be required should the offshore substations be installed after the submarine export cables are buried along the cable route and would consist of temporarily placing the remainder of the submarine export cables on two to three concrete mattresses (10 ft x 20 ft [3 m x 6 m] per mattress) with a protective cap until they could be pulled into the offshore substation facilities. Once reaching the offshore substation facilities locations, the submarine export cables would be cut, sealed, and fitted with corrosion resistant rigging. The cables would then be laid and/or buried on the seafloor until they could be pulled into and installed in the offshore substation facilities. If this activity is required, Beacon Wind would implement the use of a guard vessel and communicate the presence of the cables through the LNM system.

[30] A separate pre-survey and route clearance might be performed prior to the pre-installation grapnel run and survey if there is expected to be large quantities of debris along the route.

Installation of the submarine export cables is expected to take approximately 30 weeks for the BW1 submarine export cables and 30 weeks for the BW2 submarine export cables. The actual installation schedule will be subject to seabed characteristics, installation vessel availability, seasonal/time of year restriction windows for protected species, and weather.

3.4.2.4.1 *Pre-Installation Activities and MEC/UXO Clearance*

Prior to the installation of the cables, survey campaigns and route preparation may be completed, including debris clearance, boulder clearance, MEC/UXO clearance, and pre-lay grapnel run. This is to ensure that the submarine export cables and burial equipment will not be impacted by any debris or hazards, either natural or man-made, during the burial process, which may cause equipment damage and/or delays. It also serves to ensure sufficient burial depth. Please note that clearance activities will be implemented should avoidance through micro-siting not be feasible.

In some areas, existing, out-of-service cables and pipelines may be cut away and removed in order to install the submarine export cables, in accordance with applicable industry practices in collaboration with asset owners. This removal will only be undertaken upon pre-determined cables and pipelines in which written agreement is received from the owners and/or appropriate agencies. Should such cutting or removal of existing infrastructure be required, removal will be consistent with sound engineering practices and relevant requirements. Additional details on crossing existing submarine assets are provided within **Section 3.4.2.4.4 Cable and Pipeline Crossings**.

Beacon Wind’s objective is for operational risks associated with potential MEC/UXO to be within acceptable limits and be deemed "as low as reasonably practicable" (ALARP). Assessments for MEC/UXO hazards and risks have been performed by Beacon Wind to produce an MEC/UXO risk mitigation strategy. This risk mitigation strategy has been developed for the Project based on industry best practice and guidance from Construction Industry Research and Information Association (CIRIA) and BOEM’s Munitions and Explosives of Concern Survey Methodology and In-field Testing for Wind Energy Areas on the Atlantic Outer Continental Shelf. The MEC/UXO risk mitigation strategy will be refined and finalized prior to construction and, if necessary, specific MEC/UXO surveys will be performed. The MEC/UXO surveys, if required, would typically be performed two years prior to the beginning of installation activities. If MEC/UXO is identified within any portion of the Project Area, appropriate mitigation measures will be taken, including recommended avoidance and removal, if necessary. If removal is required, the choice of removal method and suitable safety measures will be made with the assistance of an MEC/UXO specialist and the appropriate agencies. In addition, industry standard precautions will be taken during construction operations, which include accurate positioning on submerged Project equipment, to decrease the likelihood of contact with any MEC/UXO. Those assessments completed to date by Beacon Wind have been detailed within a MEC/UXO Assessment Report and Project Strategy ALARP Report, which have been provided within **Appendix G Marine Site Investigation Report**.

3.4.2.4.2 *Pre-Sweeping and Pre-Trenching (if necessary)*

The pre-lay activities cover the necessary preparatory work for cable installation, which typically consist of boulder relocation, pre-sweeping, crossing preparation, grapnel run, and pre-lay survey. The actions required mainly depend on the seabed conditions.

The cable lay and burial operations will attempt to avoid boulders; however, if this is not possible, typically a 65.6 ft (20 m) wide corridor will be cleared from boulders. In the areas with low boulder density identified predominantly as surface boulders, a remotely operated vehicle (ROV) based boulder grab will typically be utilized. In areas with a high density of surface boulders, sub- surface boulders are also likely to be present. In this case, a pre-lay plow will normally be mobilized, which could move surface boulders as well as create a pre-cut trench. The plowing system is particularly useful for the removal of larger boulders (e.g., in excess of 3 ft [1 m] diameter). In fields with high boulder densities, removing boulders one by one becomes impractical. If this situation exists, a pre-lay plow is the more efficient method for preparing the route, where the plow may be used for boulders up to 3 ft (1 m) diameter.

During pre-lay activities where bulky, large debris may be present requiring removal, the same ROV boulder grab system can be utilized. Whereas, for smaller sized debris, an ROV and manipulator may be used by lifting debris into a basket for recovery and removal.

A towed grapnel system is the primary method used for the removal of fishing gear, wires, ropes and chains present along the planned cable route. Out of use utility cables are, if agreed with the cable owner, will be cut and removed.

In certain limited areas of the submarine export cable corridors, pre-sweeping may be necessary prior to cable lay activities if large scale mobile bedforms, including mega ripples and sand waves are identified along the submarine export cable routes. Mobile sand waves lead to the risk of either exposing the buried cable or overheating the cable due to the insulating properties of the sand. To ensure the cables are sufficiently protected, cables should be buried into the non-mobile seabed by dredging away mobile sediments (e.g., in The Race area). Pre-sweeping involves smoothing the seafloor by removing any ridges or edges that may be present.

The requirement for pre-sweeping can be considered under two main categories:

- Deep burial requirement which would be difficult/not possible to achieve with the majority of burial equipment and therefore restrict burial options; and
- Areas of bedforms that result in onerous slope angles and/or have the potential to impact achievable depth of lowering (by the burial equipment tool raising due to pitching over the features, for example). Slope angles along the Submarine Export Cable Route range from relatively flat and featureless seabed (<5 degrees) to max. 44.3 degrees at the crest of the largest bedforms.

The primary pre-sweeping method will involve using a Trailing Suction Hopper Dredger (TSHD) from a construction vessel to remove the excess sediment on the seafloor along the footprint of the cable lay. TSHD works to vacuum the seabed sediments through a drag arm placing the sediment into a hold on the vessel, which can then be transported and unloaded at either a dedicated disposal site or, if granted the necessary approvals for relocating, at a sufficient distance away from the cable corridor to avoid re-siltation prior to cable laying. Other types of dredging equipment such as mass flow excavator, may be used for pre-sweeping depending on environmental conditions and equipment availability. Beacon Wind anticipates that dredged material generated from the Project may either be side casted near the site of installation or removed after Project completion for beneficial reuse or proper disposal. The actual method of dredged material management will be based on sampling and consultation with regulatory agencies. Where required, pre-sweeping activities will occur in a corridor approximately up to 65.6 ft (20 m) wide along the length of the megaripples and sand waves; the amount of clearance will vary along the submarine export cable routes, consisting of approximately 15 percent of the route length. Megaripple and sand wave height vary depending on localized seabed and current characteristics. Approximately 325,131 yd^3 (248,581 m^3) of sediment is anticipated to be dredged as a result of these pre-sweeping activities per wind farm (BW1 and BW2).

Blasting is anticipated to be necessary in portions of the East River in order to fracture hard substrates where traditional dredging methods will not be sufficient. This technique will allow for the efficient removal of subsea obstacles to ensure that cable burial depth requirements are met. All blasting operations and procedures will be described in detail in a blasting plan that will be approved by federal and New York State authorities and will adhere to federal and state permit requirements.

A pre-lay grapnel run will be carried out to remove debris such as fishing gear, wires, and ropes located on the submarine export cable routes. The grapnel run will be carried out by towing a grapnel train from a support vessel.

Pre-cut trenching activities may also be required in certain types of ground along the submarine export cable routes in areas where moraine is found. Pre-cut trenching involves running the cable burial equipment over portions of the route in order to soften the seabed prior to cable burial and/or the use of a suction hopper dredge to excavate additional sediment. The impacts associated with this pre-trenching method are anticipated to be the same as those described in **Section 3.4.2.4.3 Cable Lay and Burial**.

Local dredging or pre-sweeping at the locations where the submarine export cables cross other assets may also be needed in order to reduce the shoaling of the crossing design. The final depth of the dredged area will be governed by the vertical distance between the natural seabed and the assets to be crossed and will be resolved by agreement with the asset owners through a crossing agreement. In typical scenarios, the crossing design would consist of the removal of approximately 8 ft (2.4 m) of sediment within a 52 ft x 85.3 ft (16 m x 26 m) area at each crossing. Approximately 679 yd^3 (519 m^3) of material will be removed by suction hopper dredge and/or mass flow excavation at each crossing. See **Figure 3.4-14** for a representative illustration of this proposed crossing methodology.

3.4.2.4.3 *Cable Lay and Burial*

Following the pre-installation grapnel run and route clearance, the cable will be brought to the appropriate section of the submarine export cable installation corridors on the cable laying vessel. From there, the cable will be laid onto the seabed and either installed directly or a second vessel will follow the cable laying process and bury the cable using one of the following methods. In shallow areas, specifically in the East River approaching landfall at the Astoria power complex or approaching the Waterford, Connecticut landfall, the submarine export cables may need to be floated into place for burial, as water depths in these areas are inadequate for the cable lay vessel. The cable burial machine will assist in lowering and burying the submarine export cables in place, as it moves along these shallower areas. The burial machine may also run out of a separate construction vessel. The cable installations will require three to six jointing campaigns, each with a duration of three to seven days, for each wind farm (BW1 and BW2).[31] The jointing will be performed with the cable installation vessels and will not introduce any additional vessels. During the jointing, the vessel will be on dynamic positioning (DP), so no anchoring or other seabed intervention will be required. If there is time between the lay-down of one cable end and the jointing campaign, there will be a guard vessel in place to protect the cable end.

