EMPIRE OFFSHORE WIND:
EMPIRE WIND PROJECT (EW 1 and EW 2)

CONSTRUCTION AND OPERATIONS PLAN

VOLUME 1: PROJECT INFORMATION

Prepared for
equinor

Submitted to
Bureau of Ocean Energy Management

Prepared by
TETRA TECH

JULY 2021

Photo Credit: Jan Arne Wold/Equinor

EXECUTIVE SUMMARY

Empire Offshore Wind LLC (Empire) proposes to construct and operate an offshore wind farm located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area). The Lease Area covers approximately 79,350 acres (ac; 32,112 hectares [ha]) and is located approximately 14 statute miles (mi) (12 nautical miles [nm], 22 kilometers [km])[1] south of Long Island, New York and 19.5 mi (16.9 nm, 31.4 km) east of Long Branch, New Jersey. 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 New York.[2] The Project Overview is shown in **Figure ES-1**.

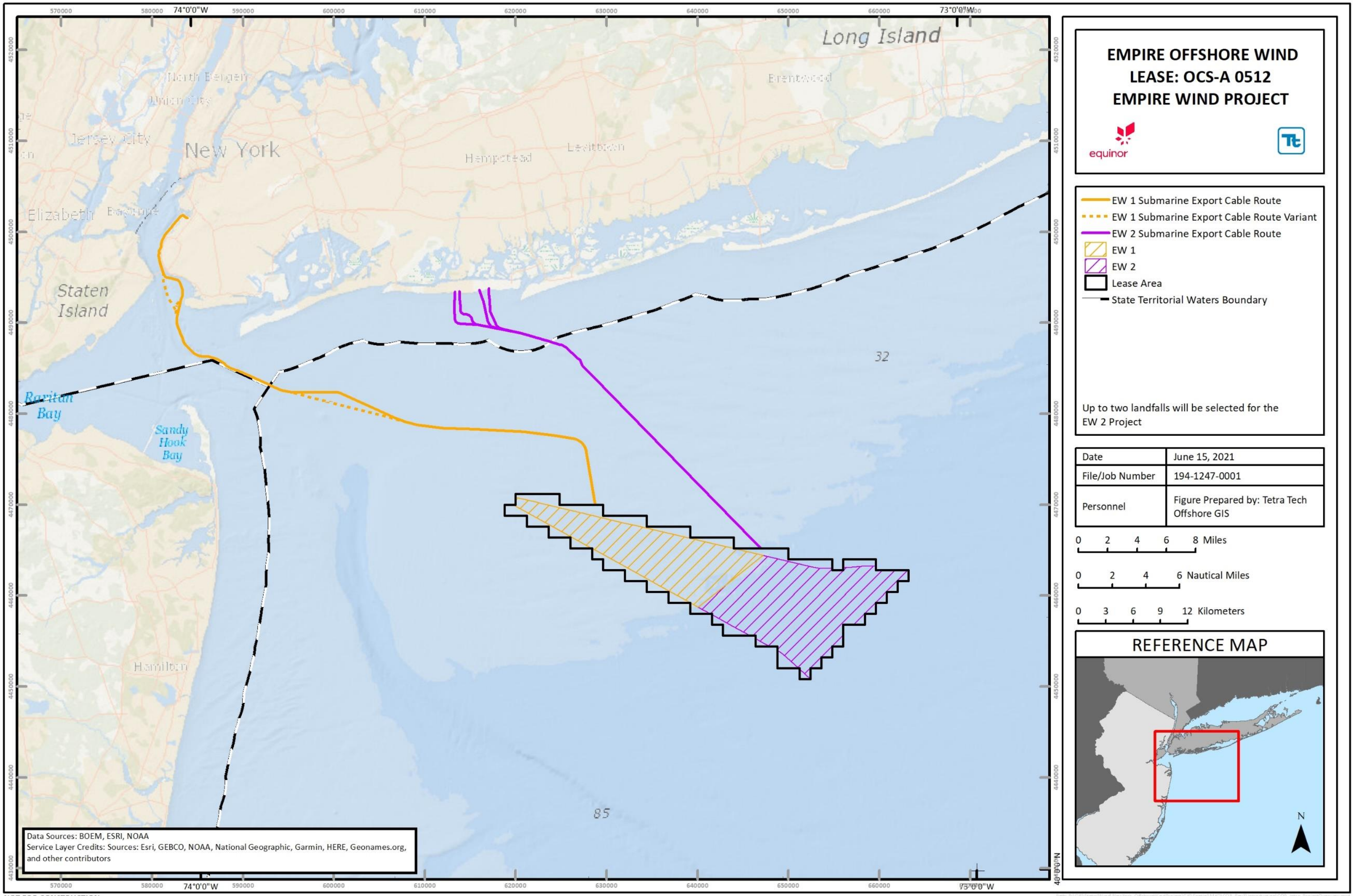
Empire proposes to develop the Lease Area in two wind farms, known as Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2) (collectively referred to hereafter as the Project). Both EW 1 and EW 2 are covered in this Construction and Operations Plan (COP). EW 1 and EW 2 will be electrically isolated and independent from each other. Each wind farm will connect via offshore substations to separate Points of Interconnection (POIs) at onshore locations by way of export cable routes and onshore substations. In this respect, the Project includes two onshore locations in New York where the renewable electricity generated will be transmitted to the electric grid.

The purpose of the Project is to generate renewable electricity from offshore wind farms located in the Lease Area to address the need identified by New York for renewable energy and help the State of New York Public Service Commission achieve its renewable energy goals.

Empire 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 [or 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.

[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 15-16, 2016, the lease sale for an area offshore New York, or the "New York Lease Area" was held by BOEM, pursuant to 30 CFR § 585.211. Statoil Wind US LLC (subsequently renamed to Equinor Wind US LLC) was the winner of Lease Area OCS-A 0512. The Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0512 (Lease) for 79,350 ac (32,112 ha) went into effect on April 1, 2017. Following issuance of the Lease, Equinor Wind US LLC 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 October 10, 2017. BOEM approved the request on November 13, 2017, extending the Preliminary Term from April 1, 2018 to April 1, 2019. Statoil Wind US LLC changed its name to Equinor Wind US LLC on May 16, 2018. Equinor Wind US LLC assigned the Lease to Empire Offshore Wind LLC on January 27, 2021 in accordance with BOEM's requirements. References to Empire generally include or also refer to the predecessor in interest to Lease OCS-A 0512, Equinor Wind US LLC, except where specifically noted.



NOT FOR CONSTRUCTION

Figure ES-1 Project Overview (Lease Area and Submarine Export Cable Routes)

This COP covers the Lease Area and therefore addresses the proposed Project elements and the means and methods used for installing and operating the facilities as well as the potential positive and adverse effects of the Project.

Offshore components of the Project will consist of up to 174 wind turbines and supporting tower structures, and two offshore substations, using up to 176 foundations. In addition, there will be associated support and access structures (for aforementioned wind turbines and offshore substations) and up to 260 nm (481 km) of interarray cable (up to 116 nm [214 km] for EW 1 and up to 144 nm [267 km] for EW 2), all of which will be located in federal waters within the Lease Area.

In addition, the Project will include up to 66 nm (122 km) of submarine export cables, consisting of up to two routes (see further details in Section 3) to New York:

- Up to 40 nm (74 km) to the EW 1 landfall, of which 24 nm (44 km) is in federal waters and 16 nm (30 km) in state waters; and
- Up to 26 nm (48 km) to the EW 2 landfall, of which 18 nm (33 km) is in federal waters and 8 nm (15 km) is in state waters.

The onshore components of the Project will include up to three export cable landfall areas in New York (one at EW 1 and up to two at EW 2):

- EW 1 Landfall; and
- EW 2 Landfall A (Riverside Boulevard), EW 2 Landfall B (Monroe Boulevard), EW 2 Landfall C (Lido Beach West Town Park), and/or EW 2 Landfall D (Lido Beach Town Park); and

Up to three onshore export and interconnection cable routes (one at EW 1 and up to two at EW 2):

- EW 1 interconnection cable route of up to 0.2 mi (0.4 km); and
- EW 2 onshore export and interconnection cable route of up to 5.7 mi (9.2 km), for a single onshore export cable and interconnection route (up to two routes proposed); and

Two onshore substation locations:

- EW 1 onshore substation in Brooklyn, New York; and
- EW 2 Onshore Substation A or EW 2 Onshore Substation B in Oceanside, New York.

Empire evaluated numerous locations for the onshore substations based on environmental resources, land use, zoning, distance to shore, grid availability, upgrade requirements, etc. For each of the landfall locations selected, the onshore export cable traverses to the onshore substation, which converts power to the appropriate voltage, and then an onshore interconnection cable connects to the POI, where power is delivered to the grid.

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

- Homeport Pier, Staten Island, New York;
- South Brooklyn Marine Terminal, Brooklyn, New York; and
- Howland Hook Marine Terminal, Staten Island, New York.

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 §§ 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 FDR/FIR submittal will be phased and will be developed on a component-by-component basis.

Within **Volume 1**, **Section 1** provides an Introduction**; Section 2** details the Project Design Development; **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**.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

PROJECT QUICK REFERENCE GUIDE

Key Project Term	Description
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.
Empire	Empire Offshore Wind LLC.
Empire Wind 1	The portion of the Project and Lease Area that will be considered a single wind farm dedicated to the Gowanus Point of Interconnection for provision of power to New York State. Also referred to as "EW 1."
Empire Wind 2	The portion of the Project and Lease Area that will be considered a single wind farm dedicated to the Oceanside Point of Interconnection for provision of power to New York State. Also referred to as "EW 2."
Export cable landfall	Area where the submarine export cables are brought onshore.
Export cable route	The linear path of the export cables from the offshore substation in the Lease Area to the Point of Interconnection in New York.
Foundation	Structure required to secure the wind turbine generator, offshore substation, and other offshore structures vertically.
Interarray cable	66-kilovolt (kV) high-voltage alternating-current (HVAC) submarine cables interconnecting the wind turbines and offshore substation. The cable consists of a three-core copper conductor with a fiber-optic cable integrated into the cable; the cable is protected by one or more layers of armoring.
Interconnection Cable	345-kV HVAC onshore cables connecting the onshore substation to the POI.
J-tubes	Metal tubes that route and protect cables against sea and wind forces as they travel from the seabed, up the foundation to the base of the wind turbine tower or offshore substation topside.
Lease	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0512).
Lease Area	BOEM-designated Renewable Energy Lease Area OCS-A 0512.
Metocean facilities	Floating light detection and ranging buoys (floating LiDARs), wave and met buoy, and subsurface current meter installed in the Lease Area.
Offshore substation	Structure that receives the power from the wind turbines through the interarray cables. One offshore substation will serve EW 1 and one offshore substation will serve EW 2. Each offshore substation 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.
Onshore construction corridor	Onshore export cable corridor and additional area required for construction to install the onshore export cables from landfall to the onshore substation, as well as the interconnection cables from the onshore substation to the Point of Interconnection.

PROJECT QUICK REFERENCE GUIDE (continued)

Key Project Term	Description
Onshore export cable	230-kV HVAC cables connecting the transition bay at the onshore landfall location to the onshore substation. The cable circuits consist of a single-core copper or aluminum conductor. Fiber optic cables for communication and temperature measurements will also be installed alongside the onshore export cable.
Onshore substation	The facility where power is collected and transformed to the appropriate voltage in order to be injected into the Point of Interconnection substation for distribution.
Point of Interconnection (POI)	The substation where the project is interconnected to distribute power into the grid. For EW 1: Location where the EW 1 Project interconnects into the New York State Transmission System is operated by the New York Independent System Operator at ConEdison's Gowanus Substation in Brooklyn, New York. For EW 2: Location where the EW 2 Project interconnects into the New York State Transmission System is operated by the New York Independent System Operator at the Oceanside Substation in Oceanside, New York.
Project	The offshore wind project for OCS A-0512 proposed by Empire Offshore Wind LLC consisting of Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2).
Project Area	Lease Area, submarine export cable routes, and onshore project facility locations including the onshore export and interconnection cables, and onshore substations.
Project Design Envelope (PDE)	The range comprising all development activities potentially associated with the Lease Area including potential onshore grid connection corridors and infrastructure, submarine export cable siting corridors, and the offshore Wind Farm Development Area. This excludes any onshore third-party that may be required for the Project to be interconnected (e.g., grid upgrades, Point of Interconnection substation upgrades).
Scour protection	Material, typically stone or rocks, placed around/on top of a structure, if required, to prevent seabed sediment from being flushed away as a result of water flow.
Seabed penetration	Valid for the monopile or jacket foundation; the value specifies the required penetration depth of original seabed for the monopile or piled jacket foundations.
Seabed preparation	Preparation of the seabed to account for scour. For gravity base structure (GBS) and monopiles, this may include a gravel pad and scour protection. For pre-piled jacket foundations, only a gravel pad is expected.
Submarine export cable	230-kV HVAC cables connecting the offshore substation to the transition bay at the export cable landfall location. The cable consists of a three-core copper conductor with a fiber-optic cable integrated into the cable; the cable is protected by one or more layers of armoring.
Submarine export cable siting corridor	Offshore cable corridor from the Lease Area to the export cable landfall, which will be temporarily disturbed during installation activities.

PROJECT QUICK REFERENCE GUIDE (continued)

Key Project Term	Description
Transition piece	The portion of the foundation that 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 that 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.

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
AADT	Average Annual Daily Traffic
ac	acre
ACHP	Advisory Council on Historic Preservation
ACPARS	Atlantic Coast Port Access Route Study
AD	Anno Domini
ADLS	Aircraft Detection Lighting System
AGL	above ground level
AIS	Automatic Identification System
ALARP	as low as reasonably practicable
AMSL	above mean sea level
ANSI	American National Standards Institute
APE	area of potential effect
AQCR	Air Quality Control Region
ASCE	American Society of Civil Engineers
ASMFC	Atlantic States Marine Fisheries Commission
AVEHP	Analysis of Visual Effects to Historic Properties
AWOIS	Automated Wreck and Obstruction Information System
BACT	Best Available Control Technology
BGEPA	Bald and Golden Eagle Protection Act
BLM	U.S. Bureau of Land Management
BMPs	best management practices
BOEM	Bureau of Ocean Energy Management
CAA	Clean Air Act
CAFRA	Coastal Area Facility Review Act
Call	Call for Information and Nomination
CBRA	Cable Burial Risk Assessment
CCTV	closed-circuit television
CD	Coastal Zone Consistency Determination
CE	concrete extender
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cm	centimeter

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
CMECS	Coastal and Marine Ecological Classification Standard
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	Carbon dioxide equivalent
COA	Corresponding Onshore Area
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
ConEd	Consolidated Edison
COP	Construction and Operations Plan
COTP	Captain of the Port
CP-29	CP-29 Environmental Justice and Permitting
CPIP	Comprehensive Port Improvement Plan
CPT	Cone Penetration Test
CRIS	Cultural Resource Information System
CSO	combined sewer overflow
CTV	Crew Transfer Vessels
CVA	Certified Verification Agent
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act of 1972
DAS/DVS	Distributed Acoustic/Vibration Sensing
dB	decibel
dBA	decibels, A-scale
DF	Direction Finding
DMA	Dynamic Management Area
DMR	Division of Marine Resources
DoD	U.S. Department of Defense
DOI	Department of Interior
DP	dynamic positioning
DPS	Distinct Population Segment
DZ/RA	Danger Zone/Restricted Area
E.O. 23	Executive Order No. 23
EA	Environmental Assessment
ECL	New York Environmental Conservation Law
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	Environmental Impact Statement

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
EMF	electric and magnetic fields
ENGO	environmental nongovernmental organizations
EPA	U.S. Environmental Protection Agency
Equinor Wind	Equinor Wind US LLC
ERAP	Emergency Response Action Plan
ERC	Emission Reduction Credit
ERP	Emergency Response Plan
ESA	Endangered Species Act of 1973
EW	Empire Wind
FAA	Federal Aviation Administration
FAST	Fixing America's Surface Transportation Act
FDR	Facility Design Report
FEMA	Federal Emergency Management Agency
FHA	Flood Hazard Area
FHWG	Fisheries Hydroacoustic Working Group
FIR	Fabrication and Installation Report
FLO	Fisheries Liaison Officer
FMC	Fishery Management Council
FMP	Fishery Management Plan
FOIA	Freedom of Information Act
FR	Federal Register
ft	feet
ft^2	square feet
gal	gallon
GARFO	Greater Atlantic Regional Fisheries Office
GBS	gravity base structure
GHG	greenhouse gas
GPS	global positioning system
GRR	General Reevaluation Report
GW	gigawatt
ha	hectare
HAP	hazardous air pollutant
HAPC	Habitat Area of Particular Concern
HARS	Historic Area Remediation Site
HAT	Highest Astronomical Tide
HDD	horizontal directional drilling

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
HDPE	high density polyethylene
HF	High frequency
hr	hour
HRG	high-resolution geophysical
HVAC	high-voltage alternating-current
HVDC	high-voltage direct-current
Hz	hertz
IALA	International Association of Marine Aids
IBA	Important Bird Area
IC	interconnection cable
IFR	instrument flight rule
IHA	Incidental Harassment Authorization
IMO	International Maritime Organization
in	inch
IP	Island Park
IPaC	Information for Planning and Conservation
IPS	Intermediate Peripheral Structure
ISO	International Organization for Standardization
ITP	Incidental Take Permit
kg	kilogram
kHz	kilohertz
kJ	kilojoule
km	kilometer
km/h	kilometer per hour
km^2	square kilometers
KOP	Key observation point
kV	kilovolt
l	liter
LAER	Lowest Achievable Emission Rate
lb	pound
LB	Long Beach
Ldn	day-night sound level
Leq	equivalent sound level
Lease Area	designated Renewable Energy Lease Area OCS-A 0512
LF	Low frequency
LiDAR	light detection and ranging

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
LIPA	Long Island Power Authority
LIRR	Long Island Rail Road
LNM	Local Notice to Mariners
LOA	Letter of Authorization
Lp	sound pressure level
LPK	peak sound pressure levels
m	meters
m/s	meters per second
m^2	square meters
m^3	cubic meters
MAFMC	mid-Atlantic Fishery Management Council
MARCO	Mid-Atlantic Regional Ocean Council
MBTA	Migratory Bird Treaty Act of 1918
MEC	munitions and explosives of concern
MF	mid-frequency
mg/kg	milligram per kilogram
mg/L	milligrams per liter
MGN	United Kingdom Maritime Guidance Note
mi	statute mile
mL	milliliter
MLLW	mean lower low water
mm	millimeter
mm^2	square millimeter
MMPA	Marine Mammal Protection Act of 1972
MOA	Memorandum of Agreement
MSFCMA	Magnuson-Stevens Fisheries Conservation and Management Act
MSL	mean sea level
MVA	minimum vectoring altitude
MW	megawatt
N.J.A.C.	New Jersey Administrative Code
N.J.S.A.	New Jersey Statues Annotated
NAAQS	National Ambient Air Quality Standard
NAVD88	North American Vertical Datum of 1988
NDAA	National Defense Authorization Act
NDZ	No-Discharge Zone
NEFMC	New England Fishery Management Council

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
Neptune cable	Neptune Regional Transmission System
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act of 1966
NJ HPO	New Jersey State Historic Preservation Office
NJDEP	New Jersey Department of Environmental Protection
NLCD	National Land Cover Data
nm	nautical mile
NO	nitric oxide
NO_X	nitrogen oxides
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NSA	noise sensitive areas
NSR	New Source Review
NSRA	Navigation Safety Risk Assessment
NVIC	Navigation and inspection Circular
NWI	National Wetlands Inventory
NY DPS	New York State Department of Public Service
NY SHPO	New York State Historic Preservation Office
NYCDEP	New York City Department of Environmental Protection
NYCEDC	New York City Economic Development Council
NYCRR	New York Codes, Rules and Regulations
NYISO	New York Independent System Operator
NYNJ	New York New Jersey
NYPA	New York Power Authority
NYS WQS	New York State Water Quality Standards
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
NYSERDA	New York State Energy Research and Development Authority
O&M	operations and maintenance
OBIS	Ocean Biogeographic Information System
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OFLR	Onboard Fisheries Liaison Representative
OGS	New York State Office of General Services
OPAREA	Operating Area
OREI	Offshore Renewable Energy Installations
OSHA	Occupational Health and Safety Act of 1970
OSRP	Oil Spill Response Plan
OW	Otariids Underwater
PAH	polycyclic aromatic hydrocarbon
PAM	Passive Acoustic Monitoring
PANYNJ	Port Authority of New York and New Jersey
PAPE	preliminary area of potential effect
PARS	Port Access Route Study
PATON	Private Aids to Navigation
PCB	polychlorinated biphenyl
PDE	Project Design Envelope
PM10	particulate matter less than 10 microns in diameter
PM2.5	particulate matter less than 2.5 microns in diameter
POI	Point of Interconnection
Poseidon	Poseidon Transmission
ppt	parts per thousand
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 Empire Wind 1 and Empire Wind 2.
PSN	Proposed Sale Notice
PSO	Protected Species Observer
PTS	permanent threshold shift
PW	Phocids Underwater
QMA	Qualified Marine Archaeologist
Raritan Bay Loop	Transco Raritan Bay Loop natural gas pipeline
RFI	Request for Interest
ROD	record of decision

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
RODA	Responsible Offshore Development Alliance
ROMS	Regional Ocean Modeling System
ROSA	Responsible Offshore Science Alliance
ROW	right-of-way
RSZ	rotor swept zone
SAP	Site Assessment Plan
SAR	search and rescue
SAV	submerged aquatic vegetation
SCADA	Supervisory Control and Data Acquisition
SEL	sound exposure level
SELcum	cumulative sound energy level
SESC	Standards for Soil Erosion and Sediment Control
SF_6	sulfur hexafluoride
SGCN	species of greatest conservation need
SHPO	State Historic Preservation Office
SMA	Seasonal Management Area
SMS	Safety Management System
SO2	sulfur dioxide
SOLAS	International Convention for the Safety of Life at Sea
SOV	service operations vessel
SPCC	Spill Prevention, Control, and Countermeasures
SPDES	State Pollutant Discharge Elimination System
SPI	sediment profile imagery
SPL	Sound Pressure Level
SSBMT	Sustainable South Brooklyn Marine Terminal
SSER	South Shore Estuary Reserve
SWPPP	Stormwater Pollution Prevention Plan
TDWR	Terminal Doppler Weather Radar
TECQ	Texas Commission on Environmental Quality
the Collaborative	the NY Offshore Wind Collaborative
TP	transition piece
tpy	tons per year
TRACON	Terminal Radar Approach Control Facilities
Transco Inc.	Transco
TSS	traffic separation scheme
TTS	temporary threshold shift

ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
U.S.C.	United States Code
UKHO	United Kingdom Hydrographic Office
UME	Unusual Mortality Event
USACE	U.S. Army Corps of Engineers
USCG	United States Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VDEQ	Virginia Department of Environmental Quality
VFR	Visual Flight Rule
VHF	Very High Frequency
VIA	Visual Impact Assessment
VMS	Vessel Monitoring System
VOC	volatile organic compound
VRM	Visual Resource Management
VTR	Vessel Trip Reports
Wall-LI	Wall, New Jersey to Long Island
WCS	Wildlife Conservation Society
WEA	Wind Energy Area
WFDA	Wind Farm Development Area
WHOI	Woods Hole Oceanographic Institute
WI/PWL	Waterbody Inventory/Priority Waterbodies List
WNS	white-nose syndrome
WTA	Weapons Training Area
XLPE	cross-linked polyethylene
yd^2	square yards
yd^3	cubic yards
μm	micrometer
μPa	micropascal

1. INTRODUCTION

Empire Offshore Wind LLC (Empire) submits this Construction and Operations Plan (COP) to support the siting, development, and operation of the Project located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area).