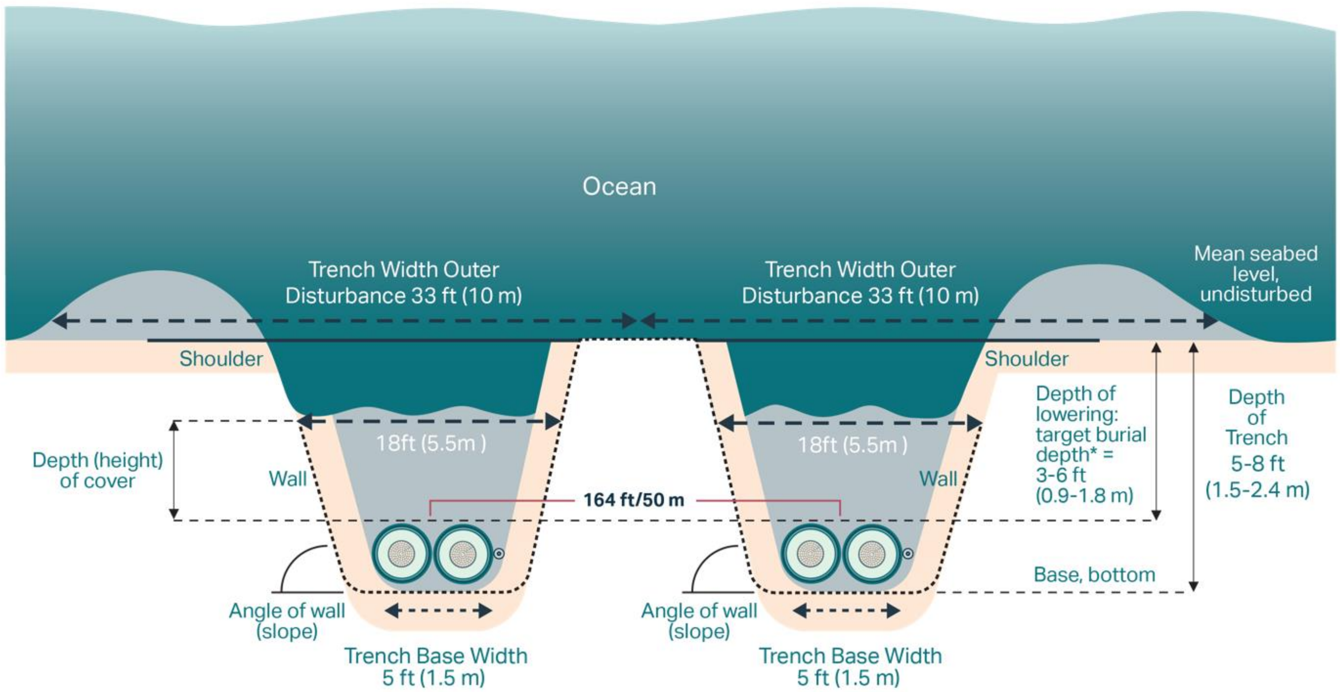
Two options are proposed for installing the submarine export cables in the seabed:

- Cable lay with simultaneous burial using jet plow, mechanical plowing, or trenching; and
- Post-lay cable burial with either a jet trencher and/or mechanical trencher.

[31] Durations provided are specific to the route to Queens, New York, for BW1 and BW2.

These two options could result in a bundled or unbundled installation, dependent upon available technology. **Figure 3.4-1** and **Figure 3.4-2** depict the trench burial for a bundled and unbundled scenario.

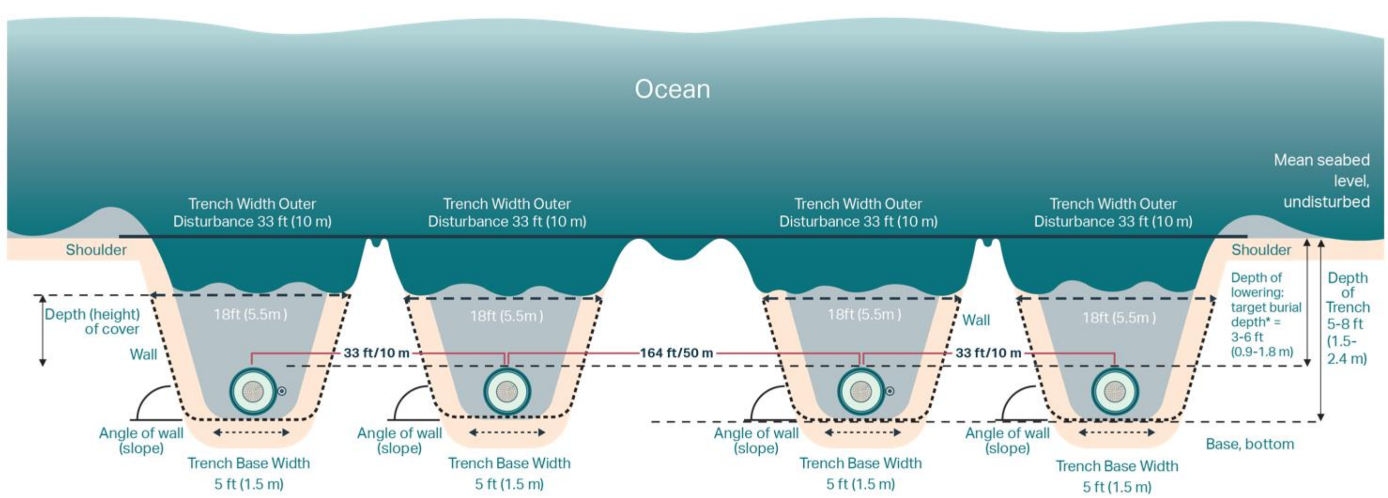
FIGURE 3.4-1. PROPOSED BUNDLED CABLE BURIAL METHODOLOGY



*Note: Target burial depth will be 15ft (4.7m) below the current (and future) authorized depth or depth of existing seabed (whichever is deeper) in federally maintained navigation features (e.g., anchorages and shipping channels).

*Note: The trench width outer disturbance of 33 ft (10 m) represents the potential maximum disturbance generated by the jet plow required for harder seabed conditions. It is anticipated that along the majority of the submarine export cable route, a jet trencher tool will be used which is expected to generate an outer disturbance with of approximately 13 ft (4m).

FIGURE 3.4-2. PROPOSED UNBUNDLED CABLE BURIAL METHODOLOGY



For all submarine export cable burial processes, additional support/guard vessels may be required to monitor and maintain safety zones.

Depending on seabed conditions, cable burial depth targets, and other design requirements, cable lay with simultaneous burial and post-lay cable burial will utilize one or more of the following methods:

- **Jetting:** Jetting will be the primary method for cable installation. Jetting may be conducted via a towed device that travels along the seafloor surface. Jetting may also be conducted with a vertical injector fixed to the side of a vessel or barge. These methods inject high pressure water into the sediment through a blade that is inserted into the seafloor to create a trench. Simultaneously, the cable is fed from the cable ship down through the device and laid into the trench. Post-lay burial with a jetting tool may also be utilized. With this method, the cable would first be laid along the seafloor, and then the post-lay jetting tool would follow and may attempt multiple passes of the area for burial.

  The high-pressure water from the jetting tool sufficiently softens the sediment such that the cable can be pushed down through the sediment to the desired burial depth. The adjacent sediment and displaced sediment then resettles into the trench. Jetting with simultaneous cable lay, using either a jet plow or vertical injector, is considered the most efficient method of submarine cable installation in many soil types. It minimizes the extent and duration of bottom disturbance for the significant length and water depths along the submarine export cable route. An example of jetting is depicted in **Figure 3.4-3**.
- **Mechanical Plowing:** Plowing is conducted with a "mechanical" (i.e., non-jetting) cable plow that is pulled along the seabed, creating a narrow trench. Simultaneously, the cable is fed from the cable ship down to the plow, with the cable laid into the trench by the plow device. Gravity causes the displaced sediment to return to the trench, covering the cable. In general, material backfills naturally under wave action and tidal currents, but if necessary, additional sediment is mechanically returned to the trench using a backfill plow. Similar to a jet plow, the cable is installed and buried in a single pass. Plowing is generally less efficient than jetting methods but may be used in limited site-specific conditions. Mechanical plowing may be used for harder soils, where jetting is determined to be problematic. An example of a cable plow is depicted in **Figure 3.4-3**.
- **Trenching (cutting):** Trenching (cutting) is used on seabed containing hard materials not suitable for jetting or plowing. For those areas containing hard materials, the trenching machine mechanically cuts through the hard materials using a chain or wheel cutter fitted with picks or teeth. The cutter creates a trench that the submarine export cable is laid into, and backfill is mechanically returned to the trench using a backfill plow. An example of trenching is depicted in **Figure 3.4-3**.
- **Drill and blast:** This established practice of blasting in bedrock within the East River has been utilized since the 1800s for creating navigational channels. Clearing channels of hard rock starts with holes first drilled into the rock/hard substrate from a drill-mounted spud barge. A hose, explosive cords, and a detonator are then lowered to the bottom of the hole and a fluid explosive material is pumped into the hole through the hose. Bags of gravel, or blast mats, are then placed at the top of the arrangement to keep the components in place and to lessen the shock wave reaching the water column. Air bubble curtains may also be used to reduce the peak pressure of the shock waves. The drill boat is then towed away from the area, the communications plan is implemented, and the area is confirmed clear before the explosives are detonated. Inserted delays may be used for each borehole. The fragmented rock is then excavated and removed.

FIGURE 3.4-3. EXAMPLES OF CABLE INSTALLATION METHODS

From top left, clockwise: plowing,[32] jetting,[33] trenching (cutting),[34] and suction hopper dredging.[35]

32 https://www.royalihc.com/en/products/offshore/subsea-equipment/subsea-cable-ploughs

33 http://docplayer.nl/58313179-Aanvraaggegevens-aanvraagnummer-net-op-zee-hollandse-kust-zuid-ingediend-op-gefaseerd-blokkerende-onderdelen-weglaten.html

34 http://www.miahtrenchers.com/page6.html

35 https://www.epd.gov.hk/eia/register/report/eiareport/eia_2512017/html/Ch%2006%20Hazard%20to%20Life%20Assessment.htm

3.4.2.4.4 *Cable and Pipeline Crossings*

There are existing cables and pipelines, both in and out of service, located along the submarine export cable routes proposed for the Project. No existing cables or pipelines have been identified within the Lease Area. While the submarine export cables have been sited to avoid cables and pipelines to the extent practicable, a number of crossings will still be required. Where crossings along the submarine export cable routes are necessary, specific crossing methodology will be developed and engineered as the submarine export cable routes are finalized. Cable crossing methodologies will be based on a variety of factors, including type of asset to be crossed (i.e., material); depth of the existing buried cable or pipeline; and whether the assets are in service or out of service. Cable crossing negotiations between the asset owner and Beacon Wind are underway and will determine the specifics of the agreed crossing method. There are currently no active third-party cables or pipelines within the Lease Area.