1.1 COP Requirements

The purpose of this COP is to provide information about the Project to the Bureau of Ocean Energy Management (BOEM) and other federal and state agencies. The COP was prepared in accordance with Title 30 of the Code of Federal Regulations (CFR) § 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.

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 - Project Description Appendix E - 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 E - Conceptual Project Design Drawings Appendix F - Oil Spill Response Plan Appendix G - Safety Management System Appendix H - Marine Site Investigation Report Appendix DD - Navigation Safety Risk Assessment

Table 1.1-1 BOEM Regulations for Developing a Construction and Operations Plan (continued)

BOEM Requirement	Location in COP
(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 8.8 - Commercial and Recreational Fishing Section 8.9 - Department of Defense and OCS National Security Maritime Uses Section 8.10 - Marine Energy and Infrastructure Appendix CC - 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 and Habitats Section 6 - Cultural Resources Section 7 - Visual Resources Section 8 - Human Resources and the Built Environment Section 9 - Summary of Mitigation and Monitoring Appendix H - Marine Site Investigation Report Appendix J - Sediment Transport Analysis Appendix K - Air Emissions Calculations and Methodology Appendix P - Ornithological and Marine Fauna Aerial Survey Appendix Q - Avian Impact Assessment Appendix R - 2018 Bat Survey Report Appendix S - Bat Impact Assessment Appendix T - Benthic Resources Characterization Reports Appendix U - Essential Fish Habitat (EFH) Assessment Appendix X - Marine Archaeological Resources Assessment Appendix Y - Terrestrial Archaeological Resources Assessment Appendix Z - Analysis of Visual Effects to Historic Properties Appendix AA - Visual Impact Assessment Appendix FF - Offshore Electric and Magnetic Field Assessment Appendix GG - Onshore Electric and Magnetic Field Assessment

Table 1.1-1 BOEM Regulations for Developing a Construction and Operations Plan (continued)

BOEM Requirement	Location in COP
(e) The project will use the best available and safest technology.	Section 3 - Project Description
(f) The project will use best management practices.	Section 9 - Summary of Mitigation and Monitoring
(g) The project will use properly trained personnel.	Section 8.12 - Public Health and Safety Appendix G - Safety Management System
30 CFR § 585.626(a)	
(1) Shallow Hazards	Section 4.1 - Physical and Oceanographic Conditions Appendix H - Marine Site Investigation Report
(i) Shallow Faults;	
(ii) Gas Seeps or shallow gas;	
(iii) Slump blocks or slump sediments;	
(iv) Hydrates;	
(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 H - 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	Section 4.1 - Physical and Oceanographic Conditions Section 5 - Biological Resources and Habitats Appendix H - Marine Site Investigation Report Appendix P - Ornithological and Marine Fauna Aerial Survey Appendix Q - Avian Impact Assessment Appendix R - 2018 Bat Survey Report Appendix S - Bat Impact Assessment Appendix T - Benthic Resources Characterization Reports Appendix U - Essential Fish Habitat (EFH) Assessment
(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.	
(4) Geotechnical Survey	Section 4.1.2 - Geologic Conditions Appendix H - Marine Site Investigation Report Appendix J - 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.	

Table 1.1-1 BOEM Regulations for Developing a Construction and Operations Plan (continued)

BOEM Requirement	Location in COP
(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
(i) A description of the historic and prehistoric archaeological resources, as required by the NHPA (16 United States Code [U.S.C.] §§ 470 *et. seq.*), as amended.	Appendix X - Marine Archaeological Resources Assessment Appendix Y - Terrestrial Archaeological Resources Assessment
(6) Overall Site Investigation	Section 4. 1- Physical and Oceanographic Conditions Appendix H - Marine Site Investigation Report Appendix J - Sediment Transport 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 1.2 - Project Overview

Table 1.1-1 BOEM Regulations for Developing a Construction and Operations Plan (continued)

BOEM Requirement	Location in COP
	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 E - 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 F - Oil Spill Response Plan Appendix G - 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 F - Oil Spill Response Plan Section 3.3.1.1 (Table 3.3-2 – Summary of Wind Turbine Oil/Grease/Fuel Maximum PDE Parameters) Section 3.3.1.3 (Table 3.3-6 - 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 DD - Navigation Safety Risk Assessment
(13) Decommissioning and site clearance procedures	Section 3.6 - Decommissioning Activities

Table 1.1-1 BOEM Regulations for Developing a Construction and Operations Plan (continued)

BOEM Requirement	Location in COP
(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	Section 9 - Summary of Avoidance, Minimization, and Mitigation Measures
(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 Agency Engagement
(18) Reference	By Section, References
(19) Financial assurance	Section 1.10 - Financial Assurance
(20) CVA nominations for reports required in subpart G of this part	Section 1.9 - Certified Verification Agent Appendix C - Certified Verification Agent
(21) Construction schedule	Section 1.2.4 - Anticipated Construction Schedule
(22) Air quality information	Section 4.3 - Air Quality Appendix K - 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 H - Marine Site Investigation Report

Table 1.1-1 BOEM Regulations for Developing a Construction and Operations Plan (continued)

BOEM Requirement	Location in COP
	Appendix J - Sediment Transport Analysis
(2) Water quality	Section 4.2 - Water Quality Appendix J - Sediment Transport Analysis
(3)(i) Benthic Communities	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix T - Benthic Resource Characterization Reports
(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 P - Ornithological and Marine Fauna Aerial Survey Appendix Q - Avian Impact Assessment
(3)(v) Fish and shellfish	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix T - Benthic Resource Characterization Reports Appendix U - Essential Fish Habitat (EFH) Assessment
(3)(vi) Plankton	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix U - Essential Fish Habitat (EFH) Assessment
(3)(vii) Seagrasses	Section 5.5 - Benthic Resources & Finfish, Invertebrates, and Essential Fish Habitat Appendix U - Essential Fish Habitat (EFH) Assessment
(3)(viii) Plant life	Section 5 - Biological Resources and Habitats Section 5.2 - Wetlands and Waterbodies
(4) Threatened or endangered species (5) Sensitive biological resources or habitats	Section 5 - Biological Resources and Habitats Appendix N - Information for Planning and Conservation (IPaC) Report, New York State Department of Environmental Conservation Response Letters Appendix P - Ornithological and Marine Fauna Aerial Survey Appendix Q - Avian Impact Assessment Appendix R - 2018 Bat Survey Report Appendix S - Bat Impact Assessment Appendix T - Benthic Assessment Attachment Appendix U - Essential Fish Habitat (EFH) Assessment

Table 1.1-1 BOEM Regulations for Developing a Construction and Operations Plan (continued)

BOEM Requirement	Location in COP
(6) Archaeological resources	Section 6 - Cultural Resources Appendix X - Marine Archaeological Resources Assessment Appendix Y - Terrestrial Archaeological Resources Assessment
(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 O - Economic Impacts of the Empire Wind Project (EW 1 and EW 2)
(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 F - Oil Spill Response Plan
30 CFR § 585.627(d)	
Safety management system	Appendix G - Safety Management System

1.2 Project Overview

Empire proposes to construct and operate the Project located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area). The Lease Area covers approximately 79,350 acres (ac) (32,112 hectares [ha]) and is located approximately 14 statute miles (mi) (12 nautical miles [nm], 22 kilometers [km])[3] south of Long Island, New York and 19.5 mi (16.9 nm, 31.4 km) east of Long Branch, New Jersey (**Figure 1.2-1**, below).

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

Empire proposes to develop the Lease Area in two wind farms, Empire Wind (EW) 1 and EW 2. EW 1 and EW 2 will be electrically isolated and independent from each other. EW 1 and EW 2 will, independently of one another, connect via offshore substations to separate Points of Interconnection (POIs) at onshore locations by way of export cable routes and onshore substations. In this respect, the Project includes two onshore locations in New York where the renewable electricity generated will be transmitted to the electric grid.

1.2.1 BOEM OCS Wind Energy Offshore New York Development

BOEM began evaluating offshore wind energy in the vicinity of the Lease Area in 2011 when it received an unsolicited request from the New York Power Authority (NYPA), Long Island Power Authority (LIPA), and Consolidated Edison (ConEd), referred to as the New York Offshore Wind Collaborative (the Collaborative). The proposal was for the installation of up to 194 3.6-megawatt (MW) wind turbines, yielding a potential 700 MW of wind energy generation in an 81,500 ac (32,982 ha) area located approximately 13 mi (11 nm, 21 km) off New York on the Outer Continental Shelf (OCS). Following receipt of the proposal, BOEM conducted the following:

- April 27, 2012 – BOEM notified the Collaborative of the USCG guidance recommending a 1 nm (1.85 km) minimum distance from the traffic separate scheme (TSS) lanes. In response, the Collaborative revised its commercial lease application to provide for additional buffer; however, this revised buffer did not result in a complete 1 nm (1.85 km) setback (NYPA 2012)[4].

- January 4, 2013 – BOEM issued a Request for Interest (RFI) to determine commercial wind facility interest within the area proposed by NYPA/LIPA/ConEd[5]. The RFI allowed interested parties to submit a notice of interest, as well as the public to submit comments on the Collaborative's proposal, the environmental consequences, and the use of the proposed location. During the comment period, 32 public comments were submitted, and two expressions of interest were received from two companies.

- May 28, 2014 – BOEM published a "Call for Information and Nominations" (Call) after determining that there was a competitive interest in the area proposed by the Collaborative[6]. The Call allowed additional companies who were interested in a commercial wind energy lease to be nominated, as well as for BOEM to seek public input on the potential for wind development in the Call Area. In response to the Call, BOEM received three additional nominations plus one additional qualifications package submission, for a total of six. An additional 27 public comments were submitted.

- On the same day (May 28, 2014), BOEM also published a Notice of Intent (NOI) to prepare an Environmental Assessment (EA) for commercial wind leasing and site assessment activities within the Call Area[7]. The NOI resulted in 32 public comments.

- March 16, 2016 – BOEM identified a Wind Energy Area (WEA) offshore New York, which consisted of the same OCS block and sub-blocks included in the unsolicited lease application, submitted by the Collaborative on September 8, 2011.

---

[4] Empire adopted a 1 nm buffer through the voluntary implementation of the layout rules.
[5] Potential Commercial Leasing for Wind Power on the OCS Offshore New York, Request for Interest, 78 Fed. Reg. 3
[6] Commercial Leasing for Wind Power Development on the OCS Offshore New York – Call for Information and Nominations (Call), 79 Fed. Reg. 102
[7] Potential Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic OCS Offshore New York, 79 Fed. Reg. 102

- June 6, 2016 – BOEM published the EA[8]. In response to stakeholder requests, the public comment period was extended until July 13, 2016. The EA received 51 public comments.

- On the same day (June 6, 2016), BOEM published a Proposed Sale Notice (PSN) for Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore New York[9]. The PSN received 403 public comments during the 60-day public comment period.

- October 27, 2016 – BOEM published the Final Sale Notice.[10].

- October 31, 2016 – BOEM published a Notice of Availability for a revised Environmental Assessment.[11] Within the EA, BOEM issued a "Finding of No Significant Impact," which concluded that reasonably foreseeable environmental effects associated with the activities that would likely be performed following lease issuance (e.g., site characterization surveys in the WEA and deployment of meteorological buoys) would not significantly impact the environment (BOEM 2016). In response to the public comments BOEM received on the original EA, five aliquots (approximately 1,780 ac [720 ha]) were removed from the northwestern portion of the initial WEA due to concerns over the sensitive habitat on Cholera Bank.

- December 15-16, 2016 – the lease sale for an area offshore New York, or the "New York Lease Area" was held by BOEM, pursuant to 30 CFR § 585.211. Statoil Wind US LLC (subsequently renamed to Equinor Wind US LLC in 2018) was awarded Lease Area OCS-A 0512.

1.2.2 BOEM Renewable Energy Lease OCS-A 0512

The Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0512 (Lease) for 79,350 ac (32,112 ha) went into effect on April 1, 2017. Statoil Wind US LLC changed its name to Equinor Wind US LLC on May 16, 2018, and updated the name with BOEM in accordance with the agency's requirements. Equinor Wind US LLC assigned the Lease to Empire Offshore Wind LLC on January 27, 2021 in accordance with BOEM's requirements. Therefore, the COP and associated attachments refer to Empire Offshore Wind LLC as the Lease holder. However, it should be noted that some technical reports and survey reports that were completed prior to the name change and the lease assignment still refer to Statoil or Equinor Wind[12]. Reports, studies, and other documentation bearing the name of Statoil Wind US LLC or Equinor Wind should be generally understood to be prepared for Empire, the proponent of this COP and current lessee for OCS-A 0512. Following issuance of the Lease, Empire 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 October 10, 2017. BOEM approved the request on November 13, 2017, extending the Preliminary Term from April 1, 2018 to April 1, 2019.

[8] Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic OCS Offshore New York; MMAA104000, 81 Fed. Reg. 108
[9] Atlantic Wind Lease Sale 6 (ATLW–6) for Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore New York—Proposed Sale Notice, 81 Fed. Reg. 108
[10] Atlantic Wind Lease Sale 6 (ATLW–6) for Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore New York—Final Sale Notice, 81 Fed. Reg. 210
[11] Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York; MMAA104000, 81 Fed. Reg. 210
[12] In addition, references to Empire generally include or also refer to the predecessor in interest to Lease OCS-A 0512, Equinor Wind US LLC, except where specifically noted.

As required by Addendum C, Lease Stipulation 2.1.1, Empire submitted a High Resolution Geophysical (HRG) and Geotechnical Survey Plan to BOEM on November 17, 2017, to conduct site characterization surveys of the Lease Area and submarine export cable routes. The Survey Plan was deemed satisfactory by BOEM on February 27, 2018, with survey work commencing in March 2018 through November 2018. A second survey campaign in 2019 was required to complete the scope of work and was conducted between May and August 2019. The results of the survey will be presented in detail in **Appendix H Marine Site Investigation Report**.

On June 18, 2018, Empire submitted its Site Assessment Plan (SAP). BOEM determined the proposed facility to be "not complex or significant" and deemed the SAP complete and sufficient on August 22, 2018. The SAP was approved by BOEM on November 21, 2018, allowing for the installation of two Floating Light Detection and Ranging (floating LiDAR) Buoys, a wave and meteorological buoy, and a subsurface current meter mooring in the Lease Area[13]. The Metocean Facilities were deployed on December 1, 2018, and collected wind profile and metocean data for an approximate two-year period. The first floating LiDAR buoy, deployed in December 2018, is located in the central part of the Lease Area (40° 17.650' N; 73° 19.382' W). On July 7, 2019, the Project deployed a second floating LiDAR buoy in the western half of the Lease Area (40° 21.610' N; 73° 30.100' W). The Metocean Facilities were decommissioned on December 28, 2020.

A second Geotechnical Survey Plan was submitted to BOEM on December 14, 2018 and proposed borings and Cone Penetration Tests (CPTs) spread across the Lease Area. The Survey Plan was deemed satisfactory on April 4, 2019, and survey activities commenced in June 2019 and completed in July 2019. The results of the survey will be presented in detail in **Appendix H**.

A third Geotechnical Survey Plan was submitted to BOEM on January 8, 2020 to conduct further geotechnical investigations, including CPTs and vibracore sampling, across the Lease Area to inform both Project design and engineering for both EW 1 and EW 2. BOEM approved the Plan on June 17, 2020, with survey work commencing in June 2020. Data acquired through this field program will be provided in the Facility Design Report (FDR) and the Fabrication and Installation Report (FIR).

Empire submitted a second HRG and Geotechnical Survey Plan to BOEM on January 17, 2020, to conduct additional HRG, geotechnical and remote operating vessel survey activities along the submarine export cable routes and within additional areas for siting in New York Harbor (e.g., temporary mooring). This Survey Plan was approved by BOEM on August 31, 2020, with survey work commencing in the fall of 2020 and continuing into 2021. These surveys will inform overall Project design and engineering and allow for siting flexibility. Data acquired through this field program will be provided in the FDR/FIR or as COP supplemental filings, as required, for the Project.

A fourth Geotechnical Survey Plan was submitted to BOEM on December 14, 2020 to conduct further geotechnical investigations, including CPTs and vibracore sampling, across the Lease Area to inform both Project design and engineering for EW 1 and EW 2. Data acquired through this field program will be provided in the FDR/FIR. BOEM approved the Plan on March 22, 2021, with survey work commencing in early summer 2021.

Empire and the prior leaseholder, Equinor Wind, have remained in compliance with all Lease stipulations throughout the life of the Lease. **Table 1.2-1** details the relevant Lease Conditions and how Empire has and will continue to comply.

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

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".	Empire agrees to and will 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.	Empire agrees to and will 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.	Empire agrees to and will comply with this condition. In this COP, Empire is requesting that BOEM issue two (2) project easements for the portions of the submarine export cable routes located in federal waters.

Table 1.2-1 Summary of Lease Stipulations (continued)

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.	Empire agrees to and will 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.	Empire agrees to and will 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 § 585, the Lessee must remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the sea floor 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 § 585.	Empire agrees to and will comply with this condition.
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 § 585 and orders from the Lessor and other Federal agencies with	Empire agrees to and will comply with this condition.

Table 1.2-1 Summary of Lease Stipulations (continued)

Lease Stipulations	Description	Statement of Compliance / COP Document Location
	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.	
Section 15: Debarment Compliance	The Lessee must comply with the Department of the Interior's (DOI's) non-procurement debarment and suspension regulations set forth in 2 CFR §§ 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.	Empire agrees to and will 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 § 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.	Empire agrees to and will comply with this condition.
Addendum B - Lease Term and Financial Schedule; Section– III - Payments:	Unless otherwise authorized by the Lessor in accordance with the applicable regulations in 30 CFR § 585, the Lessee must make payments as described below (see Lease document for payment schedule).	Empire agrees to and will comply with this condition.

1.2.3 Proposed Activities

This COP covers the Lease Area, and as such will address the proposed development of the Lease Area, both from the Project elements and the means and methods used for installing and operating the facilities and from the potential positive and adverse effects. As discussed in **Section 1.3 Design Envelope Approach**, the Project has adopted a Project Design Envelope (PDE) approach that consists of the components listed below. The PDE applies to the Lease Area and for both EW 1 and EW 2, as the range within the PDE is reasonably foreseeable for both EW 1 and EW 2. In addition, Empire has surveyed and/or assessed resources and effects for the Lease Area to the same level for both EW 1 and EW 2. For a full review of the PDE, please see **Section 3 Project Description.**

Project components in the Lease Area include:

- Up to 174 wind turbines and supporting tower structures;
- Two offshore substations;
- Up to 176 foundations and associated support and access structures (for aforementioned wind turbines and offshore substations);
- Up to 260 nm (481 km) of interarray cable (up to 116 nm [214 km] for EW 1 and up to 144 nm [267 km] for EW 2); and
- Up to 66 nm (122 km) of submarine export cables, consisting of two routes:
  - Up to 40 nm (74 km) to the Empire Wind (EW) 1 landfall, of which 24 nm (44 km) is in federal waters and 16 nm (30 km) in state waters; and
  - Up to 26 nm (48 km) to the EW 2 landfall, of which 18 nm (33 km) is in federal waters and 8 nm (15 km) is in state waters.

Project components onshore include:

- Up to three export cable landfall areas (one at EW 1 and up to two at EW 2):
  - EW 1 Landfall; and
  - EW 2 Landfall A (Riverside Boulevard), EW 2 Landfall B (Monroe Boulevard), EW 2 Landfall C (Lido Beach West Town Park), and/or EW 2 Landfall D (Lido Beach Town Park);
- Up to three onshore export and interconnection cable routes, consisting of one at EW 1 and up to two at EW 2:
  - EW 1 interconnection cable route of up to 0.2 mi (0.4 km); and
  - EW 2 onshore export and interconnection cable route of up to 5.7 mi (9.2 km), for a single onshore export cable and interconnection route (up to two routes proposed); and
- Two onshore substation locations:
  - EW 1 onshore substation in Brooklyn, New York; and
  - EW 2 onshore substation A or EW 2 onshore substation B in Oceanside, New York.

Figure 1.2-1 through **Figure 1.2-3** depict the location of the proposed Project components offshore and onshore. **Section 3** provides a detailed description of the proposed Project components.

Apart from Empire's proposed Project activities, third parties may undertake work at their own ports and facilities, in part to support the offshore wind industry, potentially including the Project. Ports under consideration to support construction and staging activities include the South Brooklyn Marine Terminal, Howland Hook Marine Terminal (Howland Hook), and Homeport Pier. Upgrades and improvements by port facilities that may be utilized by Empire as construction and staging areas for the Project are not assessed within this COP as any such upgrades are the responsibility of the port facility owners. Port and construction and staging areas will be appropriately permitted and governed by applicable environmental standards; the use of these facilities by Empire in support of the proposed Project will be consistent with the existing facilities' activities for which these sites were permitted and developed.

1.2.4 Anticipated Construction Schedule

An anticipated construction schedule for the construction and development of the Lease Area is provided in **Figure 1.2-4**. The schedule assumes that construction will start approximately in Q3 2023, initiated with onshore construction activities. The schedule anticipates that construction of EW 1 and EW 2 will be sequential, but may overlap during onshore construction and during installation of the submarine export cables (see Section 3.4.1.4 for additional information on the potential overlap of construction and installation activities for the submarine export cables). Construction schedules are subject to various factors, for example, state and federal permitting, financial investment decisions, power purchase contracts, and supply chain considerations.

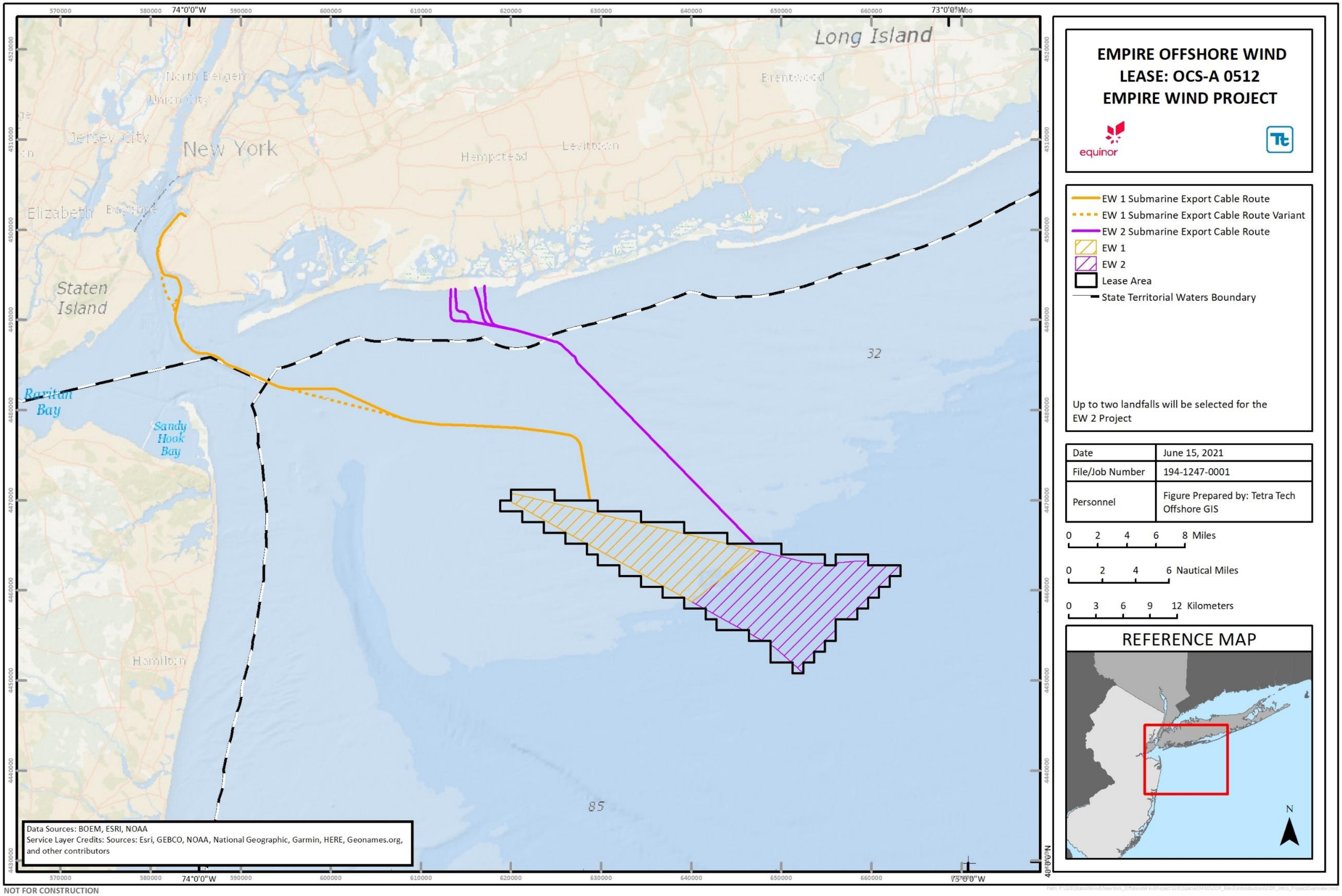


Figure 1.2-1 Project Overview (Lease Area and Submarine Export Cable Routes)

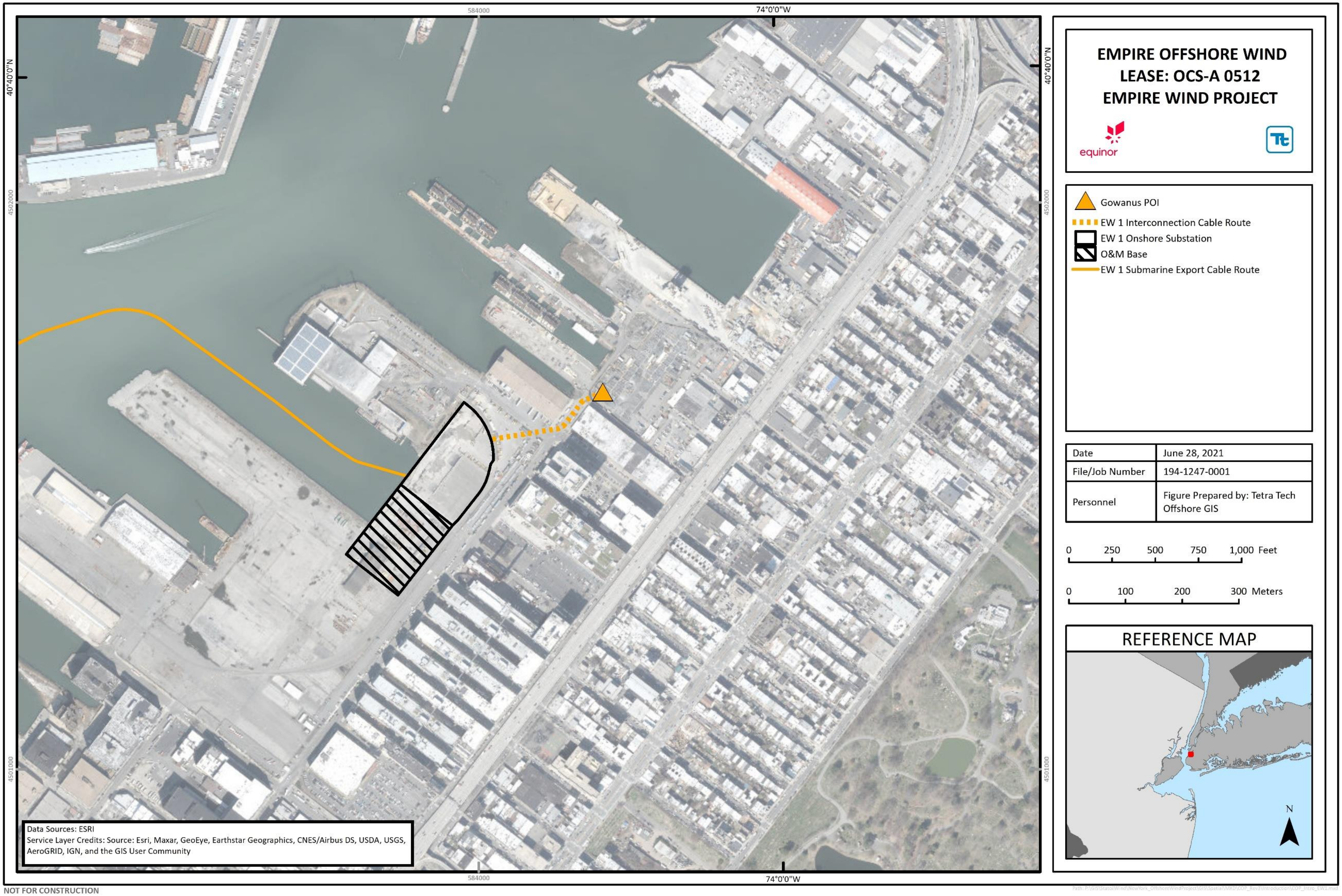
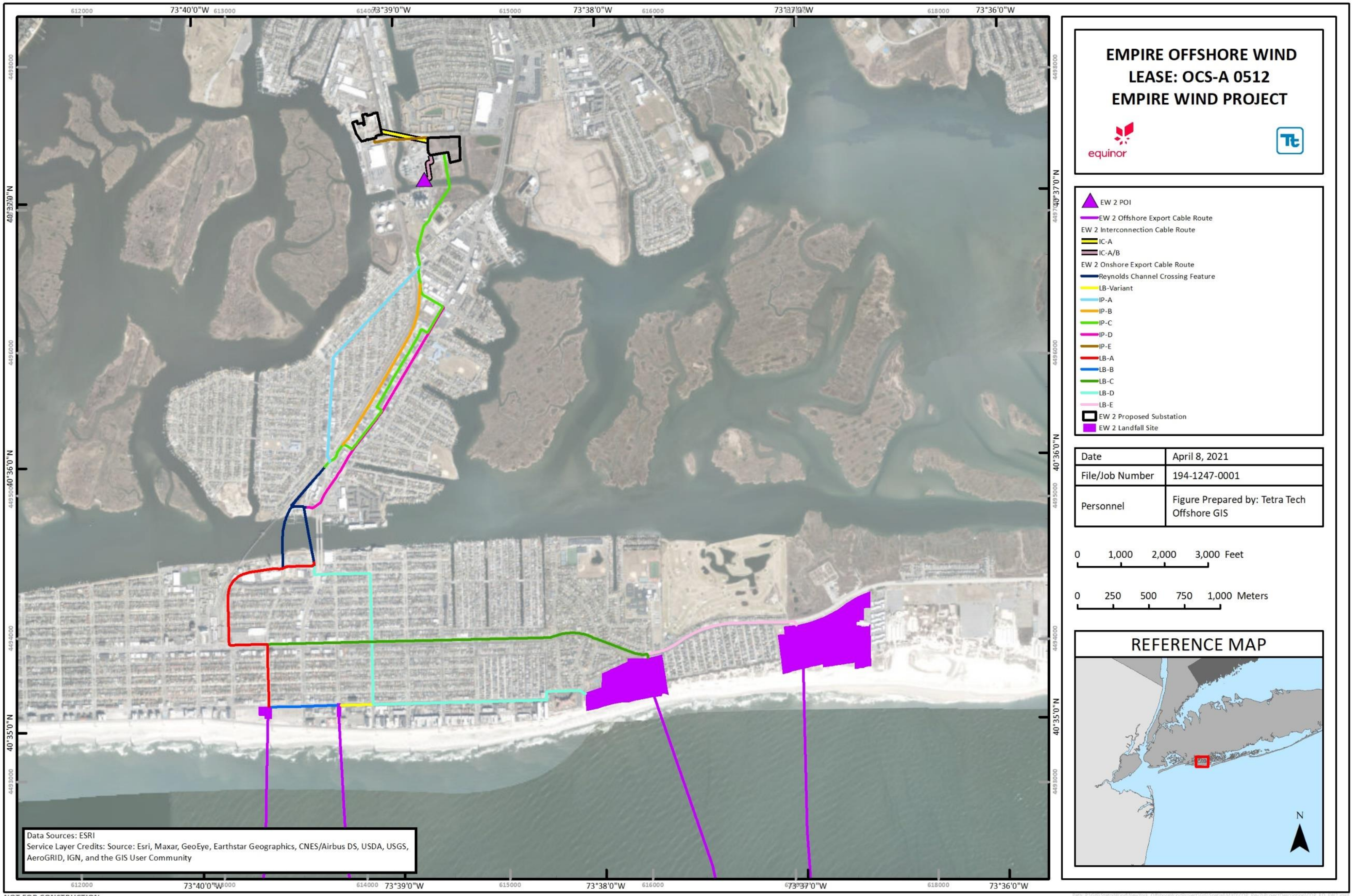


Figure 1.2-2 EW 1 Submarine Export Cable Route and Interconnection Cable Route



NOT FOR CONSTRUCTION

Figure 1.2-3 EW 2 Submarine Export Cable Route and Onshore Export and Interconnection Cable Route

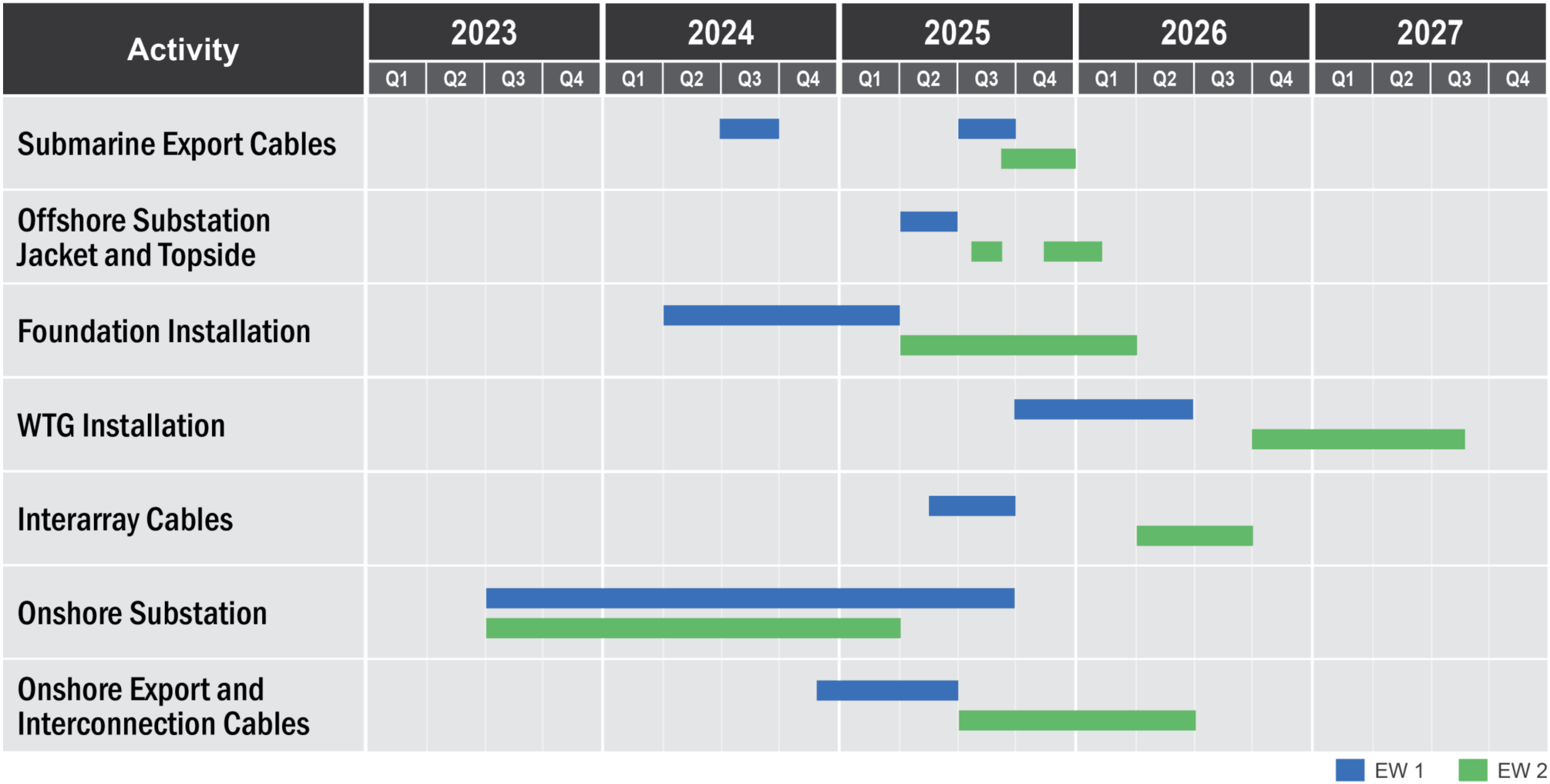


Figure 1.2-4 Anticipated Construction Schedule

1.3 Design Envelope Approach

Development of an offshore wind facility is an extensive and complex process spanning several years. As such, it is not possible to establish a final form of development at the time of the COP submittal. In Europe, it is an accepted practice for offshore wind farm projects to present a range of potential final design parameters through a maximum design scenario approach to the assessment. This is achieved by assessing the maximum parameters for key components (e.g., wind turbines, foundations, and installation methodologies) within which the Project will be limited. By assessing the 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 term used to describe the process and set of parameters adopted for a specific project is sometimes referred to as a "design envelope approach."

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 evolving, and the flexibility to take advantage of industry advancements and innovative technologies as a project progresses through development is critical to ensuring that the most technologically sound, environmentally appropriate, and cost-effective project is constructed. In addition, as projects progress through the permitting process and ongoing consultations, flexibility is needed to be able to effectively apply feedback, new design data, and permitting conditions placed on the project.

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 that represents the maximum design scenario for each unique resource (BOEM 2017).

The definition of what is considered the maximum design scenario varies based on the potentially impacted resource and is provided at the beginning of each section within **Volume II Site Characterization and Assessment of Impact-Producing Factors**; the Maximum Project Design Scenario, a full Lease Area build-out, is also detailed in **Section 3.** For example, while both GBS and monopile foundations are included in the application, the GBS foundation would not be the maximum design scenario for underwater acoustic impacts. Similarly, the monopile foundation would not be the maximum design scenario for benthic impacts. In this case, the assessment would identify and describe the greatest impact associated with that resource (i.e., GBS foundation for benthic and monopile foundation for underwater acoustic). Empire will continue to evaluate detailed design and engineering studies in order to identify conditions and the Project components that would be best suited to the Lease Area. Once regulatory permissions have been obtained, the FDR/FIR will be submitted to BOEM. These reports must be reviewed by the selected project Certified Verification Agent (CVA) prior to the commencement of any fabrication or construction activities.

Based on discussions with BOEM conducted in July 2018 and March 2019 and Empire's experience with this approach on previous projects, Empire has developed a PDE as summarized in **Table 1.3-1**. The PDE has been revised and updated as the Project has developed. Details regarding the PDE for the Project Area are provided in **Section 3** and are applicable to both EW 1 and EW 2.