A typical sequence for a submarine export cable crossing other cable and pipeline assets is as follows:

- Once the precise location of the infrastructure to be crossed is determined, usually by survey, a layer of protection is installed on the seabed. Localized dredging using equipment previously described in **Section 3.4.2.4.2 Pre-Sweeping and Pre-Trenching** may be required in order to minimize shoaling on the seabed before cable protection is installed;
- The submarine export cable is laid over the first layer of protection. Cable burial would terminate at a pre-determined distance away from this layer, where the distance will be determined as part of the crossing agreements, cable route, water depth, and seabed conditions. The submarine export cable may have a casing installed prior to placement, as an additional layer of protection;
- A second layer of protection is installed over the submarine export cable; and
- Subject to burial depth, a final layer of protection is installed over the crossing for stabilization and additional scour protection; any remaining voids in the seabed at the installation site will be allowed to backfill naturally.

Examples of cable crossings are shown in **Figure 3.4-4** and **Figure 3.4-5**.

FIGURE 3.4-4. REPRESENTATIVE OPTION FOR LOCALLY DREDGED ASSET CROSSING METHODOLOGY

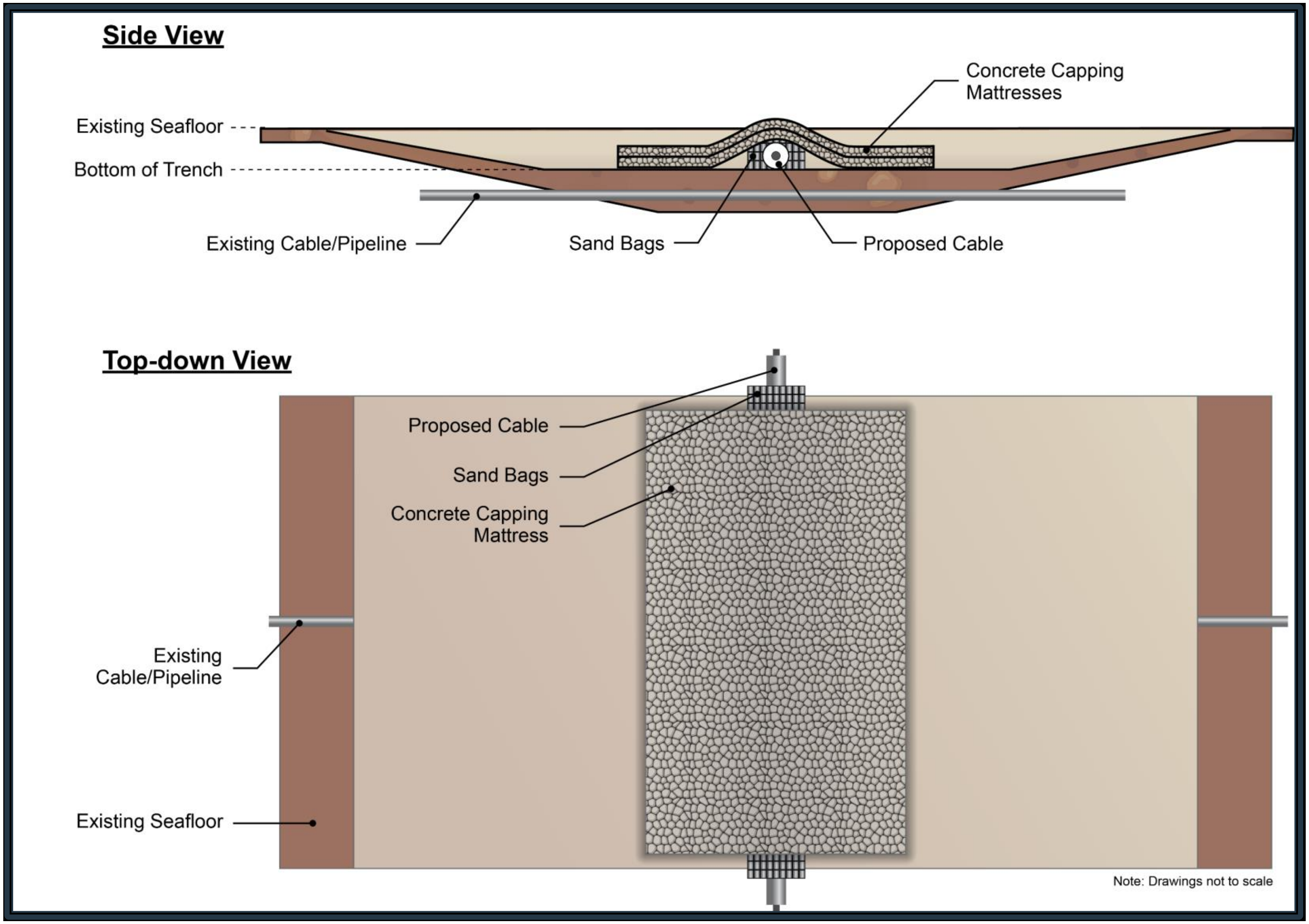
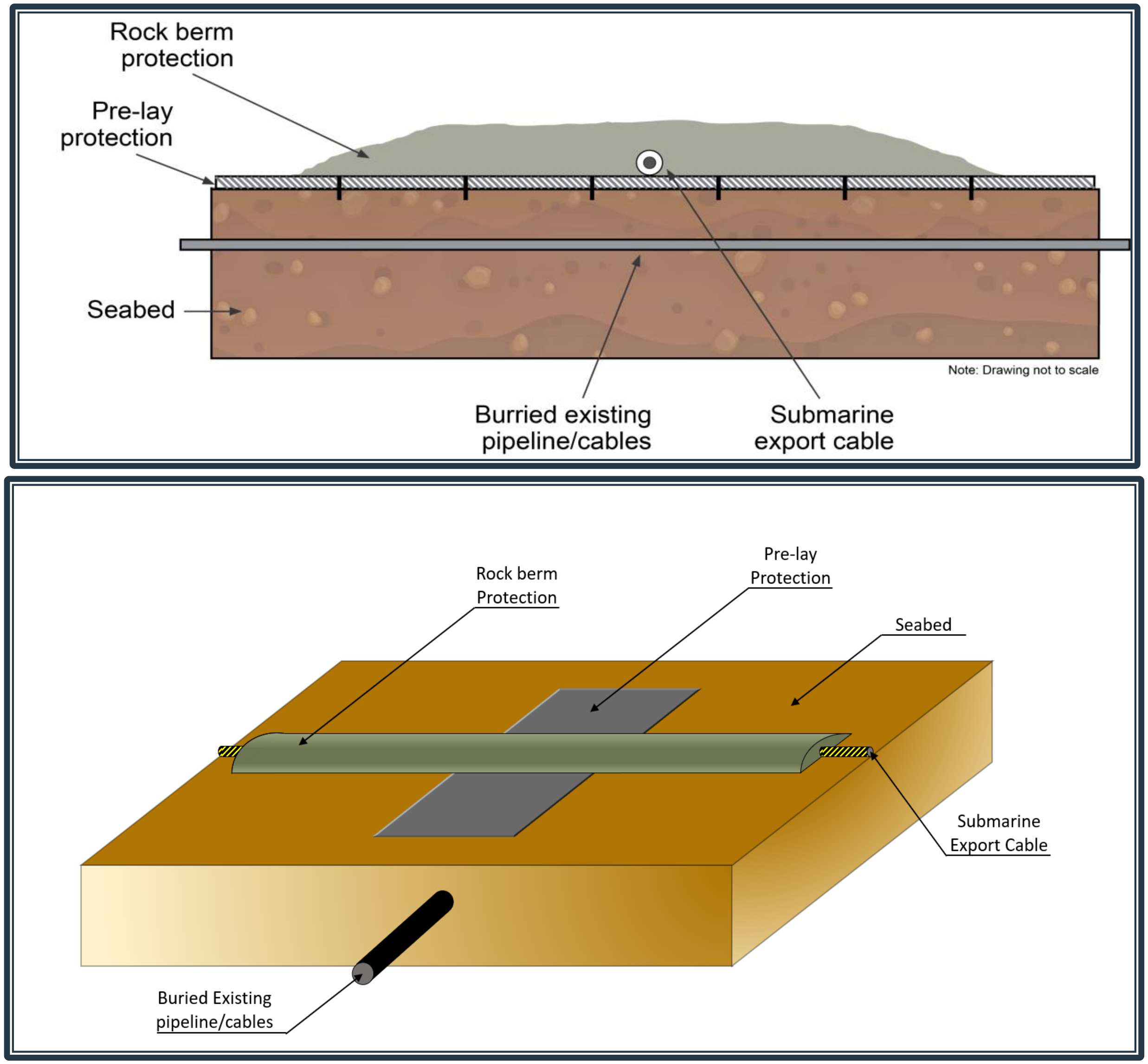


FIGURE 3.4-5. TYPICAL CABLE CROSSING DESIGN



3.4.2.4.5 *Post-Installation Survey*

After cable burial, post-installation surveys will be completed to determine the as-built conditions of the submarine export cables and the levels of burial achieved. At this time, areas requiring remedial cable protection will be identified.

3.4.2.5 *Interarray Cable Installation*

The installation methodology for the interarray cables will be largely the same as the submarine export cables using a range of installation methods (e.g., jetting, plowing), described in **Section 3.3.1.3 Submarine Export Cables.** The maximum estimated seabed disturbance resulting from the installation of the interarray cables and footprint during the operational term is detailed in **Table 3.3-8**. Details on the vessels required for the installation of the interarray cables can be found in **Table 3.4-2.**

The interarray cables will be installed and buried either before the installation of the wind turbines and J-tubes or at the same time if needed. Installation of the interarray cables is expected to take approximately three to four months per wind farm (BW1 and BW2), subject to seabed conditions, vessel availability, methodology, and weather.

3.4.2.6 *Scour Protection Installation*

The installation of scour protection around wind turbine and offshore substation foundations, as described in **Section 3.3.1.5 Scour Protection**, may be performed in two operations; pre and post installation of the foundations. The maximum estimated seabed coverage resulting from the footprint of the installation of scour protection measures is detailed in **Table 3.3-10**. Details on the vessels required for the installation of scour material can be found in **Table 3.4-2**. Installation of the scour protection measures is expected to take up to four days per foundation.

3.4.2.7 *Cable Protection Installation*

In areas where burial of the cables is not feasible or sufficient burial depth is not achieved, remedial cable protection will be installed as a secondary measure to protect the cables. Cable burial is the preferred protection technique, as it typically provides the best protection at the lowest cost in the shortest time. Therefore, the submarine export and interarray cables will be buried to the proposed burial depth wherever it is technically and commercially feasible to do so, with additional or alternative protection measures only applied if necessary and subject to outcomes of the CBRA and consultation with regulatory authorities and other users (e.g., commercial fishermen). Remedial cable protection measures include those described in **Section 3.3.1.6 Cable Protection**.

Details on the vessels required for the installation of the cable protection can be found in **Table 3.4-2**.

3.4.3 Construction and Installation: Onshore Infrastructure

3.4.3.1 *Onshore Export Cable and Interconnection Cable Routes*

As discussed in **Section 3.3.2.4 Onshore Substation Facilities**, up to two onshore export and interconnection cable route options (including landfall) are being considered in Queens, New York, to support BW1 and BW2 based on the selection from the two onshore substation facility sites under consideration. An additional site for BW2 is also being considered in Waterford, Connecticut. The construction and installation methodology proposed will comply with applicable regulations and guidelines. Based on the existing conditions along the export cable landfalls and onshore export and interconnection cable routes, both trenchless (HDD, jack and bore, or micro-tunneling) and trenched (open cut trench) methods are proposed in Queens, New York and trenchless methods in Waterford, Connecticut.

3.4.3.1.1 *Open Cut*

Landfall

Along some portions of the cable alignments, open cut methodology is currently being considered for the landfalls due to potential limitations of a trenchless alternative, including, but not limited to:

- Existing infrastructure (e.g., bulkheads, cofferdams, sheet piles, foundations);
- Encountering loose soil/sediment and geotechnical conditions not conducive to drilling fluid (i.e., risk of loss and/or spillage);
- Soil thermal resistivity characteristics limiting burial depth tolerances of the export cables;
- Vessel traffic in proximity to anticipated entrance/exit; and/or
- Limited workspace for trenchless entrances/exits (both offshore and onshore).

Open cut alternatives may require open cut trenching/dredging or jetting to facilitate installation at target burial for the cable landfall. Jetting involves the use of pressurized water jets into the seabed, creating a trench. As the trench is created, the export cable is able to sink into the seabed/waterway. The displaced sediment then resettles, naturally backfilling the trench. Dredging is used to excavate, remove, and/or relocate sediment from the seabed/waterway in order to allow for the cable to make landfall or transit across a waterway/wetland crossing at the target installation depth. Dredging can be completed through clamshell dredging, suction hopper dredging, and/or hydraulic dredging. During dredging activities, the material will be collected in an appropriate manner for either re-use or disposal (depending on the nature of the material) and in accordance with a Project disposal plan and applicable regulations. No backfilling is proposed for these activities if implemented for the purposes of landfall or waterway/wetland crossing.

At some locations, additional installation methodologies are being considered at the interface of a developed shoreline for landfall crossings (e.g., rip rap, bulkhead, or sheet pile) (see **Appendix D Conceptual Project Design Drawings** for additional information), and include:

- **Cofferdam Through Bulkhead**: A portion of the bulkhead is removed, and shoring would be installed; excavation of upland material would be conducted such that a grade would be developed beneath the mudline at the bulkhead line. The submarine export cable would be directly laid in this corridor within the cofferdam. One or more cofferdams may be required depending on the solution. A cofferdam may interface to the bulkhead if the legacy bulkhead construction is compatible.
- **Through Bulkhead**: Upland excavation of material would be conducted such that the submarine export cables slope down to the bulkhead, with minimized vertical bends. Shoring would be required due to the limited space. A cable conduit would be routed through the bulkhead at an elevation and the specified grade, based on structural and geotechnical analysis. Routing the conduit through the bulkhead may require divers. The export cable conduits may require steel structure supports in-water, or upland, depending on a structural analysis. In addition, implementation of a cofferdam may be required to facilitate installation. The means of bulkhead penetration, be it drilling, cutting, or by lifting a sheet pile section, depends on the condition of the legacy bulkhead below existing grade and as found during construction.
- **Over Bulkhead:** The submarine export cables would be routed through mildly sloped steel conduit over the edge of the bulkhead down towards the mudline; the submarine export cables would be supported by a steel structure between the bulkhead and mudline. A preferred containment is in a pipe to form a J-tube similar to that employed for cable entries to offshore

structures. The structure could be designed to be structurally independent of the bulkhead. In addition, implementation of a cofferdam may be required to facilitate installation.

The necessity of interacting with a bulkhead or other waterfront retaining method is contingent on final submarine export cable routes and landing methods. **Appendix D Conceptual Project Design Drawings** can be applied to any of the above options after detailed surveying reveals specific site conditions.

Onshore

The onshore export and interconnection cables will be installed utilizing open cut trench (except where trenchless methodologies are necessary, as discussed below), and will typically include the following main activities:

- Prepare the construction corridor;
- Establish jointing bays;
- Install ducting;
- Pull onshore export and interconnection cables through the ducts;
- Join the cables; and
- Restore the construction corridor.

Based on the existing conditions along the onshore export and interconnection cable routes, Beacon Wind proposes to utilize the open cut trench technique as the preferred methodology for all onshore export and interconnection cable routes in Queens, New York for BW1 and BW2. For the onshore installation the BW2 base case methodology is open cut for the non-HDD portion of the submarine export cable and aboveground installation is the base case methodology for the interconnection route to the POI.

Open cut trenching consists of excavating a trench along the onshore export cable route. During excavation activities, the material is stockpiled next to the trench or hauled offsite based on the suitability of reuse. The onshore civil components, including the conduits, conduit spacers, and concrete encasement, are then installed within the trench. Once installation is complete, the trench is backfilled with thermally acceptable backfill, which can include a combination of excavated soil, borrow soil, or low-strength flowable fills. Excavated soils will be used following engineering analysis and as approved for reuse by permitting authorities. Unsuitable or contaminated soils will be disposed of offsite in an approved manner and location, and suitable and/or uncontaminated soil brought in and used as backfill. The area is then restored. **Table 3.4-7** provides the dimensions for the open cut trench, recognizing the potential for the corridor widths to increase (or become individual) if the distance between circuits has to increase due to other obstructions. An example of a typical open cut trench operation is provided in **Appendix D Conceptual Project Design Drawings**.

TABLE 3.4-7. SUMMARY OF ONSHORE DUCT BANK PARAMETERS

Parameter	BW1 and BW2 – Queens, New York	BW2 – Waterford, Connecticut
Depth of Trench	15 ft (4.6 m)	15 ft (4.6 m)
Width of Trench	27.5 ft (8.4 m)	27.5 ft (8.4 m)
Number of Trenches	3	3
Construction Corridor Width	75 ft (22.9 m)	75 ft (22.9 m)
Operational Corridor Width	20 ft (6.1 m)	20 ft (6.1 m)

3.4.3.1.2 *Horizontal Directional Drilling*

HDD is used to install cables in ducts under sensitive coastal and nearshore habitats, such as shorelines, as well as man-made infrastructure such as bulkheads and roadway crossings. HDD can also be used to cross under major infrastructure, including railroads and highways. **Table 3.4-8** provides a summary of the HDD parameters proposed for the Project.

TABLE 3.4-8. SUMMARY OF HDD PARAMETERS

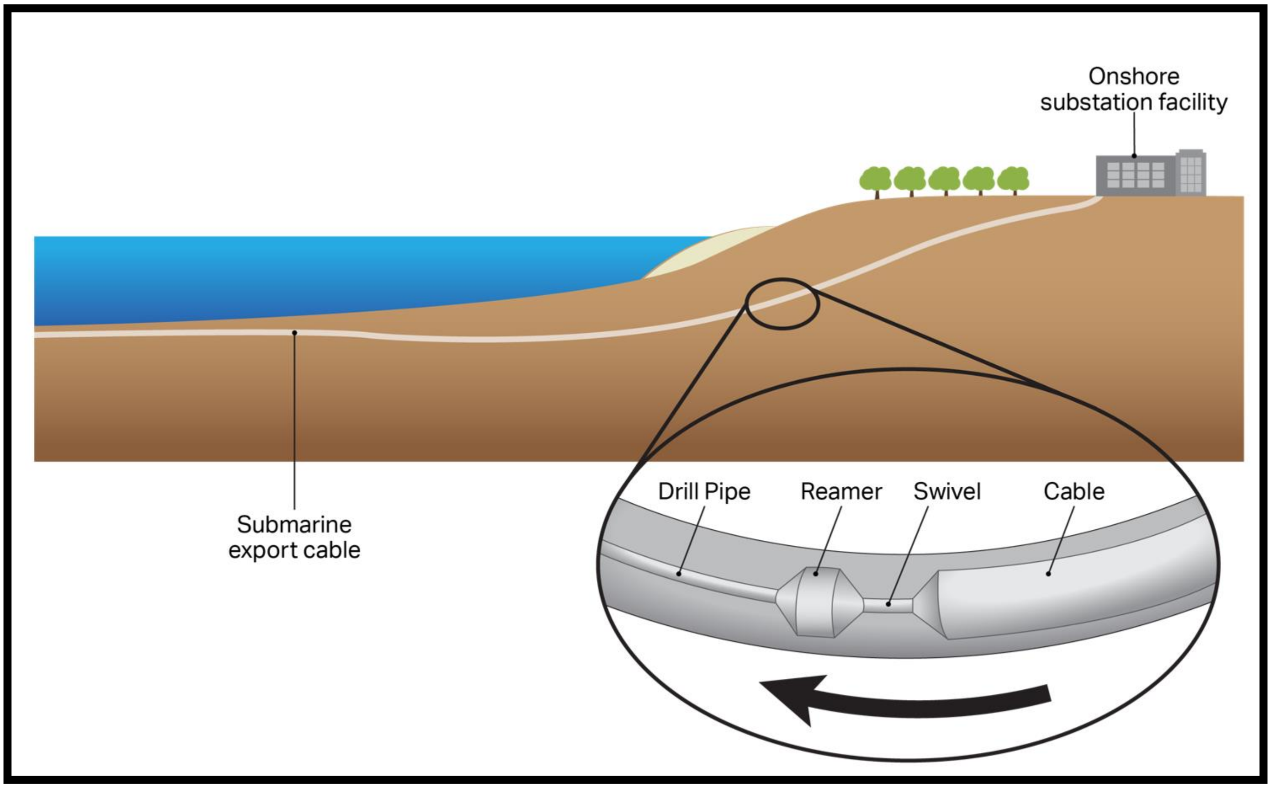
Parameter	BW1 and BW2 – Queens, New York	BW2 – Waterford, Connecticut
Submarine Export Cable Landfall HDD		
Onshore (entry) Work Area Footprint	246 ft x 246 ft (75 m x 75 m)	328 ft x 164 ft (100 m x 50 m)
Offshore (exit) Work Area Footprint (casing pipe/goalposts a/	60 ft x 7 ft (18 m x 2 m)	60 ft x 7 ft (18 m x 2 m)
Offshore (exit) Work Area Footprint (jack-up barge) b/	0.001 ac (0.0004 ha)	0.001 ac (0.0004 ha)
Onshore Export Cable/Interconnection Cable Crossing HDD		
Onshore Work Area Footprint	200 ft x 200 ft (61 m x 61 m) x 2 (entry/exit)	N/A