Table 1.3-1 Summary of PDE Parameters

Parameter	EW 1	EW 2	Total
Type of foundation (wind turbines)	gravity based structure (GBS), monopile	GBS, monopile	GBS, monopile
Type of foundations (offshore substations)	Piled jacket	Piled jacket	Piled jacket
Number of foundations	72	104	176
Number of offshore substations	1	1	2
Number of wind turbines	71	103	174
Rotor diameter	853 feet (ft, 260 meters [m])	853 ft (260 m)	853 ft (260 m)
Hub height	525 ft (160 m)	525 ft (160 m)	525 ft (160 m)
Upper blade tip height	951 ft (290 m)	951 ft (290 m)	951 ft (290 m)
Voltage of interarray cables	66 kilovolts (kV)	66 kV	66 kV
Total length of interarray cables	116 nm (214 km)	144 nm (267 km)	260 nm (481 km)
Voltage of submarine export cables	230 kV	230 kV	230 kV
Total length of submarine export cables	40 nm (74 km)	26 nm (48 km)	66 nm (122 km)

1.4 Purpose and Need for the Project

The purpose of the Project is to generate renewable electricity from an offshore wind farm(s) located in the Lease Area to address the need identified by New York for renewable energy and help the State of New York Public Service Commission achieve their renewable energy goals.

In August 2016, the State of New York Public Service Commission adopted the Clean Energy Standard.[14] Under this standard, 50 percent of New York State's electricity must come from renewable sources of energy by 2030, with 2.4 gigawatts (GW) of electricity generated by offshore wind. In January 2019, Governor Cuomo proposed a plan that would require 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 July 2019, Governor Cuomo signed the Climate Leadership and Community Project Act, which adopts a comprehensive climate and clean energy legislation and advances his mandate of 9 GW of offshore energy by 2035. On November 8, 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. On July 18, 2019, New York's Governor Cuomo announced Empire and its 816-MW EW 1 Project as a winning bidder in the State's competitive solicitation for Offshore Wind Renewable Energy Credits. On July 21, 2020, Governor Cuomo announced New York's second offshore wind procurement under which NYSERDA is seeking up to 2,500 MW of offshore wind. On January 13, 2021, Governor Cuomo announced Empire and its 1,260-MW EW 2 Project as a winning bidder in the State's competitive solicitation for Offshore Wind Renewable Energy Credits.

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

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.

As the federal agency charged with issuing the OCS Lease and reviewing and, as appropriate, authorizing the COP, BOEM will serve as the lead federal agency throughout the permitting process. 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 the National Environmental Protection 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 governing regulatory driver 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**. A detailed list of the approvals Empire will request from each federal agency, the anticipated submittal date, and the anticipated authorization date is provided in **Table 1.5-2**.

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 consult with other environmental resource agencies, including the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Environmental Protection Agency (EPA), to comply with a variety of federal regulations, including the Endangered Species Act of 1973 (ESA), the Bald and Golden Eagle Protection Act of 1940, the Marine Mammal Protection Act of 1972 (MMPA), and the Magnuson-Stevens Fishery Conservation and Management Act of 1976 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), National Historic Preservation Act of 1966 (NHPA), and Sections 401, 402, and 404 of the CWA, are properly implemented (see **Table 1.5-1**, below).

Per the Council on Environmental Quality's (CEQ's) NEPA regulations (40 C.F.R. § 1501.10(b)(2)), federal agencies shall complete an EIS within two years, measured from the date of the issuance of the Notice of Intent to the date a Record of Decision is signed.

On April 2, 2020, Empire submitted a Fixing America's Surface Transportation Act (FAST)-41 Initiation Notice to the DOI, requesting to initiate the Empire Offshore Wind: Empire Wind Project (EW 1 and EW 2) COP under the FAST-41 process. The Project was initiated as covered under a FAST-41 on April 20, 2020.[15] Through the FAST-41 process, BOEM will develop an agreed-upon timeline with all cooperating agencies, including the timeline for issuance of all federal authorizations.

1.5.2 CZMA Review

The CZMA 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 by the state before these authorizations can be issued.

As the Lease Area is geographically located nearest the coast of New York and certain project elements occur within New York State waters, a consistency determination with the New York Coastal Management Program will be required. Empire also proposes to file a voluntary consistency determination with the State of New Jersey due to the geographic proximity of the Lease Area. For a summary of applicable enforceable policies under the CZMA, please see **Appendix A Coastal Zone Management Consistency Statement**. This information is available for both of the states mentioned above and provides an evaluation of how the applicable aspects of the Project will be consistent with each policy, as well as cross references to specific sections of the COP where the policy is addressed, in accordance with the "consistency" requirement of the CZMA (16 United States Code [U.S.C.] § 1456), as well as 307(c)(3)(A) and 15 CFR § 930.

1.5.3 State and Local Permits, Approvals, and Consultations

As Project components are proposed in the State of New York, approvals from the applicable state and local agencies will also be required. Due to the geographic proximity of the Lease Area to the state of New Jersey, certain consultations with the applicable state agencies will be required.

New York Public Service Law defines a major electric transmission facility as any project "with a design capacity of 100 kilovolts (kV) or more extending for at least 10 miles, or 125 kV and over, extending a distance of one mile 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. The Article VII process is the primary state environmental review and approval for the Project.

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

[15] Additional information on the FAST-41 process and the status of the Empire Offshore Wind: Empire Wind Project (EW 1 and EW 2) can be found on the Permitting Dashboard at: https://www.permits.performance.gov/permitting-project/empire-wind-energy-project.

Table 1.5-1 Federal, State, and Local Authorizations and Consultations

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
Federal				
BOEM	Outer Continental Shelf Lands Commercial Lease, SAP, and COP	OCSLA 43 U.S.C. § 1337 Energy Policy Act of 2005	BOEM Final Rule on Renewable Energy Development on the OCS 30 CFR § 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 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.

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
NOAA's National Marine Fisheries Service (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 NOAA Fisheries 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 NOAA Fisheries 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.
	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 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 NOAA Fisheries regarding the potential effects of their actions on EFH.
USFWS Northeast Region (Region 5)	ESA Consultation	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. Consultation is necessary to determine the potential of the project to affect federally listed rare, threatened, or endangered species. A project proponent may choose to apply for coverage under an Incidental Take Permit (ITP) if the USFWS determines that any new offshore turbines or onshore transmission lines for the cable interconnection may result in a take.

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
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.
USCG, Sector New York, Sector Long Island Sound, First District, and Fifth District	Approval for 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 the Atlantic Coast Port Access Route Study (ACPARS) to determine future shipping lanes and port access routes. At this time, the implementation plan for the draft ACPARS fairways is unknown. In addition, the USCG posted a notice of study and public meetings for a Port Access Route Study (PARS) for the Northern New York Bight. The USCG should be consulted regarding preferred buffer zones to TSS, any final ACPARS routes, and any developments associated with the Northern New York Bight PARS should any routes be delineated.

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
				Request for a LNM is appropriate prior to construction. The request is generally made about 2 weeks prior to commencement of activity.
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 potential cable routes across sensitive military areas.
EPA, Region 2, Air Programs Branch	OCS Air Quality Permit and General Conformity Determination	Clean Air Act; 42 U.S.C. § 7627.	40 CFR § 55	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 facility 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

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
				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.
New York[16]				
New York State Public Service Commission	Certificate of Environmental Compatibility and Public Need under Article VII	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 401 New York Environmental Conservation	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.

[16] Export cable landfall and the onshore export and interconnection cable route(s) associated with EW 2 may require "alienation" or "conversion" of parkland with approval by the municipality and the New York State Legislature.

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
		Law (ECL) Article 15, Title 5		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.
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.
New York State Department of Environmental Conservation (NYSDEC)	State Pollutant Discharge Elimination System (SPDES) Construction Stormwater Permit	CWA Section 402 New York ECL Article 17	6 NYCRR Part 182	Before commencing construction activity that will involve soil disturbance of one or more acre, Empire must obtain coverage under the SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-20-001, effective January 29, 2020).
	Incidental Take Permit (ITP)	New York ECL Article 11	6 NYCRR § 182	An ITP is required for any activity that is likely to result in the take or taking of any species listed as endangered or threatened, as determined by NYSDEC. Taking is defined to include not only the direct killing of listed species, but

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
				also actions that are expected to result in harm to individuals, including adverse impacts to habitats occupied by listed species. For Project components that do not fall under Article VII jurisdiction, including temporary mooring of foundations, transit of GBS foundations from Port of Coeymans, and transit of towers and transition pieces from Port of Albany, an ITP will be sought if necessary.
New York State Office of Parks, Recreation, and Historic Preservation, SHPO	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 Tribal Historic Preservation Offices 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 State Department of Transportation (NYSDOT)	*(If applicable)* Highway Work Permit	New York State Highway Law, Article 3, Section 52	17 NYCRR § 131	Construction and installation of facilities, or repairs and maintenance, on any part of the state highway system, its properties, or ROWs, requires a permit.
	Exemption to Accommodation Plan for Longitudinal Use of Freeway Right-of-Way By Utilities		17 NYCRR § 131 23 CFR §§ 645.209, .211, .213. and .215	NYSDOT has an agreement with the Federal Highway Administration regarding how utilities are accommodated on controlled access highways; however, only communication utilities are permitted. Therefore, any request for a non-highway use of a controlled access highway (i.e., for construction and operation of the Project) is considered an exception to the Accommodation

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
				Plan and would require approval by the Federal Highway Administration.
New Jersey				
NJDEP, Historic Preservation Office	Review Procedures Under the New Jersey Register of Historic Places Act	New Jersey Register of Historic Places Act, New Jersey Statutes Annotated (N.J.S.A.) 13:1B-15.128 *et seq.*	New Jersey Register of Historic Places Act Rules, New Jersey Administrative Code (N.J.A.C.) 7:4, Readopted with Technical Changes (Effective July 2, 2015)	The review procedures under the New Jersey Register of Historic Places Act were established to ensure that properties listed in the New Jersey Register of Historic Places are considered during public actions by state, county, or local government entities, including the issuance of permit approvals. Projects that may impact New Jersey Register–listed properties must have prior written authorization from the Commissioner of the Department of Environmental Protection. The Historic Preservation Office administers the review procedures with public input and serves as staff to the New Jersey Historic Sites Council.
	Consultation under Section 106 of the NHPA	16 U.S.C. § 470	36 CFR § 800	The Historic Preservation Office consults with federal agencies in identifying historic properties and avoiding or minimizing any potential adverse effects from federally funded, licensed, or permitted projects in New Jersey. Section 106 is administered nationally by the ACHP, which must be provided a reasonable opportunity to comment on such federal undertakings.
NJDEP, Coastal Management Program	Concurrence with Federal Coastal Zone Consistency Determination	CZMA	State Coastal Zone Management rules, N.J.A.C. 7:7, the Freshwater Wetlands Protection Act Rules, (N.J.A.C.	In the United States, coastal areas are managed through the CZMA. This law authorizes individual states to develop plans that incorporate the strategies and policies they will employ to manage development and use of coastal land and water areas. Each plan must be approved by NOAA. One of the components of an approved plan is enforceable policies; that is, state policies that are legally binding and by which a state exerts control over coastal uses and resources.

Table 1.5-1 Federal, State, and Local Authorizations and Consultations (continued)

Regulatory Agency	Permit or Approval	Statutory Basis	Regulations	Applicability
			7:7A), Stormwater Management rules, (N.J.A.C. 7:8), New Jersey Pollutant Discharge Elimination Systems rules, (N.J.A.C. 7:14A, Subchapters 1, 2, 5, 6, 11, 12, 13, 15, 16, 18, 19, 20, 21, 24 and 25)	Empire intends to voluntarily submit a Consistency Determination to the NJDEP for the portions of the Project in federal waters.

Table 1.5-2 Summary of Federal Authorizations and Permitting Timeline

Agency	Authorization	EW 1/EW 2	Anticipated Submittal	Anticipated Authorization
USACE	Individual Permit	EW 1	June/July 2022	August 2023
		EW 2	June/July 2022	August 2023
NOAA Fisheries	Incidental Take	EW 1 and EW 2	March 2022	Early 2024
USCG	PATON	EW 1	August 2023	November 2023
		EW 2	August 2023	November 2023
EPA	OCS NOI	EW 1 and EW 2	March 2022	June 2022 – September 2022
	OCS Air Permit	EW 1 and EW 2	September 2022	September 2023

1.6 Agency and Public Outreach

Since execution of the Lease in 2017, Empire has been and continues to be engaged in extensive outreach with (including but not limited to) federal, state, tribal, and local officials; organizations; fishermen; shipping and navigation organizations; and other important stakeholders to discuss the Project. At these meetings, Empire 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. Empire also receives feedback regarding survey plans, site design (i.e., wind turbine layout), and mitigation. The agency coordination and meetings conducted on behalf of the Project are summarized in **Appendix B Summary of Agency Engagement**. Consistent with Lease stipulations, Empire also engaged informally with Native American Tribes, including the Shinnecock Indian Nation, to discuss activities specific to the Lease Area.

With regards to non-regulatory stakeholders, Empire has developed and continues to implement a dedicated public outreach program. Through this program, Empire is able to work with and address concerns from various interests, including local communities, environmental groups, fishing communities, maritime groups, and recreational boating groups. Empire has engaged in communications with these groups through various forums such as informational meetings, press releases, website promotion, information gathering sessions, and workshop participation. Additional information regarding engagement with the maritime community, fishing community, and other stakeholders is provided in **Section 8.8 Commercial and Recreational Fishing, Section 8.7 Marine Transportation and Navigation,** and **Appendix DD Navigation Safety Risk Assessment**.

Empire 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, 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, and local agencies, elected officials, and other potentially interested stakeholders to identify issues;
- Holding a series of public open houses in partnership with NYSERDA from September 9, 2019 to September 25, 2019, in seven locations throughout New York, to provide information about Empire and offshore wind projects; and
- Continuing to maintain Project-specific web sites with information on the status of the Project (https://www.equinor.com/en/what-we-do/empirewind.html) 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.

As part of Empire's continued stakeholder communications and public outreach plans, Empire would be happy to set up discussions with any interested party (see **Section 1.8** for contact information).

1.7 Company Overview

Empire is a direct, wholly owned subsidiary of Empire Offshore Wind Holdings LLC ("Empire HoldCo"). Empire 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 interests in Empire HoldCo in a transaction that closed on January 29, 2021.

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 $50 billion[17]. With an extensive portfolio of offshore wind, oil, and gas facilities developed over its 40-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 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 that 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 Lease OCS-A 0512 in New York representing the company's first significant U.S. offshore wind investment. Beacon Wind LLC, an affiliate of Equinor and BP, also holds Lease OCS-A 0520, located offshore New England, which was acquired in 2018.

Additional information on Equinor can be found on their website: www.equinor.com.

[17] As of September 2020.

1.8 Authorized Representative

Equinor Wind will be the operator of the Project. The contact information for the Authorized Representative for the Project is:

Matthew Brotmann
Secretary
Equinor Wind US LLC
120 Long Ridge Road #3E01
Stamford, Connecticut 06902
Email: mbrot@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 Empire nominated to serve as the CVA on June 26, 2020 (see **Appendix C Certified Verification Agent**).

1.10 Financial Assurance

In accordance with 30 CFR § 585.516, Empire is required to provide BOEM a supplemental bond, a decommissioning bond, or other financial assurance 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.

Equinor has a strong financial standing and a long history of undertaking, self-funding, or obtaining, the necessary financing for large infrastructure projects in a responsible manner. Empire is prepared to demonstrate its financial strength, as required by 30 CFR § 585.527 during the COP 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 Project design and development process. The final selection of design standards is not completed, but at this stage of the Project Empire has established a preliminary Hierarchy of Standards, which will be provided as **Appendix D Preliminary Hierarchy of Standards**.

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). 2016. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York*. United States Department of the Interior Office of Renewable Energy Programs, Bureau of Ocean Energy Management. October 21, 2016. Available online: https://www.boem.gov/NY-EA-FONSI-2016/. Accessed September 25, 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.

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.

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. Available online: https://www.boem.gov/COP-Guidelines/. May 2020. Accessed July 23, 2020.

NYPA (New York Power Authority). 2012. "Long Island – New York City Offshore Wind Project Amendment to Unsolicited Commercial Lease Application." Personal communication from NYPA to BOEM. Available online: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/NYPA%20to%20BOEM%20amending%20application%2006202012.pdf. Accessed September 14, 2020.

NYSERDA (New York State Energy Research and Development Authority). n.d. Clean Energy Standard. Available online: https://www.nyserda.ny.gov/All%20Programs/Programs/Clean%20Energy%20Standard. Accessed December 6, 2018.

2. PROJECT DESIGN DEVELOPMENT

2.1 Project Siting

This section presents a description of the development and evolution of the PDE as conducted by Empire. The evolution 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 agency outreach and engagement is provided in **Appendix B Summary of Agency Engagement**). Where existing public data was available, this was also used to inform the siting assessment. The following sections document the criteria used in evaluating various alternatives and refining the components that define the PDE. Wind turbine sizing and spacing is addressed in **Section 3 Project Description**.

2.1.1 Selection of Points of Interconnection

The initial assessment revolved around identifying the preferred POIs at existing substations to support two independent wind farms with interconnection in New York. Empire evaluated 30 POI options in the New York Independent System Operator (NYISO) system. High-voltage substations were reviewed using the following criteria:

- Deliverability of energy;
- Land to accommodate additional equipment (and that avoids sensitive environmental and cultural resources);
- Proximity to shore;
- Complexity of the associated submarine export cable route;
- Configuration of existing equipment;
- Availability of spare bays and feeder positions; and
- Overhead line constraints and configurations.

Preliminary POIs in New York were evaluated against these criteria through electrical studies as well as site visits to verify feasibility for the Project. Additionally, a high-level assessment was completed in evaluating various offshore constraints and how export cables would be routed to reach the selected POIs. Based on the criteria summarized above, a subset of five onshore substation sites in New York were advanced for further analysis. The remaining POIs under evaluation were not advanced as they did not sufficiently satisfy the criteria identified above. The POIs selected for further analysis are identified in **Figure 2.1-1** and include:

- Gowanus 345-kV Substation, New York;
- Oceanside 138-kV Substation, New York;
- Ruland Road 138-kV Substation, New York;
- Pilgrim 138-kV Substation, New York; and
- Brookhaven 138-kV Substation, New York.

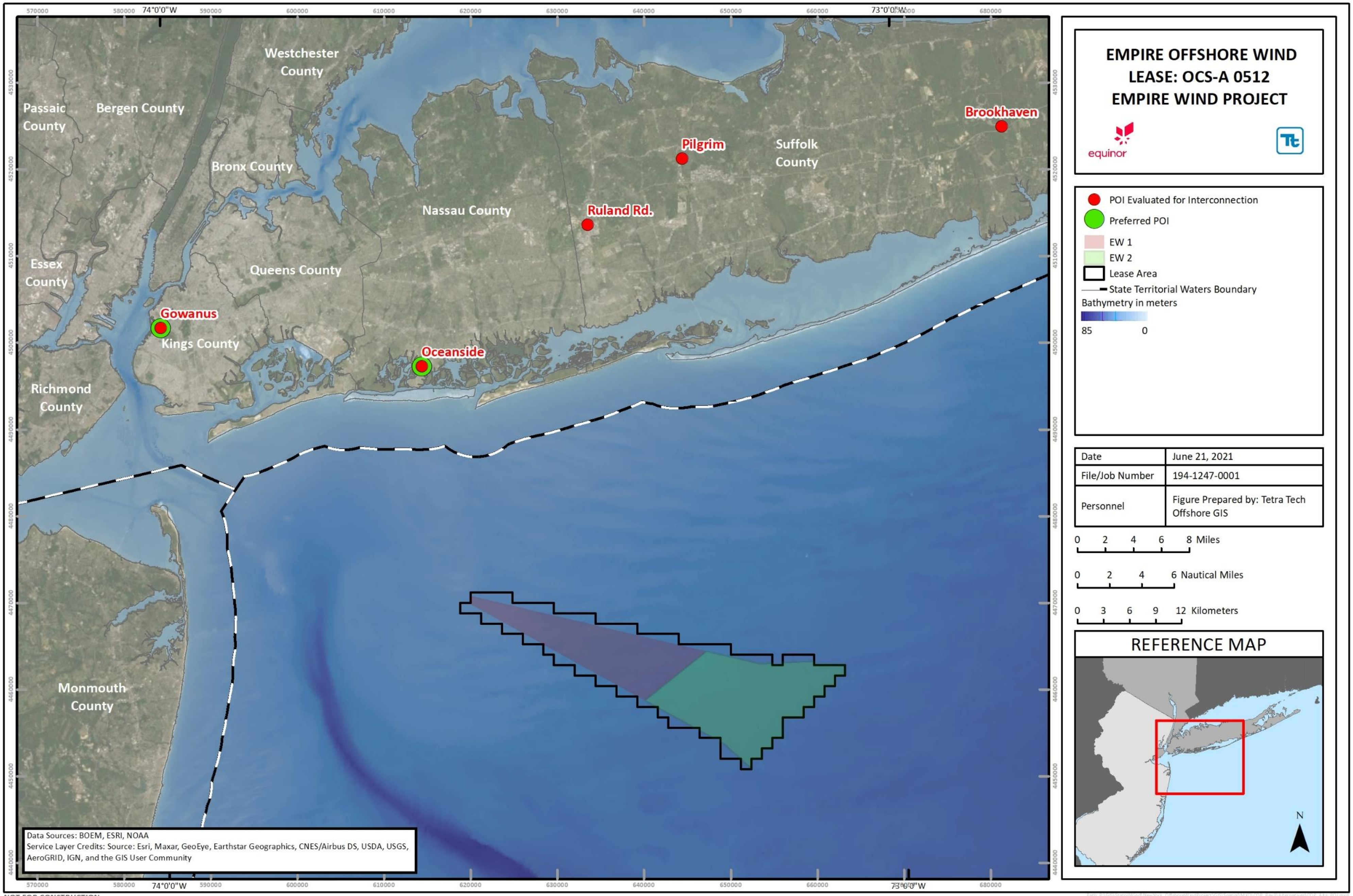


Figure 2.1-1 POI Evaluation

These five sites were subjected to further detailed evaluation of potential offshore cable routing, length and complexity of potential onshore cable routing, landfall construction options, environmental resource presence, residential areas, and potential stakeholder concerns. Based on the analysis completed, the Gowanus and Oceanside substations were identified as the preferred POIs to support delivery of energy from two independent wind farms. Other substations evaluated as potential POIs would result in greater disturbance due to distance from the shore, complexity in submarine export cable routing, complexity in onshore export cable routing, feasibility and constructability challenges for export cable landfall, and/or the potential for additional impacts to environmental resources and/or residences in proximity. As such, these two preferred POIs were selected as the end points for the further development and assessment of two independent wind farms. These two independent wind farms are referred to as EW 1 (connecting to the Gowanus POI) and EW 2 (connecting to the Oceanside POI).