Notes:
a/ The HDD will require a total of one casing pipe and three goalposts with a footprint of 60 ft x 7 ft (18 m x 2 m) in total.
b/ An area of 400 ft x 400 ft (120 m x 120 m) will be utilized for HDD installation which includes a jack-up barge, casing pipe/goalposts, and space for vessel maneuverability. The barge/liftboat would be supported by up to four 42 in (107 cm) diameter or similar spuds/piles when jacked-up, with the piles representing the total footprint of disturbance detailed here.

Typically, HDD operations for an export cable landfall originate from an onshore landfall location and exit a certain distance offshore, which is determined by many factors including the water depth contour, geologic characteristics, and total length considerations. To support this installation, both onshore and offshore work areas are required. The onshore work areas are typically located within the landfall parcels.

Once the onshore work area is set up, the HDD activities commence using a rig which drills a borehole underneath the surface (a typical HDD schematic can be found in **Figure 3.4-6**). Once the drill for the HDD exits onto the seafloor, the ducts in which the submarine cable will be installed are floated out and then pulled back onshore within the drilled borehole. A single, larger HDD bore may be completed to install the entire cable bundle or individual, smaller HDD bores may be installed depending on a number of engineering and constructability factors.

FIGURE 3.4-6. TYPICAL ONSHORE HDD LANDFALL



Nearshore work for the HDD will be completed by utilizing a goal post pipe which marks and keeps the borehole in place. Goalposts are installed along the established nearshore alignment of the HDD with the intent to support the large diameter casing pipe during drilling operations. Casing pipe is installed to provide for improved boring conditions at the beginning of the HDD alignment. The leading edge of the casing pipe is embedded into the marine soils and the casing is rested on top of the goalposts for support. Proper installation of casing pipe nearshore aids in the containment of drilling fluid by facilitating an open flow pathway from the HDD exit location to the marine support equipment and to the fluid collection barge. Marine support is needed (e.g., vessels, barges, divers) to support HDD drilling operations.

Onshore Crossings: HDD is also a potential trenchless method proposed to cross utilities and infrastructure onshore. Similar to the export cable HDD landfall, onshore HDD crossings utilize a rig which drills a borehole underneath the surface. Once the rig exits onshore, the ducts in which the cable will be installed are then pulled back within the drilled borehole. Onshore crossings require two onshore work areas to support the activities.

3.4.3.1.3 *Other Trenchless Methods (non-HDD)*

The onshore export cables and/or interconnection cables may also be installed using micro-tunneling, jack and bore, or other non-HDD trenchless technologies. While each method has its own characteristics, micro-tunneling and jack and bore are generally completed by installing a steel pipe or casing under existing roads or other infrastructure. This is completed by excavating a bore (entry) pit and receiving (exit) pit on either side of the crossing. An auger boring machine or tunneling boring machine installs the casing pipe through the earth connecting each pit. A conduit bundle will be installed with the borehole, grouted, and the onshore export or interconnection cable will then be pulled through the crossing. Micro-tunneling is also a method that can be employed for the landfall as an alternate to HDD and the topology of the seabed might avoid the need for an exit pit, noting however that the micro-tunneling technique is frequently more sensitive than HDD to appropriate geotechnical conditions offshore. In general, the decision to use one method over the other will be a factor of the length and size of the pipe, but the construction layout, cable landing, and handling considerations will be similar.

Table 3.4-9 provides a summary of the micro-tunnel or jack and bore parameters proposed for the Project. A representative drawing of this installation methodology is provided in **Appendix D Conceptual Project Design Drawings**.

TABLE 3.4-9. SUMMARY OF OTHER TRENCHLESS CROSSING (NON-HDD) PARAMETERS

Parameter	BW1 and BW2 – Queens, New York	BW2 – Waterford, Connecticut
Work Area Footprint	98 ft x 98 ft (30 m x 30 m)	98 ft x 98 ft (30 m x 30 m)
Bore Pit Footprint	16 ft x 39 ft (5 m x 12 m)	16 ft x 39 ft (5 m x 12 m)
Receiving Pit Footprint	33 ft x 33 ft (10 m x 10 m)	33 ft x 33 ft (10 m x 10 m)

There are no known railroad crossings for the BW1 or BW2 project.

Additional trenchless crossings may be required, as Beacon Wind continues to gather buried utility and infrastructure information from the utility owners and/or municipalities in which the Project's onshore components are located.

3.4.3.2 *Onshore Substation*

As discussed in **Section 3.3.2.4 Onshore Substation Facility**, the construction and installation of up to two onshore substations is proposed to support the Project. The construction and installation methodology is proposed to be similar for BW1 and BW2 and will comply with local and state regulations and guidelines. A typical construction and installation methodology is as follows:

- Site access;
- Site preparation, including clearing and/or filling (if necessary), excavation, and grading;
- Construction of the stormwater management system;
- Installation of the foundation and/or potentially piles to adhere to flood elevation requirements;
- Installation of the electrical infrastructure and other associated structures and services including connection to local utilities; and
- Land reinstatement and landscaping.

Alternative construction methodologies, such as onsite construction and prefabricated modular components with onsite assembly, will be evaluated for the installation of the onshore substation facilities. Conceptual plans in support of the Beacon Wind Project are provided in **Appendix D Conceptual Project Design Drawings**.

3.5 Operations and Maintenance Activities

The commercial lifespan of BW1 and BW2 is expected to be 35 years, based on the design life of the Project components. Consistent with BOEM's regulations and applicable guidance, Beacon Wind intends to pursue 35-year Operations Terms for BW1 and BW2 at the appropriate time.[36]

The Project will be designed to operate with minimal day-to-day supervisory input, with key systems monitored from a central location, 24 hours a day. Beacon Wind intends on maintaining a staffed O&M Base at SBMT, where Beacon Wind's affiliate, Empire Offshore Wind LLC, intends to construct an O&M base. Construction activities at SBMT are being addressed as part of the Empire Wind permitting process, with this facility's impacts assessed under the Empire Wind BOEM NEPA review. Therefore, this facility is not further considered in duplication related to BW1 and BW2. This O&M Base will monitor operations and include office, control room, warehouse, workshop facilities, and pier space. The Project is assessing New Bedford, Massachusetts, to act as a satellite O&M facility.

During the Operations Term, the Project will require both planned and unplanned inspections and maintenance, which will be carried out by a team of qualified engineers, technical specialists, and associated support staff. The team will ensure that all components are maintained and operated in a safe and reliable manner, compliant with regulatory conditions, and in accordance with commercial objectives.

3.5.1 Offshore O&M

All offshore components will require routine maintenance and inspections. It is anticipated that SOVs, Crew Transfer Vessels (CTVs), and smaller support vessels will be used to support operations and maintenance activities offshore. Helicopters are currently being considered to support the Project; Beacon Wind is continuing to evaluate logistics, and the relevant impact assessments will be updated pending the final decision. The onshore control room and primary supply warehouse necessary for supporting offshore O&M activities for Beacon Wind will be co-located with those for Empire Wind at SBMT. Additional satellite facilities to support offshore O&M in the region may be utilized occasionally on an as needed basis. The Project is assessing New Bedford, Massachusetts, to act as a satellite O&M facility.

Generally, offshore O&M activities will include:

- Inspections of offshore components for signs of corrosion, quality of coatings, and structural integrity of the wind turbine components and foundations;
- Inspections and maintenance of the wind turbine and offshore substation electrical components/equipment;
- Surveys of the submarine export cables and interarray cables, to confirm the cables have not become exposed or that the cable protection measures have not worn away. The frequency and schedule of these surveys will be determine based upon various factors, to be detailed with and agreed upon during discussions with the applicable agencies;
- Sampling and testing (including of lubricating oils, etc.);
- Replacement of consumable items (such as filters and hydraulic oils);
- Repair or replacement of worn, failed, or defective systems (such as wind turbine blades, gearboxes, bolts, corrosion protection systems, protective coatings, cables, etc., including

[36] Beacon Wind will request an extension to the 33-year Operations Term, in accordance with 30 CFR § 585.235.

cleaning off subsea marine growth, realigning machinery, renewing cable protection using additional rock dumping or mattress placement, etc.);
- Updating or improving systems (such as control systems, sensors, etc.); and
- Disposal of waste materials and parts (in line with best practice and regulatory requirements).

The wind turbines will be monitored through the SCADA system (as discussed in **Section 3.3.1.1 Wind Turbines**). In the event of a fault or failure of the offshore components, Beacon Wind will repair and replace the Project component in a timely manner. Unplanned maintenance and repair of the wind turbines and offshore substations is anticipated and planned as part of the operational component of the Project. Should the submarine export or interarray cables fault, the portion of the cable will be investigated, and it may require splicing, replacement, addition of a new, working segment or other repair as deemed necessary. This will require the use of various cable installation equipment, as described in **Table 3.4-2**.

3.5.2 Onshore O&M

The onshore substations will be equipped with remote monitoring and operational capability. The onshore substations will be regularly inspected during the operations term, which will result in routine maintenance activities including:

- Inspections and routine maintenance of perimeter security and fencing, including access gates, luminaires, closed circuit television (CCTV), etc.;
- Inspections of buildings for signs of corrosion, quality of coatings, and structural integrity of skids, substructures, foundations, stairs, ladders, etc.;
- Inspections and routine maintenance including the replacement of and/or update to HVDC and HVAC electrical components/equipment;
- Inspections and routine maintenance of ancillary equipment including cooling system, fire protection system, etc.;
- Inspections and routine maintenance of storm water system, site appearance (e.g., mowing, vegetation spraying), and snow removal etc.;
- Periodic testing and inspections of the onshore export cables. Routine maintenance and/or repair is not anticipated except in the event of a major electrical fault or damage caused by a third party or unanticipated events;
- Sampling and testing (including of HVDC cooling medium, transformer cooling medium, lubricating oils, etc.);
- Replacement of consumable items on select equipment (such as filters and hydraulic oils in the backup diesel generator);
- Repair or replacement of worn, failed, or defective systems (such as station post insulators, outdoor grounding equipment, bolts, protective coatings, cables, etc.);
- Updating or improving systems (such as control systems, sensors, telecommunication equipment, etc.); and
- Disposal of waste materials and parts (in line with best practice and regulatory requirements).

Critical electrical equipment and infrastructure will be monitored and controlled through the SCADA system with provisions for local management and control during both planned and unplanned events. In the event of a fault or failure of the onshore components, Beacon Wind will repair and replace the Project component in a timely manner. Unplanned maintenance and repair of select onshore substation facility equipment is anticipated and planned as part of the operational component of the Project.

3.5.3 Offshore Marking and Lighting

The wind turbines and offshore substations will be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively, including USCG Frist District Local Notice to Mariners (LNM) entry 44-20. Beacon Wind will light and mark all wind turbines and offshore substations in accordance with FAA Advisory Circular 70/7460-1M, BOEM's Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development (2021c), and *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA 2021),[37] as applicable and detailed below (and shown in **Figure 3.5-1**, **Figure 3.5-2**, and **Figure 3.5-3**), unless a variance is approved by the applicable agency prior to construction. Marking and lighting specifications as described in these documents are listed below.

- All foundation structures will be painted yellow (RAL1023) from the level of Mean Higher High Water (MHHW) to a minimum of 50 ft (15.3 m) above MHHW, as shown on **Figure 3.5-3.** Paint colors for blades and towers will follow BOEM visual guidelines (2021c).
- Wind turbine towers and offshore substations will have alphanumeric marking in black, as near to 9.8 ft (3 m) in height as practicable, located between 30 ft (9.1 m) to 50 ft (15.3 m) above MHHW, and will be visible above service platforms in all directions in both daytime and nighttime. Markings will be duplicated below servicing platforms as feasible. BOEM designated a uniform marking scheme for the Rhode Island and Massachusetts Lease Areas in 2021 – the Beacon Wind turbines and offshore substations have a unique label (ex: AU 41) based on their location within the defined BOEM structure plot. Letters shall be easily visible as shown on **Figure 3.5-3**. **Figure 3.5-4** depicts the alphanumeric labeling that will be assigned to each wind turbine and offshore substation.
- Wind turbines above the yellow demarcation line for navigational aids will be painted no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey as shown on **Figure 3.5-3**.
- All wind turbines in with a tip height in excess of 699 ft (213 m) will require two synchronized flashing red lights (with medium intensity L-864 and light-emitting diode [LED] color between 800 and 900 nanometers) placed as high as possible on the back of the nacelle on opposite sides. Mid-level lighting will be required at a half-way point on the tower and will consist of at least three L-810 F flashing red lights configured to flash in unison with the nacelle lighting.

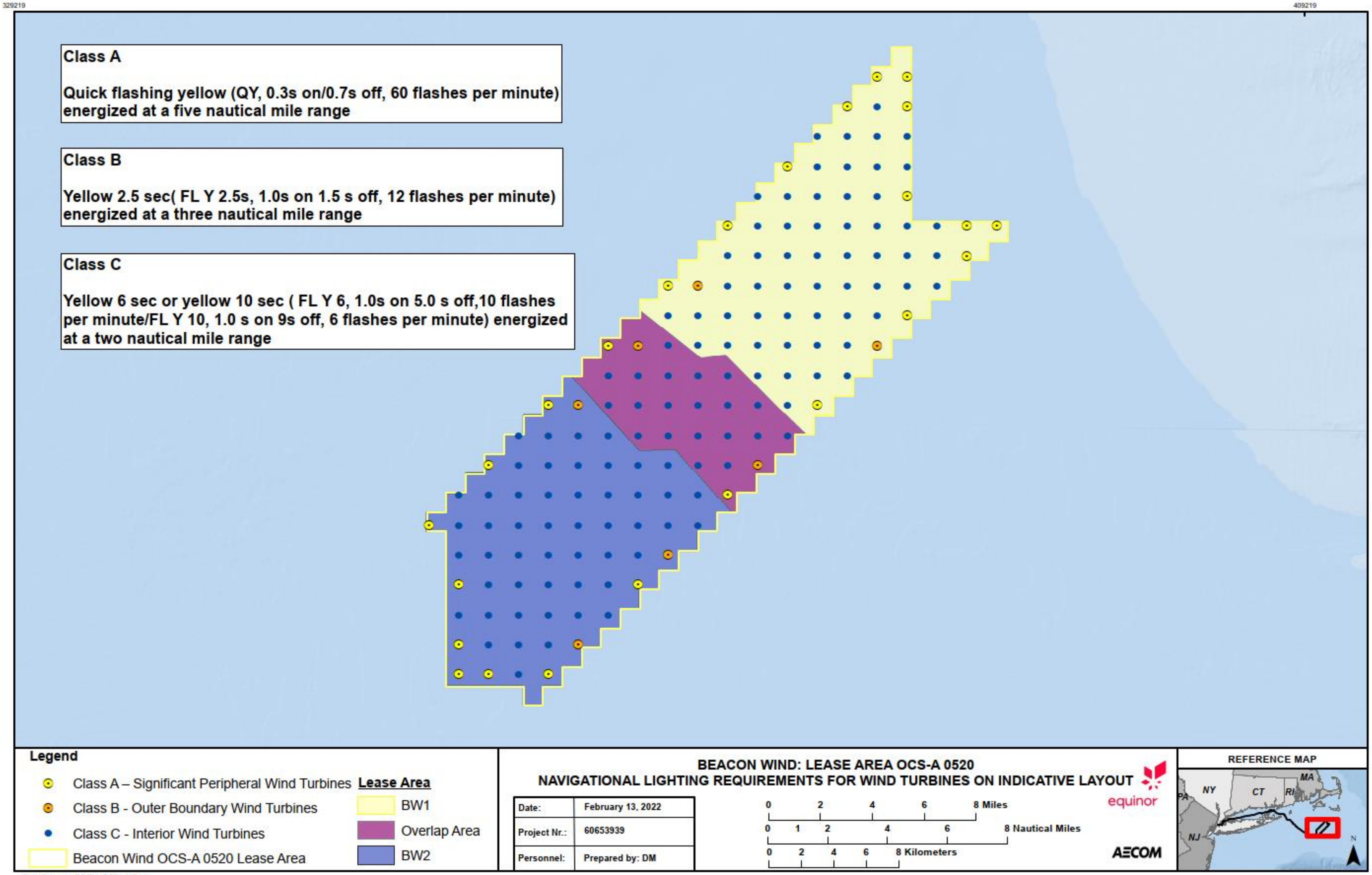
In accordance with IALA 0-139 and USCG LNM entry 4420, the following will also apply:

- Each wind turbine and offshore substation will be lit as an offshore structure in accordance with 33 CFR § 67 and USCG First District LNM entry 44-20.
- Lighting will be located on all wind turbine and offshore substation structures and visible throughout a 360-degree arc from the water's surface.
- Corner Towers/Significant Peripheral Structures (SPSs), Class A, will have quick flashing yellow lights (QY) energized at a 5 nm (9.3 km) range.
- Outer Boundary Towers, Class B, will have yellow 2.5 second lights (FL Y 2.5s) energized at 3 nm (5.6 km) range.

[37] Noted that the IALA O-139 guidance was updated in December 2021 to G1162/R139 (IALA, 2021). The updates are under review and liaison will be ongoing with USCG and BOEM in terms of any applicable updates to relevant U.S. lighting and marking guidance.