2.1.2 Siting Assessment Overview

This section details the siting assessment completed for EW 1 and EW 2 associated with the preferred POIs. Empire evaluated the submarine export cable route, onshore substation location, export cable landfall, and onshore export cable route to interconnect with each POI relative to constructability, reliability, environmental resource, and stakeholder impact criteria. Although each component is discussed separately, it is important to recognize that the siting process was completed holistically relative to submarine and terrestrial constraints to identify the most feasible and least impactful overall solution to deliver energy from the Project to the grid.

2.1.2.1 Submarine Export Cable Routing

An offshore routing constraints analysis was conducted to identify potential submarine export cable routes, evaluate routing feasibility, and understand any significant challenges (**Figure 2.1-2**). As discussed in Section 2.1.1, the potential challenges and complexity of the submarine export cable routing was considered as part of the selection criteria for the preferred POIs. Following the identification of preferred POIs, the potential submarine export cable routes for EW 1 and EW 2 were further evaluated and refined considering the following criteria:

- Segment length;
- Installation constraints and complexity, including water depth, slopes, and seabed features;
- Ability to adequately bury and protect the cable;
- Avoidance or minimization of man-made hazards to cable installation and operations, and use conflicts (e.g., dredged and maintained channels, anchorages and de facto anchoring areas, vessel TSSs, existing utilities, charted danger zones, disposal areas, sand borrow areas);
- Avoidance of biological and cultural resources (e.g., eelgrass, shipwrecks); and
- Avoidance of high-use commercial and recreational fishing grounds.

An overview of how these selection criteria were used to identify and refine the submarine export cable route alternatives is provided in this section. Sections 2.1.3.1 and 2.1.4.1 provide detailed discussion of offshore constraints associated with route alternatives for each of the preferred POIs.

To the extent possible, the most direct route served as the starting point in developing the submarine export cable route. This is driven by technical constraints and costs, including cable costs, installation time, and limits associated with available and efficient high-voltage alternating-current (HVAC) transmission. Additional discussion regarding high-voltage direct-current (HVDC) as an alternative for cable technology is provided in Section 2.2.2.

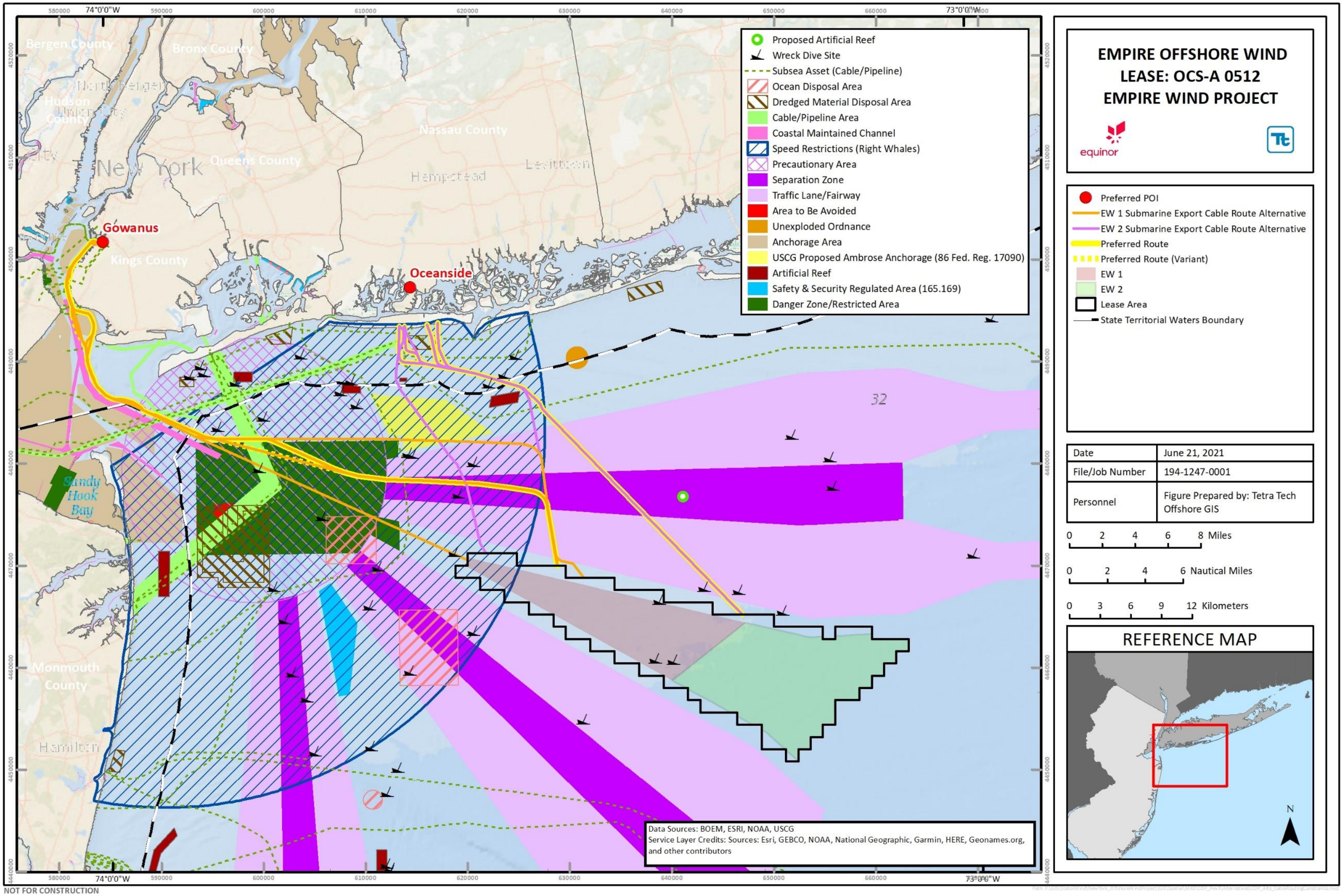


Figure 2.1-2 Submarine Export Cable Routing Constraints in the Project Area

The seafloor of the New York Bight is predominantly characterized as sand with isolated patches of gravel-sand and occasional outcropping and subcropping older, more indurated strata. Although generally flat-lying, the area contains sand ridges, filled valleys, shoal-retreat massifs, and paleo-shorelines, including the most prominent regional feature, the Hudson Shelf Valley (NYSERDA 2017). In general, the seabed throughout the area is expected to be relatively homogeneous and characterized by gentle seabed gradients.

During the BOEM planning process, an isolated topographic high, known for its value to commercial and recreational fishing, was identified to the northwest of the Lease Area; this area, called Cholera Bank, is a potentially sensitive feature. BOEM removed Aliquots F, G, H, K, and L of Block 6655 of the Lease Area prior to Lease Sale to actively avoid this feature (see **Section 1 Introduction** for additional details on the leasing process for Lease Area OCS-A 0512). Empire has avoided submarine export cable routes through the area near Cholera Bank, immediately northwest of the Lease Area, due to the benthic habitat and the fishing effort this area receives. While early route alternatives explored routing through this area, the preferred routes avoid this feature.

Dredged and maintained channels are typically managed and regulated by the USACE. The location and depths of navigation channels are authorized by the federal government, and the USACE periodically performs condition surveys to identify when maintenance dredging may be needed to keep channels available at the authorized depth. Should a cable route cross a maintained channel, it must be buried deeply enough below the authorized depth to ensure that the channel can be safely maintained without posing a risk to the cable and must account for future increases in channel depth. According to USACE guidance, submarine export cables will be required to be buried 15 ft (4.6 m) below the current or future federally authorized channel depth or 15 ft (4.6 m) below the existing seabed, whichever is deeper. As such, the crossing or occupancy of federally maintained channels has been avoided to the extent practical by the cable routing.

Some anchorages in the vicinity of the Project Area are federally designated and under the purview of the USACE. Others anchorage areas are managed by the USCG and/or the Port Authority of New York and New Jersey (PANYNJ). Unofficial anchoring areas may also exist in areas where pilots have vessels await their turn in the queue to enter the New York harbor area or are on standby for orders on the next destination. Vessel captains may choose to anchor in these locations out of habit rather than per specific instruction, making these "de-facto anchorages" difficult to fully regulate. Automatic identification system (AIS) data from the vicinity of the Lease Area gives an indication of the frequency and distribution of anchoring across the area and provides a first-order constraint on these risks. The USACE may directly require increased cable burial depths for existing authorized depth (or potential future depth) within federally designated anchorages[18]; the USCG or local port authority may also make similar recommendations. Therefore, crossing these areas has been avoided to the extent feasible by the cable routing. Deeper burial may be deemed prudent through risk analysis when traversing de-facto anchorage areas[19].

Traffic separation schemes are commonly used to identify and constrain inbound and outbound traffic lanes, typically with a separation zone between, to minimize the likelihood of vessel collisions. These traffic lanes have been considered from a cable routing perspective for two reasons. The first reason is that there is an increased level of activity in these areas, so the risk of an anchor drag or other mishap causing external aggression to the cable is greater. The second reason is that increased vessel traffic poses a concern and potential complication during cable installation or maintenance operations. For these reasons, TSS areas have been avoided where

[18] The USACE is currently evaluating the official widening and deepening of official anchorage areas in New York and New Jersey Harbor (USACE 2019).
[19] Empire is in the process of completing a Cable Burial Risk Assessment, which will be used to refine the submarine export cable installation methodology.

possible by the cable routing. If crossings are necessary, they are completed as directly (i.e., perpendicular to the directions of traffic) as feasible without unduly increasing the overall length of the cable route.

Existing utilities and other assets pose a risk to the submarine export cable due to several factors. Any crossed asset will need a formalized crossing agreement with the owner, ensuring that the location, methodology of the crossing, and responsibilities of both parties are understood and documented. Typical minimum separation must address the specific properties of each asset, the crossing itself, and the risk tolerances of the asset owners. An installed asset may limit the methods and depth of burial available for a cable installation at the crossing. Additional cable protection for the Empire assets is therefore anticipated on top of the crossing. This may add cost and complexity to the installation, as well as residual risks to the installed cable from reduced burial in the area, the installation of external protection, or from maintenance activities on the existing asset. As such, cable crossings or close parallels have been avoided to the extent feasible by the cable routing.

NOAA-charted Danger Zones, Restricted Areas, and Warning Areas exist for a variety of reasons and serve to advise mariners of the risks of navigating an area or conducting some type of bottom-contacting activity, such as fishing or cable laying. For these reasons, traversing charted danger zones were evaluated to determine the level of risk and then avoided, as necessary and to the extent practical. Where avoidance is not entirely possible, Empire has minimized the traverse and plans additional analysis and mitigation of residual risk.

Similarly, NOAA-charted Disposal Areas warn of the risk associated with traversing these areas of seabed. While some areas may contain relatively harmless material such as dredged spoils from maintained channels, others may contain "Acid Wastes" (an industrial byproduct), "Municipal Waste" (a sewage treatment product), or munitions. These areas have been avoided to the extent feasible when routing the submarine export cable.

Sand borrow areas serve as source regions for beach nourishment projects, which are part of coastal resiliency measures. BOEM's Marine Minerals Program works to manage sources of material to mitigate and replenish coastline and related terrain lost to erosion. Out of the eleven "Requests and Active Leases" for marine minerals to date, none are located in the North Atlantic region or within reasonable proximity to the Project Area (BOEM, n.d.). However, both New York and New Jersey have identified Sand Resource Areas, which are areas deemed to have some likelihood to be used as a sand resource (MMIS 2019). Sand Resource Areas, similar to BOEM's identified Atlantic OCS Aliquots with Sand Resources, are to be leased or authorized for use by BOEM as necessary for mitigation of coastal erosion and storm damage restoration. The submarine export cable routes have been designed to avoid impacting these potential sand resource areas to the extent that is practical, and to minimize interaction with these areas where other constraints require close approaches or traversing the potential sand resource areas. Major damages from the impact of Superstorm Sandy brought attention to the need for sand resources off New York State (BOEM 2014) and New Jersey (NJGWS 2019). The submarine export cable routes avoid known active sand borrow areas to the extent practical.

Shipwrecks and other obstructions are cataloged in the NOAA Nautical Charts and within the NOAA Automated Wreck and Obstruction Information System (AWOIS) database. These features may represent physical hazards to installation as well as being potentially historically or culturally significant. These features have been avoided to the extent practical by the cable routing, and where features are closely approached, HRG survey will provide insight into the location and nature of the contact for avoidance through further route refinement and micrositing. Identified features and recommended buffer distances are defined through review of the HRG survey data by a qualified marine archaeologist (QMA).

Fishing areas, artificial reefs, and regions of sensitive benthic habitat have also been avoided by the routing to the extent possible. Areas of increased fishing effort are often difficult to identify and quantify, due to the transient nature of the activity within the region. (See **Section 8.8 Commercial and Recreational Fishing** for additional detail regarding Empire's extensive outreach with the fishing community and regulators to supplement existing data and better characterize this activity). Artificial reefs, fixed-bottom fishing areas, and fish havens are charted and have been avoided by the routes, both as the potential to be a seabed hazard and to minimize impacts on other seabed users.

2.1.2.2 Onshore Substation

Following the identification of the preferred POIs, another Project component Empire assessed was the suitability of nearby parcels for the development of a new onshore substation, which is required to step up or step down the voltage prior to interconnection. The preference was to use space available within or immediately adjacent to the existing POI to locate the onshore substation, if possible, in order to minimize additional disturbance for installation of the onshore interconnection cables between the onshore substation and the existing POI, and to maintain consistency with existing land uses in the vicinity.

Empire 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 hazard elevations;
- Zoning;
- Setback requirements;
- Existing land use;
- Available space;
- Proximity to environmental and cultural resources;
- Constructability factors (e.g., extent of site grading needed, access); 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 site suitability for each of the POI locations are provided in Sections 2.1.3.2 and 2.1.4.2. Viable substation parcel alternatives that are supported by the evaluation criteria have been retained within the PDE.

2.1.2.3 Export Cable Landfalls

The transition from submarine export cables to the onshore export cables will occur at the export cable landfall location. To identify the preferred landfall sites, Empire conducted a coastal and waterfront engineering analysis of the risks and benefits of potential export cable landfall locations at sites in New York. This analysis was informed based on selection of the preferred POIs included in the PDE (see Section 2.1.1) and the export cable routing analysis (see Section 2.1.2.1). The following criteria were used in evaluation of export cable landfall locations:

- Proximity to preferred POIs (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, dredging);

- Environmental and cultural considerations (e.g. eelgrass, dunes, wetlands, buried and/or submerged cultural resources);
- Constructability complexities (e.g. long additional water crossings, vessel access); and
- Land use (consistency of existing uses, minimizing impacts to public lands).

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

2.1.2.4 Onshore Cable Routing

Once the submarine export cables make landfall, they transition to onshore export cables, which travel from the cable landfall to the new onshore substation. Interconnection cables leave the onshore substation to deliver power to the POI. The onshore cable route refers to the complete route traversed by the onshore export and interconnection cables between the submarine cable landfall and the POI. Because installation methods and construction corridor impacts are similar for the onshore export and interconnection cable installation, no distinction was made between the onshore cable types and segments for the purposes of evaluating the onshore cable route alternatives.

To identify the preferred onshore cable routes, Empire 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; and
- Environmental aspects such as wetlands and water bodies, historic and cultural resources, sensitive species habitat, potential for contamination, and potential community opposition, among others.

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

2.1.3 EW 1

The routing and siting assessment for the EW 1 Project included onshore substation and landfall locations as well as associated onshore and submarine export cable routes. In general, Empire prioritized a marine route for the export cables to minimize the onshore cable route, as described in more detail in Section 2.1.3.1. Onshore cable routing between potential landfalls and the POI involve extensive in-street work within densely developed areas of Brooklyn and/or the use of public parkland or open space to partially avoid in-street work. Street corridors in Brooklyn 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 HVAC 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 likelihood of high stakeholder opposition to onshore routes due to community impacts, make the longer onshore routes through Brooklyn impracticable for construction of the Project.

2.1.3.1 Submarine Export Cable Routing

In developing the preferred submarine export cable route, Empire prioritized minimizing terrestrial impacts by evaluating landfall locations relatively close to the Gowanus POI. Three major submarine cable route alternatives were assessed for EW 1, which are presented in **Figure 2.1-3**. These routes were evaluated relative to the criteria and constraints described in Section 2.1.2.1. As summarized below, Empire selected Route B as the preferred option to carry forward in the PDE due to its minimization or avoidance of interaction with key constraints such as Cholera Bank, TSS lanes, and a charted Danger Area.

In response to stakeholder feedback, Empire also evaluated landfalls on Coney Island and within Gravesend Bay, and the associated onshore routes to the POI for EW 1. These would have resulted in significantly longer onshore routes than the other alternatives described below, and would be particularly challenging in the densely populated and developed areas of Coney Island and the Brooklyn shoreline. Additionally, waters south of Coney Island and along most of Gravesend Bay are shallow, and the geophysical and geotechnical characteristics of the area (i.e., non-cohesive soils) add complexity, risk, and cost to an HDD landfall, as well as increasing the risk of inadvertent returns and associated environmental impacts. An open cut cable landfall in either location would result in both greater environmental disturbances, as well as stakeholder concerns, given the recreational use of the southern shore of Coney Island and the Shore Road Park and Parkway. Onshore routes from Coney Island could also require an additional HDD to cross Coney Island Creek. Onshore routing through Brooklyn is significantly constrained by the presence of existing utilities. Lengthier onshore construction would increase overall impacts to local stakeholders in comparison to a route that remains in-water until closer to the POI. In reviewing a Coney Island or Gravesend Bay alternative against the routing criteria, Empire determined that it was less favorable than routes that prioritized remaining in-water and eliminated these from the PDE.