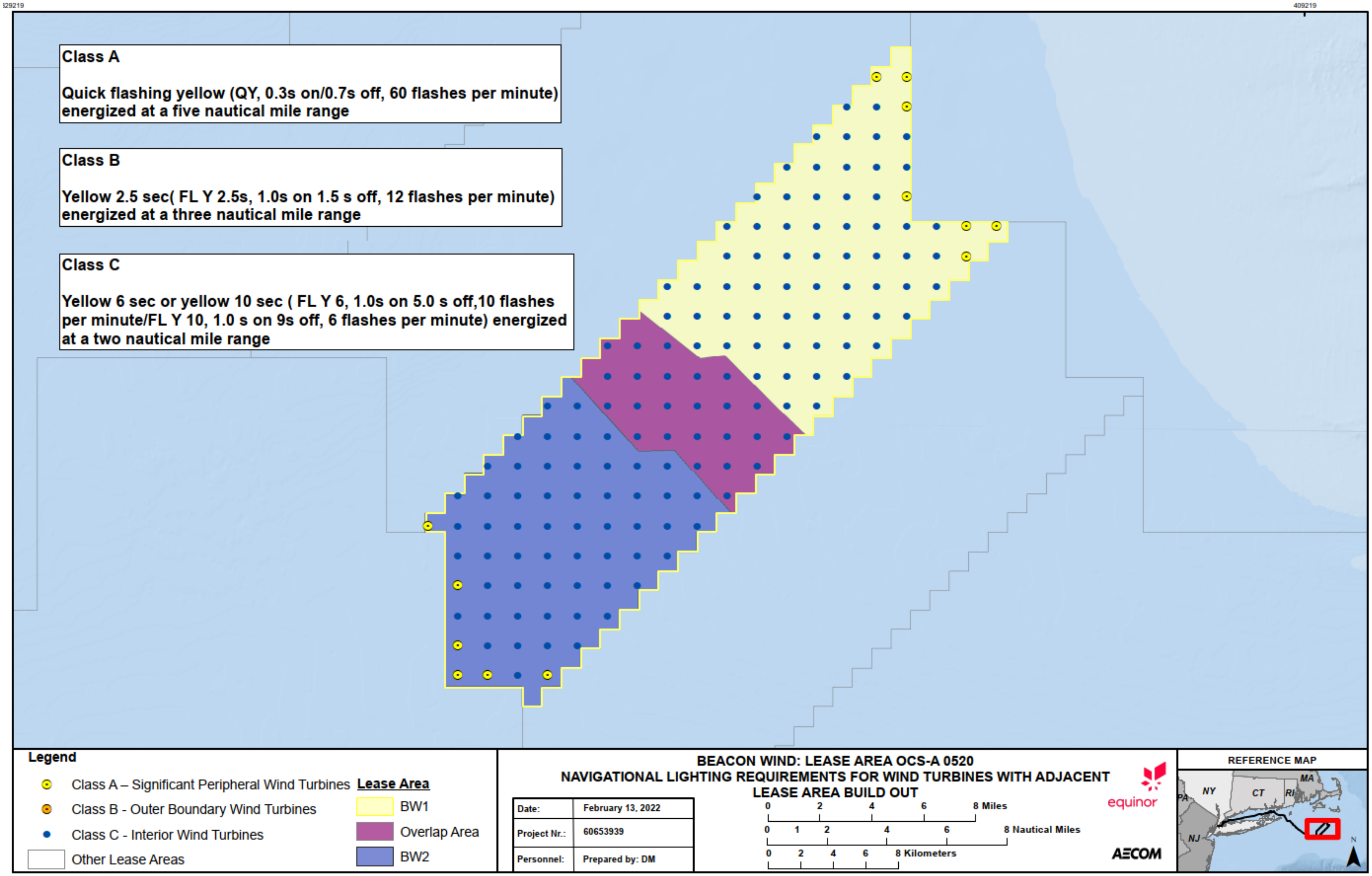
- Interior Towers, Class C, will have yellow 6 second or yellow 10 second lights (FL Y 6/FL Y 10) energized at a 2 nm (3.7 km) range and all lights should be synchronized by their structure location within the field of structures.
- All temporary base, tower, and construction components preceding the final structure completion will be marked with quick yellow obstruction lights visible throughout 360 degrees at a distance of 5 nm (9.3 km). These will not require permits, only USCG notification for appropriate marine notices and broadcasts until the final structure marking is established.
- **Figure 3.5-1** shows the navigational lighting for the Project without development of surrounding lease areas. With those lease areas developed, the wind turbines along the Northwest and Southeast borders of the Project would be lit as Class C structures and not as Class A or Class B structures.
- The aids to navigation on each wind turbine will be mounted below the lowest point of the arc of the rotor blades and will exhibit at a height above highest astronomical tide of no less than 20 ft (6 m) and no more than 50 ft (15 m).
- Sound signals will be located on all structures located at corners/SPSs and will sound every 30 seconds (4 second blast, 26 seconds off), will be set to project at a range of 2 nm (3.7 km); should not exceed 3 nm (5.6 km) spacing between perimeter structures, and will be Mariner Radio Activated Sound Signal activated by keying a very-high frequency (VHF) Radio frequency 83A five times within ten seconds.
- Sound signals will be timed to energize for 45 minutes from the last VHF activation.
- Aeronautical obstruction lights, when fitted to the tops of wind turbines, will not be visible below their horizontal plane.
- Aeronautical obstruction lights will be night vision imaging system compliant.

FIGURE 3.5-1. NAVIGATIONAL LIGHTING REQUIREMENTS FOR WIND TURBINES ON INDICATIVE LAYOUT



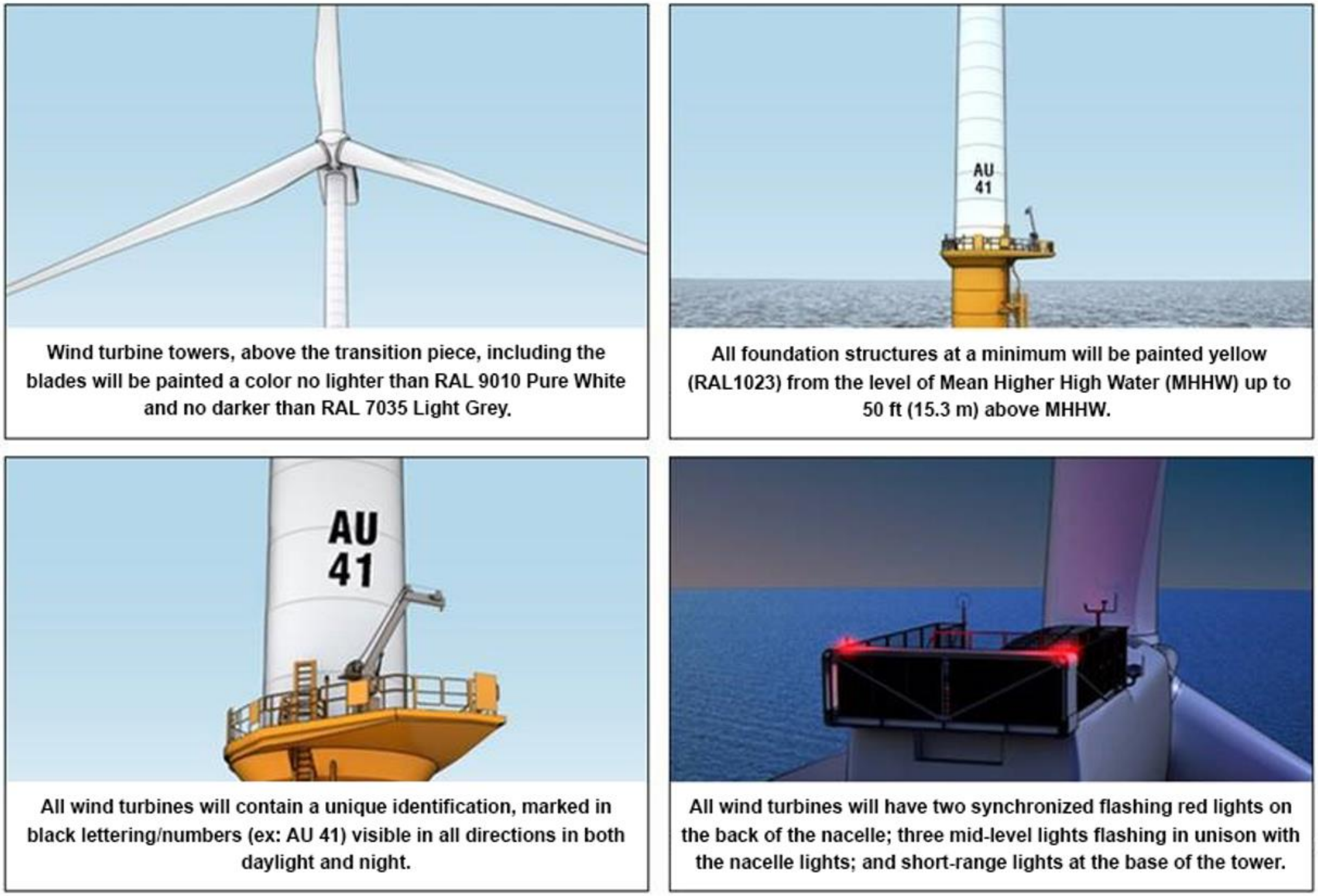
Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 3.5-2. NAVIGATIONAL LIGHTING REQUIREMENTS FOR WIND TURBINES WITH ADJACENT LEASE AREA BUILD-OUT



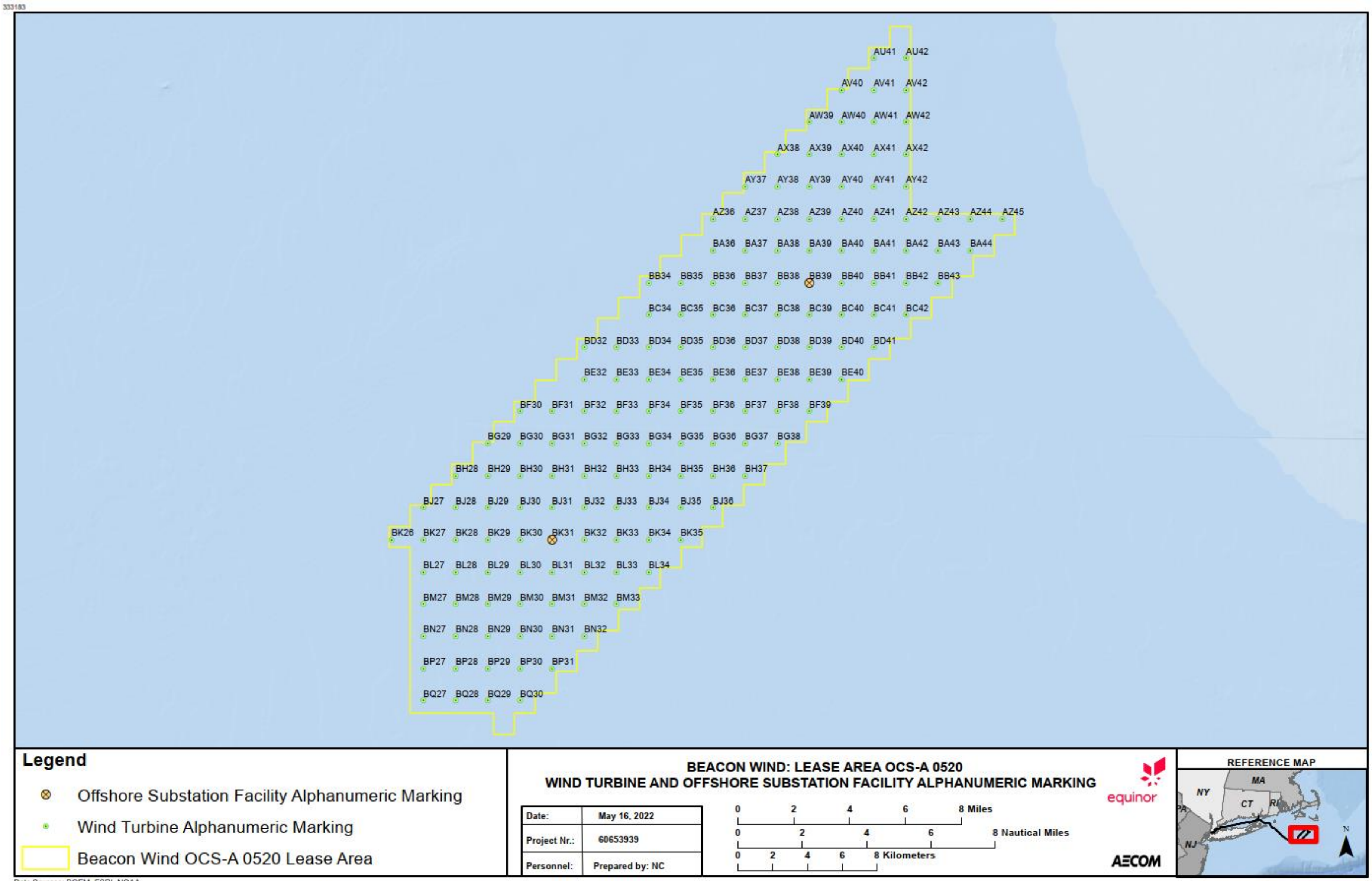
Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 3.5-3. PAINT COLOR AND MARKING REQUIREMENTS FOR WIND TURBINES[38]