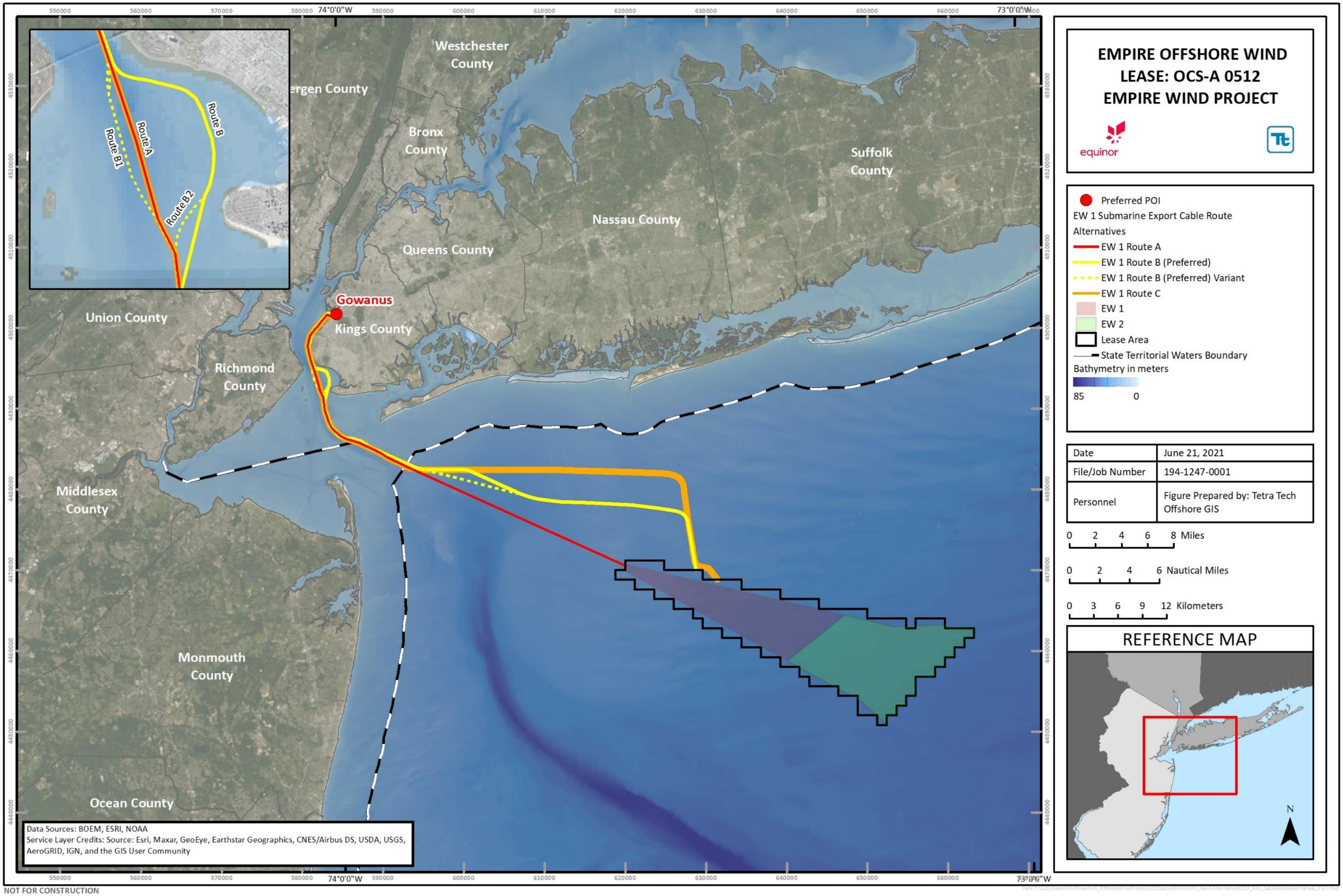


Figure 2.1-3 EW 1 Submarine Export Cable Route Alternatives

EW 1 Route A

Submarine export cable Route Alternative A represents approximately the shortest and most direct route from the offshore Lease Area to export cable landfall alternatives near the Gowanus POI (36 nm [42 mi, 67 km]). Minimizing route length was a primary driver in route selection, as it directly impacts project costs, electrical transmission, and environmental and stakeholder impacts of cable installation. Route A, the first alternative considered, traversed northwest from the westernmost portion the Lease Area. This route then crossed a bathymetric high exhibiting increased seabed complexity and higher backscatter in regional seabed studies. Known as Cholera Bank, this feature has an increased potential as valuable seabed habitat and is targeted by fishing efforts. Route A avoids interactions with the TSS lanes, but crosses a Dump Site with a usage status of 'discontinued' and previously used for 'municipal sewage sludge'. Route A enters the Precautionary Area associated with the entrance to Ambrose Channel. Prior to reaching the Precautionary Area, the route enters a charted Danger Area. Risks of encountering unexploded ordnance (UXO) in this area have been and will continue to be studied to evaluate what mitigation measures may be necessary. Route A then follows the same alignment as Route B to landfall.

EW 1 Route B

Submarine export cable Route Alternative B (40 nm [46 mi, 74 km]) evaluated the length, complexity, and associated risks of a route designed to mitigate the impacts to Cholera Bank. Route B departs the Lease Area along its northern boundary and continues north-northwest across the outbound lane of the Ambrose to Nantucket TSS and then enters the Separation Zone between the traffic lanes before turning to the west. The route continues through the Traffic Separation Zone towards New York Harbor reaching the Precautionary Area at the end of the traffic lanes. Prior to reaching the Precautionary Area, the route enters a charted Danger Area. Risks of encountering UXO in this area have been and will continue to be studied to evaluate what mitigation measures may be necessary. This routing avoids the shallower and more complex seabed areas associated with Cholera Bank while minimizing impacts to the TSS lanes.

To minimize the traverse of the charted Danger Area, the route turns to the northwest and crosses the planned path of the Wall, New Jersey to Long Island (Wall-LI) telecommunications cable system (personal communications). The route passes approximately 2.0 nm (3.8 km) north of the Ambrose Channel Pilots Buoy, where it resumes a westerly direction after exiting the Danger Area. The route crosses a cable corridor from Sea Bright, New Jersey to Breezy Point, Long Island, New York. No known in-service cables occupy this corridor, and reviewing historical nautical charts indicates that the corridor has been charted since the 1950s.

North of the Red "4" Ambrose Channel buoy, the route turns to the northwest to stay north of the Ambrose Channel, a dredged and maintained shipping channel under the authority of the USACE. Ambrose Channel is authorized to a depth of 53 ft (16.2 m), with a width of 2,000 ft (610 m).[20] The route maintains an approximately 1,250 to 1,300-ft (380 to 400-m) offset from the designated channel boundary and is over 980 ft (300 m) outside of the boundaries of the areas dredged to maintain the channel.

After the route crosses from federal into state waters, it continues paralleling the maintained Ambrose Channel and then crosses the Transco Lower New York Bay Lateral gas (Transco) pipeline, which is buried in this area. The crossing methodology and separation distance will be negotiated between Empire and the asset owner to ensure protection of both assets.

[20] Additional correspondence with the USACE dated August 20, 2020 indicates that that the USACE has received approvals to evaluate and report on the feasibility of improving Ambrose Channel from 53 ft (16 m) to 58 ft+ (18 m) MLLW.

Approximately 1,060 ft (323 m) northwest of the Transco pipeline crossing is the HVDC Neptune Regional Transmission System (Neptune cable), which is also indicated as buried in this area. The proposed Poseidon Transmission (Poseidon) cable is documented to closely follow the Neptune cable route and would also be crossed in a similar orientation if the Poseidon cable is installed before the EW 1 submarine export cable.

Approximately 0.4 nm (0.7 km) to the northwest, the route crosses the location of the planned Transco Raritan Bay Loop natural gas pipeline (Raritan Bay Loop) project. Empire's current understanding is that this project is moving forward, although there has been public opposition. The status of the Raritan Bay Loop project will be monitored throughout its permitting and design. The details of the crossing will be determined by which asset is installed first and pending agreement of crossing methodology.

Shoals of 16.4 to 23.0 ft (5 to 7 m) water depth are noted in this area, and the charts and survey data indicate that the seabed may be harder material, both of which present challenges to cable installation. The route therefore approaches the Ambrose Channel due to the presence of these rocky shoals to the northeast of the route. As currently proposed, the route maintains an offset of 410 ft (125 m) or greater from the channel. This is well outside of the approximately 150-ft (45-m) offset from the toe-of-slope, which has been estimated based on a USACE indication of a 3:1 side-slope associated with the channel.[21]

The route turns to the north-northwest and continues to parallel the Ambrose Channel. An area of deeper water is charted between Ambrose Channel and East Bank and the route is currently sited on the eastern flank of these features. Based on the HRG survey data, the route will be microsited to optimize for minimal seabed slopes. Water depths in this area range between 39 and 66 ft (12 and 20 m).

Areas of sediment waves are observed related to seabed currents being steered and concentrated by the topography resulting from the dredging of Ambrose Channel. The waves generally have an amplitude on the order of 1.6 to 2.5 ft (0.5 to 0.75 m), although an area of large waves is observed within the Empire bathymetry data. These waves have an amplitude of up to 6.5 ft (2 m) and a wavelength of 98 to 131 ft (30 to 40 m). The current route centerline avoids the largest of these features, and additional analysis will be needed to optimize between a route that minimizes risks due to de-burial from mobile sediments and a route that is better for installation with lower cross-track slopes.

Entering Lower New York Bay, the cable traverses a charted cable area, roughly linking Swinburn Island and Norton Point on Coney Island. The Empire geophysical data does not appear to indicate an existing cable in this area. Scattered magnetometer contacts and a short linear side-scan sonar contact are observed in the vicinity but do not align in a manner indicative to an intact cable.

Approaching Gravesend Bay and the Verrazzano-Narrows Bridge, the availability of unencumbered seabed suitable for cable routing greatly decreases. Within Gravesend Bay, the federally designated USACE anchorage Area lies within the larger charted Anchorage #25 area identified by NOAA Chart 12402 for the Port of New York (USCG Anchorage #25). As the route does not cross the USACE-managed portion of the anchorage, the USACE may not have reason to require deeper burial; however, the risks to the cables from anchoring will continue to be evaluated and inform burial depth decisions. The USACE has prepared a General Reevaluation Report (GRR) to evaluate environmental impacts from reasonable project alternatives related to the improvement of the anchorage(s) included in the New York and New Jersey Harbor Federal Navigation Project (USACE 2020). Included within this analysis is the potential deepening and expansion of the Gravesend Anchorage. Inside of Gravesend Bay and inside of USCG Anchorage #25, the USACE-designated anchorage

[21] The offset from the existing channel and associated side-slopes will be verified with the USACE during the permitting process.

has an Authorized Depth of 47 ft (14.3 m); the most likely alternative identified in the GRR includes deepening this to 50 ft (15.2 m). Due to present water depths at the locations of the current routing, future change to the Authorized Depth is unlikely to require any change to the installation plan, as deep burial is already being considered to mitigate anchor-strike risk; however, the USACE's plans for the Gravesend Anchorage are being monitored by Empire.

To account for routing constraints in and around Gravesend Bay along EW 1 Route B, three variants were under consideration in this area, two of which were carried forward in the PDE: EW 1 Variant B1 and EW 1 Variant B2 (**Figure 2.1-3**). EW 1 Variant B1 is located west of and parallel to Route A, in the northbound lane of Ambrose Channel. EW 1 Variant B2 deviates from the original route by traversing northwest, following close to EW 1 Route A, then turning northeast into Gravesend Bay, where it connects with Route B.

Immediately north of USCG Anchorage #25, the route enters a charted cable area. The current route encroaches to within approximately 82 ft (25 m) of the designated channel boundary due to the seabed constraints. A Safety Zone is depicted on NOAA Chart 12334 between the bridge footing and shore, which is understood to be related to UXO located on the seabed.

As the route turns to the north, it crosses a charted pipeline area. This area was identified by the USACE in a recent dredging contract as the Ambrose Channel Utility Corridor, but little direct documentation exists on what assets are within this area. Empire worked with the USACE via a Freedom of Information Act (FOIA) Request to understand installed and planned seabed assets available via publicly available information. Direct dialogue with asset owners regarding the crossings of specific assets within these utility corridors is ongoing to establish detailed crossing methodology requirements with these items of critical infrastructure.

The route turns to the northeast and enters the Bay Ridge Channel, where it crosses a second charted pipeline area. The Empire survey identified an asset in this corridor, which is understood to be one of two disused and partially removed Brooklyn-Staten Island Water Siphons (out of service; New York City Department of Environmental Protection). The route then crosses the replacement in-service Brooklyn-Staten Island Water Siphon, which has been deeply tunneled well below the seabed and below the depth of concern of the submarine export cable. A third charted pipeline area is crossed by the route and is understood to contain the second of two out of service New York City Department of Environmental Protection Brooklyn-Staten Island Water Siphons.

The route turns to the northeast and follows the eastern side of the Bay Ridge Channel. The Bay Ridge Channel is authorized to a depth of 40 ft (12.2 m) and recent surveyed depths are generally 41 to 45 ft (12.5 to 13.7 m) in the southern portion of the channel and shoal to 29 to 36 ft (8.8 to 11 m) along the central axis of the northern end of the channel. The southeastern flank of the Bay Ridge Channel is shallow and has remnants of docks, piers, and other structures and is not suitable for cable routing. The northwest flank is Bay Ridge Flats and contains multiple charted anchorage areas, also not suitable for cable routing. In addition, it is anticipated that the submarine export cables will be required to be buried 15 ft (4.6 m) below the current or future authorized channel depth of the Bay Ridge Channel, or 15 ft (4.6 m) below the existing seabed, whichever is deeper (as described above, in Section 2.1.2). The alignment of the cable route exits the channel and side-slope limits before the crossing of subsea assets in order to mitigate issues of achieving target burial depth at the crossings with existing assets.

Within the Bay Ridge Channel, the route turns to the northeast and then east to land at EW 1. The seabed and approach to either of these landfalls will be driven by the final siting and design of the landfall. The route avoids parallels or close approaches with the Bayonne-Gowanus Power Transmission cables, which approach Gowanus Bay from the north through the Red Hook Channel.

EW 1 Route C

Submarine export cable Route Alternative C (41.8 nm [77.4 km]) was designed to minimize potential risks from UXO by avoiding the charted Danger Area. Route C follows Route B out of the Lease Area and then continues across both the inbound and outbound traffic lanes of the TSS before turning west to stay north of the Danger Area. This route increases the distance within the inbound TSS traffic lane and also traverses a large but not formally defined de facto anchorage just north of the Danger Area. As anchoring here is less regulated and more disperse, protection via deeper cable burial would need to occur over a larger area, increasing costs and impacts. As such, Route B has been evaluated as the best approach alternative to the Gowanus interconnection location. West of this area, Route C follows the same alignment as Route B.

2.1.3.2 Onshore Substation

Evaluation of the Gowanus POI indicated that an additional site would be required to support the Project's onshore substation. Several potential parcels along the Brooklyn waterfront in Sunset Park were assessed for their feasibility and suitability for the development of a new onshore substation. Sites considered for onshore substation development for EW 1 are depicted in **Figure 2.1-4**. As summarized below, the EW 1 site was determined to be most suitable for construction of the new onshore substation and is retained in the Project PDE. The other sites were eliminated from further consideration due to a combination of potential conflicts with existing site uses and planned development, as well as greater construction complexity, cost, and potential environmental impacts.

EW 1 Onshore Substation Site

Empire evaluated the use of a portion of the South Brooklyn Marine Terminal (SBMT) to site the new onshore substation due to limited space availability directly adjacent to the POI. SBMT is located in Sunset Park adjacent to 1st Ave/2nd Ave between 29th and 39th St. There are approximately 10 ac (4 ha) of space on the 88 ac (36 ha) SBMT site, owned by New York City and leased by the New York City Economic Development Corporation (NYCEDC). Although the marine terminal has been largely inactive for maritime transport in recent years, a recycling facility is located on the 29th Street Pier within SBMT, and there are plans to reactivate the site as a marine shipping facility. SBMT is one of 17 terminals in the Port of New York and New Jersey included in the Comprehensive Port Improvement Plan. The terminal contains several newly constructed (2011) rail infrastructure features, including a rail spur for break-bulk along the 39th Street shed, two new rail sidings for auto rack loading and unloading, and a rail connection to the Sims recycling facility.

The EW 1 site was determined to be a suitable site based on space availability. It is the closest sufficiently sized parcel to the Gowanus POI, at a distance of less than 0.1 mi (0.2 km) from the POI. Because the site is already developed for industrial use, no major environmental or cultural resource issues are anticipated.

Narrows Generating Station

The Astoria Generating Company, L.P., a wholly owned subsidiary of Eastern Generation, LLC, operates two electric generating stations in the Gowanus/Sunset Park neighborhoods in Brooklyn, namely the existing Gowanus Generating Station and the Narrows Generating Station. The Narrows Generating Station is approximately 352 MW and consists of 16 simple-cycle combustion turbine units on two floating power barges, located in Sunset Park adjacent to 1st Ave between 54th and 53rd St. Recently announced plans include the retirement of the Narrows Generating Station upon the commencement of operation of the repowered Gowanus Generating Station; the selection of the Narrows Generating Station site for the location of the onshore substation would be contingent upon the facility retirement. The overall parcel size is approximately 6 ac (2 ha).

Figure 2.1-4 EW 1 Onshore Substation Alternatives

The interconnection cable route from a substation at the Narrows Generating Station site to the POI is approximately 1.4 mi (2.2 km). Potential redevelopment areas that comprise the Narrows Generating Station site could be used for the new onshore substation. However, current space availability is more constrained by the presence of existing structures. 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 was initially considered suitable, but the ability to develop an electrical substation on the site is dependent upon the decommissioning and associated removal or demolition of the existing facility. This made the Narrows Generating Station site less favorable for the EW 1 Project; therefore, it is no longer considered for the onshore substation.

65th Street Railyard

The 65th Street Railyard is an approximately 33 ac (13 ha) railyard located on the Brooklyn waterfront between 65th and 63rd Streets. Formerly the Long Island Rail Road's (LIRR) Bay Ridge Yard, it was renovated by the NYCEDC in 2000. The railyard is now maintained and operated by the New York New Jersey Railroad (NYNJ), which also provides rail service along 1st Avenue in Sunset Park to the Sims Municipal Recycling-Sunset Park Material Recovery Facility at SBMT (just north of the EW 1 site for the onshore substation). It consists of nine body tracks and two float bridges and is intended for use as a railcar float facility. In 2016, approximately 3,500 loaded railcars used the NYNJ Rail carload float system between Greenville Yard in Jersey City and 65th Street Railyard, and the PANYNJ was recently awarded a FASTLANE grant to improve the transload capabilities of the 65th Street Railyard.

The interconnection cable route from an 65th Street Railyard substation to the POI is approximately 1.9 mi (3 km). Given the focus of maintaining and expanding rail operations and trans-harbor freight movement through the 65th Street Railyard, it was determined that the development of an electrical substation may not be compatible with the regional transportation plans and the planned expansion of intermodal operations at this site.

Sunset Park Pier

The Sunset Park Pier site was evaluated as a waterfront development opportunity for a new pier north of the Brooklyn Army Terminal between 57th and 58th Streets. Development rights extend from the pierhead line to the shoreline, a distance of approximately 1,400 ft (427 m) with a lot frontage of approximately 315 ft (96 m), providing a total area of approximately 10 ac (4 ha). Review of historic aerial photographs indicated that a former pier was removed from this location, indicating prior disturbance of this benthic habitat and possible remains of the former structure below water.

The interconnection cable route from a Sunset Park Pier substation to the POI is approximately 1.6 mi (2.5 km). Environmental concerns associated with building a new pier for the onshore substation site would include water quality and permanent shading impacts, which would add permitting challenges to development relative to using an existing industrial site. Empire conducted historic background research for the former pier site based on available resources and concluded it is relatively unlikely that archeological resources persist in this area; however, additional verification would be needed to confirm that development of the pier would not impact cultural resources. Due to the complexity and cost of permitting and developing a new pier and the potential additional environmental resource impacts, this site was not retained in the PDE.

2.1.3.3 Export Cable Landfall

The Upper Bay of the New York Harbor is well protected from ocean waves, but it can be subject to storm surge. Relic structures and marine debris remain from historical shoreline developments. The shoreline is typically comprised of bulkheads, steel sheet pile, seawall, wood piles, riprap, relic concrete, or a combination. The waterfront is adjacent to high use navigation channels. Cable and other asset crossings are present across the navigation channel.

Within the Upper Bay of the New York Harbor, potential locations of adequate size for the submarine export cables to make landfall are limited, due to the highly developed nature of the area. Empire considered three sites immediately adjacent to potential substation sites evaluated in Section 2.1.3.2 as potential landfall locations, including the 65th Street Railyard site, the Narrows Generating Station (EW 1 South), and SBMT (EW 1). Additionally, Empire considered one landfall site (the Verrazzano-Narrows Bridge site) that makes use of an available open space but would result in a significantly longer onshore cable route. Landfall sites and alternative onshore routes that were considered are shown in **Figure 2.1-5**. Each landfall was evaluated relative to the constructability, environmental resource and stakeholder criteria described in Section 2.1.2.3, considering the possibility that either HDD or open cut installation methodologies could be used to make landfall at each location.

In addition, in response to stakeholder feedback, Empire also evaluated the possibility of making landfall before entering Upper Bay, either on Coney Island or into Gravesend Bay, and an associated longer onshore route to the POI for EW 1.

Evaluation of landfall locations is summarized below. Note that the route lengths described in Sections 2.1.3.3 and 2.1.3.4 describe the complete onshore route from the export cable landfall, and therefore may differ from lengths described in Section 2.1.3.2 for routes from onshore substation sites. Based on the criteria considered, the EW 1 site was retained as the singular preferred potential landfall within the PDE.

Coney Island

In evaluating the potential for an export cable landfall on Coney Island, Empire considered waterfront parcels along the beach with sufficient space to stage and construct the cable landfalls. Empire also evaluated nearshore water depths, sediment type, and the presence of submarine constraints. In general, the waters to the south of Coney Island are shallow, and its geophysical and geotechnical characteristics (i.e., non-cohesive soils) add complexity, risk, and cost to an HDD landfall, as well as increasing the risk of inadvertent returns and associated environmental impacts. Potential landfall parcels on the south side of Coney Island were generally similar in these characteristics.

As a representative cable landfall alternative centrally located on the south side of Coney Island, Empire also evaluated a large public parking area on the north side of Brighton Beach. This parking lot represents one of a relatively few large parcels without structures directly adjacent to the beach, with a relatively unobstructed approach for landfall. Other open parcels along the south side of Coney Island are generally more obstructed and/or consist of public parkland in recreational use. With the exception of similar large parking areas associated with Steeplechase Park and the Abe Stark Sports Center to the west, or Manhattan Beach parking towards the eastern end of Coney Island.