[38] The final details of the marking and lighting plan will be discussed with and approved by the appropriate federal agencies.

FIGURE 3.5-4. WIND TURBINE AND OFFSHORE SUBSTATION FACILITY ALPHANUMERIC MARKING



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

In addition, Beacon Wind is considering the use of agency-approved ADLS (or a similar system) to turn the aviation obstruction lights on and off in response to detection of nearby aircraft and is actively completing an evaluation to determine the impacts of the implementation of this system. The commitment as a mitigation is subject to final Project evaluation and agency approval.

3.6 Waste Management

In accordance with 30 CFR § 585.626(b)(9), Beacon Wind has provided a list of wastes expected to be generated during the Project in **Table 3.6-1**.

TABLE 3.6-1. LIST OF WASTES EXPECTED TO BE GENERATED DURING PROJECT

Types of Waste and Composition	Approximate Total Amount Discharged	Maximum Discharge Rate a/	Means of Storage or Discharge Method
Sewage from vessel	Approximate amounts will be subject to the equipment type and supplier	N/A	Tanks/Sewage Treatment Plant
Domestic water	Approximate amounts will be subject to the equipment type and supplier	N/A	Tanks or discharged overboard after treatment
Drilling cuttings, mud, or borehole treatment chemicals, if used	Dependent upon final selection of HDD technique	To be determined based on HDD design	Approved disposal facility
Uncontaminated bilge water	Volume subject to vessel site	Rate subject to vessel size and equipment	Tanks or discharged overboard after treatment
Deck drainage and sumps	Volume subject to vessel type	Rate subject to vessel size and equipment	Discharged overboard after treatment
Uncontaminated ballast water	Volume subject to vessel type	Rate subject to vessel size and equipment	Discharged overboard
Uncontaminated fresh or seawater used for vessel air conditioning	N/A	N/A	Discharged overboard
Solid trash or debris	As generated	As generated	Recycled, incineration or onshore landfill, location to be determined
Chemicals, solvents, oils, and greases	Volume subject to vessel type	Rate subject to vessel size and equipment	Recycled, incineration or onshore landfill, location to be determined

Note:
a/ Final discharge volumes and rates will be provided in the FIR following selection of both the supplier and equipment type and/or final design and location. Wastes will be managed in accordance with applicable regulations.

3.7 Decommissioning Activities

In accordance with 30 CFR Part 585 and other BOEM requirements, Beacon Wind will be required to remove and/or decommission all Project infrastructure and clear the seabed of all obstructions. The decommissioning process for the wind turbines and offshore substations is anticipated to be the reverse of installation, with Project components transported to an appropriate disposal and/or recycling facility. All foundations/Project components will need to be removed 15 ft (4.6 m) below the mudline (30 CFR § 585.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM. Submarine export and interarray cables will be retired in place or removed in accordance with a Decommissioning Plan; Beacon Wind would need to obtain separate and subsequent approval from BOEM to retire any portion of the Project in place. Environmental impacts are anticipated to be similar to those experienced during construction and installation activities, as described in **Section 3.4 Construction and Installation Activities**. Onshore components will be decommissioned in accordance with a plan developed with and approved by the appropriate parties (i.e., landowners, local and state agencies). Although the Project has assumed a Project lifetime of approximately 35 years for the purposes of this COP, some installations and components may remain fit for continued service after such time. Unless otherwise authorized by BOEM, Beacon Wind will complete decommissioning within two years of termination of the Lease and either reuse, recycle, or responsibly dispose of all materials removed. Decommissioning activities will be detailed in a Decommissioning Plan, which is subject to an approval process that includes public comment and government agency consultation. The Decommissioning Plan will be developed based on a factor-based approach, utilizing the environmental and socioeconomic factors to determine a strategy and methodology that is appropriate at the time. As part of this plan, Beacon Wind will compile an inventory of Project components and detail the methods proposed to decommission the Project components. As Project components are decommissioned, Beacon Wind will record and remove from the inventory list, to facilitate confirmation that Project components have been properly removed from the seafloor and that the Project Area is cleared of obstructions. This inventory will include those components described in **Section 3.3 Project Infrastructure Overview**.

Project components will be decommissioned using a similar suite of vessels as those described in **Table 3.4-2**. The types of vessels and total vessel trips required for decommissioning are expected to be approximately the same as or less than construction, as the decommissioning process is anticipated to be the reverse of installation. Surveys are not anticipated to be required for decommissioning. If surveys are required to support decommissioning activities, the equipment used for these surveys will be similar to those permitted for the completed surveys to support construction and will be subject to applicable permitting prior to the initiation of survey.

Table 3.7-1 provides additional detail on likely removal methods and assumptions that would be applicable based on present day understanding of available decommissioning approaches, though it is acknowledged that in 35 years technology advances are anticipated that could lessen impacts of decommissioning.

TABLE 3.7-1. SUMMARY OF DECOMMISSIONING METHODS AND ASSUMPTIONS

Item	Removal Method	Comments and Assumptions
Wind Turbines	Removal of the wind turbines is done using a reversed installation method. Oils, greases, and fuels will be removed in accordance with the Oil Spill Response Plan (OSRP) and relevant safety requirements before the wind turbines are disassembled. Decommissioning of the turbines and towers is assumed to include removal of the rotor, nacelle, blades, and tower to be removed in the reverse installation order.	Materials brought onshore for recycling and disposal. Steel in the tower is assumed to be recycled. The blades are assumed to be disposed at an approved location.
Monopile Foundation and TP	Removal of the monopile TP foundations is done using a reversed installation method. Sediments inside the monopile will be removed by suction prior to cutting, if necessary, and replaced in the depression once the monopile is removed. Diver-assisted or remote-operated hoses may be used to reduce sediment disturbance. The monopile is assumed to be cut off below the mud line and be lifted off by a heavy lift vessel to a barge prior to decommissioning.	Monopile to be cut below mudline and transported for recycling. Monopiles are assumed to be cut using mechanical cutting, high-pressure water jet, and/or cutting torches designed for underwater use. No pile driving will be required for decommissioning. Steel is assumed to be recycled.
Offshore Substation Topside	Removal of the topside is done using a reversed installation method. Oils, greases, and fuels will be removed in accordance with the OSRP and relevant safety requirements before the offshore substation topside is removed. The offshore substation topside is assumed to be lifted off by a heavy lift vessel to a barge prior to decommissioning.	Transported for recycling and disposal. Removed fluids would be brought for recycling and disposal. Steel from the topside is assumed to be recycled.
Jacket with Piles	The piles are assumed to be cut below the mud line, before the jacket is lifted off in one section by a heavy lift vessel to a barge prior to decommissioning.	Cut below mudline and transported for recycling. Piles are assumed to be cut using mechanical cutting, high-pressure water jet, and/or cutting torches designed for underwater use. No pile driving will be required for decommissioning. Steel from the jacket and piles is assumed to be recycled.

Item	Removal Method	Comments and Assumptions
Suction Bucket Jacket	The jacket is cut between suction bucket and jacket, and the jacket is lifted off in one piece. The suction bucket is either removed by positive pressure and crane or cut below the mudline in a similar fashion as a piled jacket.	Either way of removal will be transported to U.S. ports for recycling. Steel from the jacket is assumed to be recycled.
Offshore Cables	The submarine export cables and interarray cables are assumed to be lifted out and cut into pieces or reeled in onto barges for transport. Cables will be disconnected from wind turbines and the offshore substation before removal. J-tubes will be removed.	If total removal of cables is required, cables will be transported to Europe or U.S. port for recycling. In some places, jet plowing may be used to loosen sediment above the cable. Core material to be recycled.
Onshore Substation Facility	Removal of the buildings and equipment is assumed, unless suitable for future use.	Materials to be recycled. Buildings to be demolished and recycled unless suitable for future use. Site to be prepared for future use. Disassembly of the onshore substation and preparation of the site for future use is assumed to use similar vehicles and equipment as construction.
Onshore Cables	Removal of the cable is assumed to be limited to disconnecting and cutting below ground level. The onshore export and interconnection cables and the duct banks are assumed to be retired in place.	Remaining cable capped off and earthed. Removal of termination points and cut off cable 3 ft (0.9 m) below ground level.
Scour Protection and Rock Filling	Alternatives: Removal of scour protection and rock filling. Leave scour protection in place, as undisturbed as possible.	Assumed to be removed unless leaving in place is deemed appropriate through consultation with the authorities. Removal of scour protection is assumed to use a dredging vessel. Removed material would be reused, if possible, or transported to U.S. port for disposal.

3.8 References

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