The Brighton Beach public parking area is located immediately to the south of Brightwater Circuit, opposite Brighton 3rd Street. The parking area covers approximately 2 ac (0.8 ha), and it's bounded by the Rieglemann Boardwalk to the south and Brighton Beach Playground to the west. Otherwise, the surrounding area consists largely of high-rise buildings with mixed residential and commercial developments.

Figure 2.1-5 EW 1 Landfall and Onshore Cable Route Alternatives

Water depths in the vicinity of a south shore Coney Island export cable landfall alternative are likely to present a significant challenge for an HDD cable landfall construction. Nearshore waters out to 3,000 ft (914 m), the longest HDD considered, are predominantly less than 16 ft (5 m) deep. The result is that an HDD export cable landfall to the southern shore of Coney Island would result in a longer/riskier HDD, due to the additional cost and complexity necessary for the implementation of specialized techniques typically required for a landfall installation in shallower water. The water depth at the HDD exit would also be unlikely to substantially mitigate concerns of seabed mobility at the punchout location, increasing the risk of the cable becoming unburied or requiring burial mitigation during operation of the system. A potential HDD installation at this location would likely have a high risk for inadvertent returns of drilling fluid, due to the likely presence of loose sediments and soils at drill depths. Empire could not find any records of successful HDD installation or operations in the vicinity of the south shore of Coney Island.

The Coney Island landfall alternative was determined to be less viable than other cable landfall alternatives for a variety of technical, stakeholder, regulatory, and environmental reasons. While an HDD cable landfall is likely to prove challenging, it is also unlikely that an open cut would be feasible or permitted, because Coney Island's shoreline is regulated as a Coastal Erosion Hazard Area. It is also a potential area of significant erosion risk in New York City (NYC Emergency Management 2019), due to the area's exposure to wave action from the Atlantic Ocean, which would require the export cable landfall to be installed deep enough to avoid impacts from coastal processes. Unlike the other export cable landfall alternatives considered, a landfall at Brighton Beach would cross sandy beach and intertidal habitat.

Although surface impacts would be avoided by an HDD, noise and disturbance adjacent to the beach could impact the use of the area by wildlife, such as shorebirds, as well as public users of the beach, which is heavily used for recreation. It would also likely add significant regulatory challenges and risks associated with the need to pursue New York State parkland alienation legislation for the crossing of Brighton Beach. Additionally, the Coney Island landfall alternative is located the furthest distance away from the Gowanus POI; resulting in greater onshore impacts and significant challenges along an in-street route passing through densely developed portions of Brooklyn (see Section 2.1.3.4).

Gravesend Bay

As an alternative to the challenges of a cable landfall at Coney Island and an onshore cable route crossing Coney Island with in-street construction through the densely developed neighborhoods of Brooklyn, Empire also considered a route that would make landfall to the north of Coney Island, within the southern portion of Gravesend Bay. Since the preferred submarine export cable route alternative crosses into Gravesend Bay to avoid known and potential anchorage areas (see Section 2.1.3.1), an export cable landfall alternative along Gravesend Bay would represent a compromise between reducing the length of the submarine export cable and reducing some of the onshore construction activities occurring within city streets.

Similar to Coney Island, there are a number of constraints for selecting potential export cable landfall locations to the north of Coney Island and within Gravesend Bay. In particular, there are very few sufficiently sized, open land parcels available that are not already dedicated as public parklands. As a representative export cable landfall alternative in southern Gravesend Bay, the Applicant selected a private car lot located to the north of the New York City Sanitation Department BK11 garage along 25th Avenue, adjacent to Shore Parkway. To the south of this location, landfalls are constrained by shallow waters, public open space and/or piers and other obstructions. Another similar parking lot space and parkland exists immediately to the north. Due to the Shore Parkway and adjacent high-rise development, no potential spaces for export cable landfall exist further to the north until near Fort Hamilton, discussed further below, at the very north end of Gravesend Bay.

The Gravesend Bay cable landfall alternative is presently a car lot located along the waterfront, between 25th Avenue to the south and Bay 38th Street to the north. The lot occupies approximately 3 ac (1.2 ha). The approach and shoreline are partially obstructed, with evidence of old piers and shallow riprap along the shoreline. A seawall appears to bound the area to the north and west.

Water depths in the vicinity of this export cable landfall alternative could present a significant challenge for HDD cable landfall construction. Nearshore waters are mostly shallow, with much of the area out to 3,000 ft (914 m), the longest HDD considered, at depths of 13.1 ft (4 m) or less. However, a deeper channel at 26 ft (8 m) runs near the Gravesend Bay shoreline from the north, presumably providing pier access. This does not achieve the 33 ft (10 m) depth that is typically required, but it could provide some water deep enough for operation and staging of typical HDD cable landfall equipment. Assessment of a potential HDD also indicated a potential high risk for inadvertent returns of drilling fluid, due to the likely presence of loose sediments and soils at drill depths, and of fill materials present on the onshore entry side of the HDD. The sediment in the area is expected to be loose, likely to be underlain by glacial tills (unconsolidated material from boulders and pebbles to sands and clays). These highly variable soil conditions are not conducive to HDD operations because cohesive soils improve the ability to maintain the borehole, and if large grain content (i.e. gravel, cobbles, till) is present, this may limit the technical feasibility of HDD operations and increase risks of inadvertent returns. The Gravesend Bay export cable landfall alternative was determined to be less viable than other export cable landfall alternatives, primarily because of challenges along the associated onshore export cable route (see Section 2.1.3.4), as well as HDD landfall constraints, including shallow water, shoreline obstructions, and risk of inadvertent returns during HDD installation. Because of the greater area and duration of construction within shallow waters associated with this export cable landfall alternative, it is also expected to result in somewhat greater impact to habitats for species such as winter flounder and horseshoe crab. The Gravesend Bay export cable landfall alternative is significantly further from the Gowanus POI than the export cable landfall alternatives to the north. It would therefore result in greater onshore impacts along the cable route than export cable landfalls located to the north of the Verrazzano-Narrows Bridge would (see Section 2.1.3.4).

Verrazzano-Narrows Bridge

The parcel at the Verrazzano-Narrows Bridge landfall location consists of open park space (Shore Road Park) under the control of New York City Department of Parks and Recreation adjacent to Shore Road and the Belt Parkway, on the northwest side of the Verrazzano-Narrows Bridge. This site represents one of the few areas of open space available along the waterfront with adequate space for staging landfall installation equipment (e.g., HDD rig). However, this site is also the farthest from the Project POI, requiring an onshore cable route of approximately 4.4 mi (7.1 km).

For construction of the export cable landfall itself, interferences at the site include a seawall that is assumed to extend 23 to 26 ft (7 to 8 m) below the mudline, built on a timber crib wall or timber piles, with riprap extending to the shoreline. Water depths adjacent to the landfall site vary, with the nearshore bottom contours being shallow, extending to at least 98 ft (30 m) deep in the channel. No UXO are noted, but other unidentified obstructions are present on NOAA charts and include a cable area south of the bridge. Strong currents may also be present in the area, but coastal processes do not appear to be a limiting constraint.

Another consideration for use of this site would be stakeholder concerns, including potential disruptions affecting open space users and local residents. Local road closures are not anticipated to be required, but tree removal may be required for staging and access. Because this site is not developed for industrial use, impacts to vegetation, land use, and terrestrial habitats would likely be greater than at most other sites considered.

The Verrazzano-Narrows Bridge landfall was determined to be less viable than other export cable landfall alternatives because of the potential for conflict with marine traffic, disruption of recreational use of Shore Road Park, noise, and stakeholder concerns during cable landfall installation activities. It would also likely add significant regulatory challenges and risks associated with the need for New York State parkland alienation legislation. Potential constructability issues associated with human made obstructions, HDD landfall constraints, and risk of inadvertent returns during HDD installation are also present. The Verrazzano-Narrows Bridge landfall is also significantly further from the Gowanus POI than export cable landfall alternatives located to the north, resulting in greater onshore impacts along the cable route (see Section 2.1.3.4).

65th Street Railyard

The parcel at the 65th Street Railyard landfall location consists of rail tracks and open industrial land adjacent to the Owls Head Wastewater Treatment Plant and north of the Belt Parkway. This site is adjacent to the 65th Street Railyard substation site that was considered by Empire (see Section 2.3.1.2).

Artificial interferences are present at the site. Although as-builts of the seawall were not available, it is assumed to have deteriorated riprap that likely extends below the mudline. Other unidentified obstructions are also present on NOAA charts with only a narrow unobstructed corridor. No UXO were noted. Water depths adjacent to the landfall are very shallow. Coastal processes in this location do not appear to be a limiting constraint.

Similar to other sites considered, the in-water HDD exit would be in deeper waters, which correspond with areas of higher marine traffic offshore. Based on the nature of the site, tree removal is not anticipated to be required, nor are local road closures required, and residential impacts should be minimal.

Similar to other locations, there is a potential to encounter contaminated soils and/or sediments, based on its nature and historic use as an industrial site. The onshore cable route from the 65th Street cable landfall alternative to the POI is 2.2 mi (3.6 km), although the onshore cable route length is not as long as from the Verrazzano-Narrows Bridge landfall site. Empire determined this site is similar to EW 1 for landfall construction. However, due to the potential land use conflicts associated with the 65th St. Railyard, this landfall location was not retained in the PDE (see Section 2.3.1.2). This site also does not offer significant benefits over other landfall sites considered and is associated with a longer and more complex onshore cable route to the POI.

Narrows Generating Station

The Narrows Generating Station landfall site is located at Astoria Generating Company, LP's Narrows Generating Station parcel, which was also considered by Empire for locating the new onshore substation (see Section 2.3.1.2). The landfall would be located on a pier with a bulkhead sheet pile wall, which would require cable burial depths of 30 to 50 ft (10 to 15 m). Manmade obstructions are present and include submarine dolphin piles and ruins of a historical pier to the south.

Vessel traffic around this site is expected to be heavy; however, similar to other sites, because of the industrial nature of the site, use of the site is not anticipated to require tree clearing or local road closures, and residential impacts should be minimal.

Upland sediment in this area may be contaminated, similar to other industrial sites considered. This site would result in a slightly longer onshore cable route than EW 1, approximately 1.8 mi (3.0 km). This site was initially considered suitable, but was not retained in the PDE because of its disadvantages as an onshore substation location in comparison to the EW 1 site (see Section 2.3.1.2), and because of challenges for HDD and open cut landfall installation due to shoreline infrastructure and depth requirements. The Narrows Generating Station landfall is also located slightly further from the Gowanus POI, resulting in greater onshore impacts along the cable route (see Section 2.1.3.4).

EW 1 Onshore Substation Site

The EW 1 landfall is located on the SBMT site. As described further in Section 2.3.1.2, SBMT is an NYC-owned parcel designed to support marine transportation facilities and is under consideration by Empire for siting the onshore substation. The pier at the EW 1 landfall location consists of deep, concrete-filled caisson bulkheads at the pier tip. The north and south sides of the pier appear to be constructed of a steel sheet pile bulkhead and riprap shoreline.

Other unidentified obstructions noted on NOAA charts include an obstruction near the seaward entry of the waterway. Pier ruins are noted on the north side of the tip of the pier. The waterway on the north side of the pier contains additional pier ruins.

Depths adjacent to and between the piers at EW 1 vary and may be as shallow as 6.5 ft (2 m) below Mean Lower Low Water (MLLW), increasing towards the bay. Coastal processes in this location do not appear to be a limiting constraint. No UXO are noted.

It appears there are low levels of vessel traffic within approximately 328 ft (100 m) of the landfall at the shoreline, with higher density vessel traffic further from the pier in Gowanus Bay. Similar to other industrial sites, no tree removal or road closures are anticipated to be required to complete the shoreline installation of the cable at SBMT, and minimal residential impacts would be anticipated because of the nature of land use in the area. However, similar to other industrial sites, potential existing contamination could be present.

This site is the closest to the Gowanus POI, resulting in an onshore cable route of only approximately 0.2 mi (0.3 km), and is considered a viable option for cable landfall as it has sufficient space and minimizes impacts to environmental and cultural resources.

2.1.3.4 Onshore Cable Route

In evaluating the least impactful and most feasible onshore cable route solution for the EW 1 Project, Empire considered routes for the onshore export cables from the potential landfall locations to the potential onshore substations and routes for the interconnection cables from the onshore substation to the Gowanus POI. This included evaluating two longer onshore export cable routes from cable landfall alternatives located on Coney Island and within Gravesend Bay, as well as potential routes from cable landfall alternatives located along the waterfront in the Sunset Park area of Brooklyn (Verrazzano-Narrows Bridge, 65th Street Railyard, the Narrows Generating Station, and the EW 1 site). Landfall sites and major alternative onshore routes that were considered are shown in **Figure 2.1-5**. Additional minor variants of these routes were also considered during Empire's onshore cable route evaluation. To minimize disturbance and onshore impacts to the natural and human environments, Empire preferred alternatives resulting in shorter onshore cable routes.

The route from EW 1 was determined to be preferred. As indicated below, more favorable discussions with the landowner at EW 1 were also considered in this analysis. Other onshore route alternatives result in longer onshore routes, additional construction complexity due to utilities and existing infrastructure (including a New York City Department of Environmental Protection [NYCDEP] interceptor main), and potential traffic impacts. As such, the 2nd Avenue route from the EW 1 landfall was retained as the preferred onshore cable route within the PDE for the EW 1 Project.

EW 1 Onshore Route

The onshore cable route from the EW 1 landfall to the Gowanus POI is approximately 0.2 mi (0.3 km) long. This route runs northeast from the proposed EW 1 landfall and onshore substation site to a parking lot along the northwestern side of 2nd Avenue. It then continues north along 2nd Avenue to 28th Street and travels east along 28th Street where it enters the existing substation at the Gowanus POI.

The route from EW 1 was determined to be preferred route retained in the PDE.

Narrows Generating Station Onshore Routes

From the Narrows Generating Station landfall, two major route alternatives were considered:

- The Bush Pier Terminal Park onshore cable route alternative runs northwest from Narrows Generating Station site along 1st Avenue from the intersection with 54th Street to the intersection of 51st Street. The route heads west then north, along a right-of-way adjacent to the Bush Pier Terminal Park, until reaching 43rd Street. Here the route runs southeast along 43rd Street to 2nd Avenue. From there, the route continues along the same path as the route from the EW 1 landfall, travelling northeast along 2nd Avenue to 28th Street where it enters the existing substation at the Gowanus POI. This route is approximately 2.0 mi (3.2 km).

- The 1st Avenue Route runs north from the Narrows Generating Station landfall site at the intersection of 54th Street and 1st Avenue to the intersection at 43rd Street. The route then turns southeast on 43rd Street to 2nd Avenue. From here, the route continues along the same path as the route from the EW 1 landfall, travelling northeast along 2nd Avenue to 28th Street where it enters the existing substation at the Gowanus POI. This route is approximately 1.8 mi (2.9 km).

The Bush Pier Terminal Park onshore cable route alternative from the Narrows Generating Station would result in additional potential impacts to recreational resources, and feedback from New York City stakeholders prioritized a route that would avoid Bush Pier Terminal Park, due to the existence of a landfill and associated infrastructure beneath the park.

65th Street Railyard Onshore Routes

From the 65th Street Railyard, a route alternative would exit the site to 2nd Avenue, travel northeast to 28th Street and follow it to the Gowanus POI. Empire also evaluated a route from the 65th Street Railyard that follows 1st Avenue to 39th Street, traveling east along 39th Street to 2nd Avenue, and continuing to the Gowanus POI along routes previously described from there. These routes are approximately 2.2 to 2.3 mi (3.5 to 3.7 km).

Verrazzano-Narrows Bridge Onshore Routes

The initial route that was evaluated (the Shore Road Park onshore cable route alternative) from the Verrazzano-Narrows Bridge landfall site would run north and slightly west from the landfall through Shore Road Park and along the Belt Parkway to Owl's Head Park. From there, the route would require an HDD crossing of the Belt Parkway and the 65th Street Railyard. To the north of the 65th Street Railyard, it would continue north along the west side of the Brooklyn Army Terminal and then turn east along 58th Street. The Shore Road Park onshore cable route alternative would then turn north along 2nd Avenue to SBMT and eventually to the POI, similar to other route alternatives described in this section. This route is approximately 4.4 mi (7.1 km) long.

Empire also evaluated a second route (the 3rd Avenue onshore cable route alternative) from the Verrazzano-Narrows Bridge cable landfall alternative. From the export cable landfall in Shore Road Park, this route goes directly north across Shore Road and follows 96th Street to the northeast. The route cuts over to the 3rd Avenue corridor with a jog to the south along Marine Avenue and then east on 97th Street. After continuing north along 3rd Avenue, it turns west along Bay Ridge Avenue to Owl's Head Park, then crosses the Belt Parkway and 65th Street Railyard and follows a similar alignment to the Shore Road Park onshore cable route alternative described above. This route is approximately 4.5 mi (7.2 km) long. The 3rd Avenue onshore cable route alternative was selected for the evaluation of a north-south corridor that substantially avoids a significant portion (but not all) of the parkland impacts along the waterfront, but requires extensive in-street work in the densely developed Bay Ridge neighborhood.

The Shore Road Park onshore cable route alternative from the Verrazzano-Narrows export cable landfall alternative results in extensive routing and impacts to municipal parkland. Empire evaluated three onshore HDDs to reduce impacts to parks, adding cost and complexity, as well as the 3rd Avenue onshore cable route alternative, to avoid some of the routing within Shore Road Park and Parkway. Although these reduce the length of the route within municipal parks and the associated impacts to recreational users, neither alternative avoids park impacts entirely and parkland alienation legislation is still expected to be required for either alternative. Both route alternatives also cross areas of potential cultural sensitivity in the vicinity of Owl's Head Park. Additionally, the 3rd Avenue onshore cable route alternative is expected to encounter significant utility congestion within the relatively narrow roadway corridors found throughout the densely developed Bay Ridge neighborhood of Brooklyn. Such routing may not be feasible, and both routes are likely to encounter significant public stakeholder opposition.

Gravesend Bay Onshore Routes

Further south, Empire evaluated a route from the Gravesend Bay cable landfall alternative that follows 25th Avenue to Shore Parkway, and then turns northwest, following along a relatively narrow vegetated margin on the west side of Shore Parkway, crossing Bensonhurst Park and continuing along the narrow shoreline to Dyker Beach Park. At that point, the route crosses Shore Parkway and continues along the northeast side of Shore Parkway adjacent to Fort Hamilton, due to the very limited space between the Shore Parkway and the seawall along the shoreline. Crossing under the Verrazzano-Narrows Bridge, this onshore cable route alternative continues along the north side of Shore Parkway to Shore Road Park. From there, this route can continue along the Shore Road Park onshore cable route alternative or continue inland along the 3rd Avenue onshore cable route alternative, as described above for the Verrazzano-Narrows Bridge route alternatives. Routes from the Gravesend Bay landfall are approximately 7.3 to 7.5 mi (11.7 to 12.1 km) long.

The Gravesend Bay onshore cable route alternative was eliminated from the PDE on the basis of its onshore impacts, regulatory challenges, and construction risks. As previously described, this route crosses several municipal parklands, which would likely require parkland alienation legislation. Further, the federal land associated with Fort Hamilton would require coordination and easement rights obtained through the Department of the Army. Portions of this route are also challenging for construction due to space constraints and the presence of dense outfall infrastructure along the Gravesend Bay shoreline. It is also likely that one or more on-land HDD segments would be required, to avoid existing infrastructure, such as on/off ramps in the area of the Verrazzano-Narrows Bridge.

Coney Island Onshore Route

From the export cable landfall alternative on the south shore of Coney Island, the onshore export cable route alternative maximizes use of Ocean Parkway, which is the widest north-south roadway corridor in the vicinity. Space-related considerations for construction and utility congestion would therefore be expected to be greater along other north-south corridors in the vicinity. From the export cable landfall at the Brighton Beach public parking area, this route alternative proceeds north up Brighton 3rd Street to Neptune Avenue, and then north along Ocean Parkway for most of the distance. Ocean Parkway is a wide, divided 6-lane road, edged by trees, and with additional carriage lanes on either side. After entering the Kensington neighborhood, the route turns west along Ditmas Avenue, briefly north along Dahill Road and then continues northwest along 39th Street to the south of the Green-Wood Cemetery until it reaches 2nd Avenue at the southeast corner of the SBMT. This route is approximately 7.4 mi (11.9 km) long.

The longest onshore cable route, from the Coney Island export cable landfall alternative, was determined to be unreasonably challenging, disruptive, and expensive in light of existing utilities, traffic diversions, development density, and space constraints. The route would involve extensive in-street work within densely developed areas of Brooklyn. At the same time, street corridors in Brooklyn already have significant existing utility congestion.

On December 11, 2020, Empire met with the NYCDEP to better understand these constraints and the presence of existing infrastructure. According to the information provided, at minimum, the Coney Island onshore route alternative would expect to encounter a water main and sewer main on every block, with additional considerations needed for storm sewers as well. Additionally, a NYCDEP interceptor main runs east-west along the length of Coney Island, along with the New York MTA subway lines.

This existing utility and infrastructure congestion constraints the available space for routing duct banks for the cables, and the number of infrastructure crossings along the roadway corridor adds significant cost. The construction duration associated with the need for additional geotechnical work; cable splice and transition vaults; HDD, jack-and-bore and other trenchless infrastructure crossings; utility relocations; and soil and water management, decontamination, and disposal is also a factor. In addition to these considerations, Ocean Parkway, which was selected as the widest potential north-south corridor, is designated as New York City Scenic Landmark, which makes it unlikely to be permitted as an onshore export cable route. Stakeholder opposition, due to disruptions from construction noise, traffic, and recreational use are also likely to preclude the use of this route.

2.1.4 EW 2

The routing and siting assessment for EW 2 included onshore substation and export cable landfall locations, as well as associated onshore and submarine export cable routes. In assessing the various alternatives, Empire prioritized a shorter and less complicated onshore route and a marine route avoiding significant constraints offshore. Due to the developed nature of the shoreline, landfalls and onshore routes were developed to minimize impacts to residential areas and stakeholders where possible, while avoiding constructability challenges.

2.1.4.1 Submarine Export Cable Routing

The preferred EW 2 submarine export cable route to the Oceanside POI was designed to minimize environmental impacts by developing the shortest overall route that would avoid major offshore constraints. Two submarine cable route alternatives are discussed for the EW 2 export cable route, which are presented in **Figure 2.1-6**. These routes were evaluated relative to the criteria and constraints described in Section 2.1.2.1. As summarized below, Empire selected EW 2 Route C as the preferred option to carry forward in the PDE due to its avoidance of key constraints such as Cholera Bank and areas with demonstrated higher frequency anchoring activity. In addition, EW 2 Route C exits the Lease Area within the EW 2 Project boundaries, supporting the electrical isolation and commercial independence of EW 2.

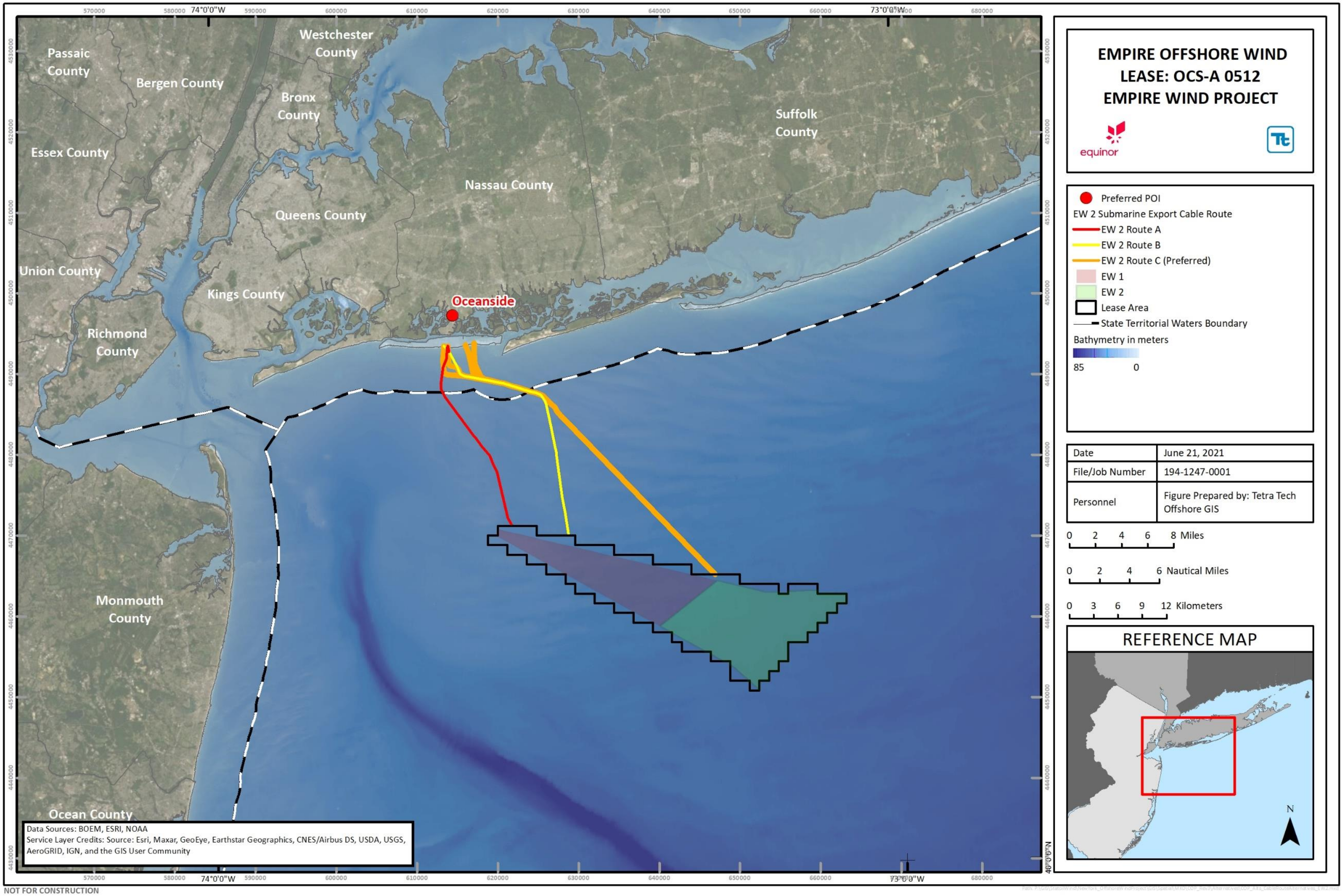


Figure 2.1-6 EW 2 Submarine Export Cable Route Alternatives

EW 2 Route A

A submarine export cable route alternative from the northwestern corner of the Lease Area to Long Beach was evaluated to minimize cable length (18.6 nm [34.5 km]). This route traversed north from the Lease Area, across the outbound and inbound traffic lanes of the TSS. This caused a traverse closer to the higher grounds of Cholera Bank, potentially increasing the impacts to benthic habitat and areas of increased fishing. Further north of the inbound traffic lane, the route crosses an area identified with the AIS vessel data to show increased anchoring by large vessels. As anchoring here is less regulated and more disperse, protection via deeper cable burial would need to occur over a larger area, increasing costs and impacts.

EW 2 Route B

EW 2 Route B (19.6 nm [36.2 km]) was designed to depart the Lease Area from a more centrally located position and stay east of both Cholera Bank and the de facto anchorage area. The route from the Lease Area to the EW 2 landfall runs north-northwest, crossing the inbound and outbound lanes of the Ambrose-Nantucket TSS.

The crossing of the FLAG Atlantic South telecommunications cable occurs about 8.9 nm (16.5 km) from the landfall in approximately 59 ft (18 m) of water, with the route crossing nearly perpendicularly to the fiber optic cable. The route then precedes north, keeping over 1,148 ft (350 m) east of a charted artificial reef area containing multiple known wrecks, before turning to the west-northwest. As the route continues to the west-northwest and approaches the export cable landfall, there are several landfalls under consideration which would result in minor changes to the cable route. These changes are addressed in relation to specific landfall options in Section 2.1.4.3. However, there is a possibility of crossing existing assets including the HVDC Neptune Power Transmission Cable, Transco Lower New York Bay Lateral and the FLAG Atlantic Telecoms cable. Additionally, depending on the landfall, the route may cross the Dredged Material Disposal area understood to take spoils from the dredging of the nearby Jones Inlet. With regards to cable crossings, a similar landfall location with the Transco Lower New York Bay Lateral and the FLAG Atlantic Telecoms cable has been selected to potentially accommodate an HDD capable of drilling under the other assets nearshore, precluding the need for a marine crossing of either asset.

EW 2 Route C

EW 2 Route C (26 nm [48 km]) was designed to better align with the anticipated location of the EW 2 offshore substation, which is expected to be located further southeast within the Lease Area (**Figure 2.1-6**). The EW 2 Route C exits the Lease Area from the central north edge of the Lease Area and travels in a northwestern direction in a relatively straight line until turning west and joining the EW 2 Route B seaward of the state water boundary. From here, the EW 2 Route C then follows the same alignment as EW 2 Route B to landfall. **Figure 2.1-6** shows EW 2 Route C, the preferred EW 2 submarine export cable route, as proposed in this COP.

2.1.4.2 Onshore Substation

Evaluation of the Oceanside POI indicated that adequate space was available immediately adjacent to the existing POI. Empire also assessed the use of a second parcel to the northwest of the Oceanside POI for feasibility and suitability for the development of a new onshore substation. These two sites under consideration for onshore substation development for EW 2 are depicted in **Figure 2.1-7** and were both carried forward in the PDE.

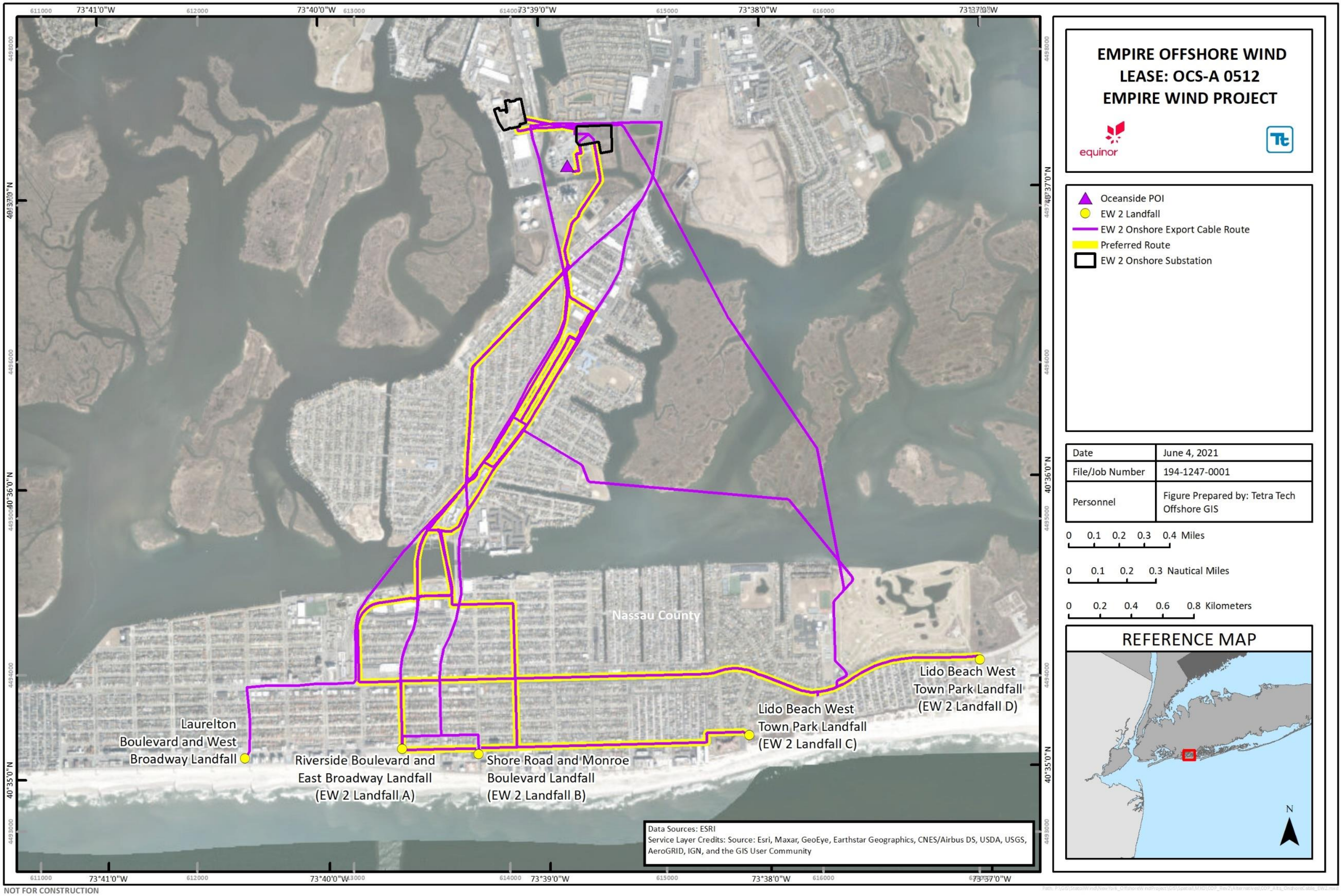


Figure 2.1-7 EW 2 Landfall and Onshore Cable Routes

EW 2 Onshore Substation A

The EW 2 Onshore Substation A will be located on a property at the corner of Daly Boulevard and Hampton Road, in Oceanside, New York. The site is boarded by Hampton Road to the west, Daly Boulevard to the south, and the LIRR and a residential development to the east. North of the site is predominately used as an industrial area. The parcel is privately owned industrial facility. The site does not contain any existing structures that would need to be removed for the construction of the onshore substation.

The interconnection cable route from the EW 2 Onshore Substation A to the POI is approximately 0.5 mi (0.6 km) and crosses NYSDEC mapped tidal wetland adjacent areas. The cable would also be required to cross the LIRR right-of-way and existing overhead transmission, as it enters into the POI parcel.

EW 2 Onshore Substation B

The EW 2 Onshore Substation B will be located at 4005 Daly Boulevard, in Oceanside, New York. The site is bordered by Daly Boulevard and a residential development to the north, Long Beach Road to the east, and an existing power station to the west and south. The parcel is owned by National Grid and currently contains an existing power station. The portion of the parcel in which the onshore substation would be constructed is undeveloped, contains vegetation, and is located within NYSDEC-mapped tidal wetland adjacent areas. The site does not contain any existing structures that would need to be removed for the construction of the onshore substation.

The interconnection cable route from the EW 2 Onshore Substation B to the POI is approximately 0.1 mi (0.2 km) and crosses mapped tidal wetland buffer areas. The cable would cross existing infrastructure within the POI parcel.

2.1.4.3 Export Cable Landfalls

The shoreline adjacent to the export cable landfall locations associated with the Oceanside POI consists of sandy beaches and a boardwalk along Long Beach. The boardwalk consists of sheet piling that would require a trenchless method for installation of the submarine export cable. Long Beach recently underwent a USACE renourishment project, which included the placement of new sand material and the repair of rock jetties. The offshore environment consists of sandy material with wave and current action typical to the region.

Based on the criteria described in Section 2.1.2.3., an analysis was conducted that resulted in the identification of five export cable landfall options within the City of Long Beach and Town of Hempstead, New York. These include, from west to east: a parcel located at the intersection of Laurelton Boulevard and West Broadway; Riverside Boulevard and East Broadway (EW 2 Landfall A); Shore Road and Monroe Boulevard (EW 2 Landfall B); the Lido Beach West Town Park (EW 2 Landfall C); and the Lido Beach Town Park (EW 2 Landfall D). Each is described in more detail below and shown in **Figure 2.1-7**. Empire evaluated only an HDD solution for these export cable landfalls given the nature and potential sensitivity of the area, the need to avoid the sheet piling associated with the boardwalk, and challenge of constructing an open cut landfall on the beach. In selection of preferred export cable landfall alternatives, optimizing the onshore cable route was a key priority due to the potential complexity of cable routing in this area.

In addition, the three westernmost export cable landfalls (not including the Lido Beach West Town Park and Lido Beach Town Park landfalls) are proposed to cross through the proposed Bayside Development, a potential project listed in the City of Long Beach's comprehensive plan, "Creating Resilience: A Planning Initiative," which was updated in January 2018 (City of Long Beach 2018). This comprehensive plan is an update to the City's 2007 Comprehensive Plan, focusing on addressing resiliency measures post-Superstorm Sandy and a more sustainable economy post-economic downturn. The shoreline, which is part of the redevelopment plan, would include programming of pedestrian and bike paths, as well as active recreation and passive recreation, including a kayak launch and new open space areas along the Bayfront. This additional open space would also assist in stormwater management in the area of the new redevelopment as well as the existing North Park neighborhood. Any development proposed by Empire would consider these plans in order to support co-existence.

Based on the assessment summarized below, Empire selected four export cable landfalls as preferred in the PDE for EW 2.

Laurelton Boulevard and West Broadway

This potential export cable landfall location is located in the City of Long Beach and is the furthest west of the sites evaluated along Long Beach. According to the Nassau County Land Records online viewer, this parcel is categorized as vacant commercial land, and it is bounded to the north by West Broadway, to the east by Laurelton Boulevard, and to the south by the raised oceanfront boardwalk adjacent to Ocean Beach Park. There is a high-rise residential complex called Lafayette Terrace to the west, with Lafayette Boulevard further to the west. Immediately across Laurelton Boulevard, there is a high-rise assisted living facility at 274 West Broadway. The site appears to have housed construction trailers and been used for parking. In general, the Ocean Beach Park area offers a variety of recreation opportunities to visitors in summer, including concerts. Use of this export cable landfall would require crossing of the existing Transco Lower New York Bay Lateral potentially via HDD nearer to shore, and then crossing the HVDC Neptune Power Transmission Cable and the FLAG Atlantic Telecoms further offshore.

Potential onshore routes from this export cable landfall location are approximately 3.5 mi (5.6 km) long and would potentially require longer crossings of Reynolds Channel, the inlet feature between Long Beach Island and the mainland (see Section 2.1.5.4). For the HDD landfall construction, this site has the shortest distance to deeper water suitable for setting up the offshore portion of the HDD and potentially the shortest export cable landfall distance. Access from offshore is not completely unobstructed, however, as the route would need to traverse the raised oceanfront boardwalk, which would need to be considered during HDD design. Based on the longer onshore routes and constructability challenges, this export cable landfall was determined not to be preferred.

Riverside Boulevard and East Broadway (EW 2 Landfall A)

This potential export cable landfall location is located in the City of Long Beach and features a mostly bare, vacant parcel adjacent to East Broadway. To the south there is a raised oceanfront boardwalk adjacent to Ocean Beach Park. Immediately to the north across East Broadway there are various high-rises. The site appears to be used predominantly for parking. In general, the Ocean Beach Park area offers a variety of recreation to visitors in summer, including summer concerts. Use of this export cable landfall would require crossing of the existing Transco Lower New York Bay Lateral potentially via HDD nearer to shore, and then crossing the HVDC Neptune Power Transmission Cable and the FLAG Atlantic Telecoms further offshore. The HDD would also be located in the vicinity of the FLAG Atlantic Telecoms cable, but would be appropriately offset.

Potential onshore routes from this export cable landfall location are approximately 3.2 mi (5.1 km) long and offer some of the most favorable routes to the Oceanside POI. This parcel also has a relatively short distance to deeper waters suitable for setting up the offshore portion of the landfall HDD. Access from offshore is not completely unobstructed, however, as the route would need to traverse the raised oceanfront boardwalk, which would need to be considered during HDD design. Empire selected this export cable landfall as one of four preferred options to carry forward in the PDE due to its avoidance of key constraints at the export cable landfall such as residences, commercial properties, and environmental resources (i.e., vegetated habitat or wetlands).

Shore Road and Monroe Boulevard (EW 2 Landfall B)

This export cable landfall in the City of Long Beach consists of an existing paved parking lot to the north of Shore Road and east of Monroe Boulevard. The site is bounded to the west and north by apartments. To the south, the potential HDD path would traverse the end of Monroe Boulevard and a raised oceanfront boardwalk, adjacent to Ocean Beach Park. Compared to other sites considered, it is relatively far from the shoreline along the beach. Use of this export cable landfall would require crossing of the existing HVDC Neptune Power Transmission Cable further offshore. The HDD would also be located in the vicinity of the FLAG Atlantic Telecoms cable, but would be appropriately offset.

Potential onshore routes from this export cable landfall location are approximately 3.4 mi (5.5 km) long and offer some of the most favorable routes to the Oceanside POI. This parcel also has a relatively short distance to deeper waters suitable for setting up the offshore portion of the landfall HDD. Access from offshore is not unobstructed, however. The route would need to traverse the raised oceanfront boardwalk and also the narrow corridor at the end of Monroe Drive between two buildings, which would provide a limited angle of entry for the HDD and which will need to be considered during HDD design. Additionally, due to the proximity of the site to the beach, construction during the summer months may be limited by the local authorities to allow for beach parking during that timeframe, and the use of this area for beach parking represents a potential stakeholder impact for this area. Empire selected this export cable landfall as one of four preferred options to carry forward in the PDE due to its avoidance of key constraints such as HDD length and complexity, offshore depths, and land use.

Lido Beach West Town Park (EW 2 Landfall C)

The export cable landfall at Lido Beach West Town Park consists of an existing large paved parking lot used for beach access, within the Lido West Town Park in Lido Beach in the Town of Hempstead, New York. The site extends to the north as a parking area, not quite reaching Lido Boulevard. Access to the area is from the west, off of Regent Drive. The park extends further to the west with tennis courts and overflow parking areas. Immediately to the south is the beach access, a protective dune area, and a wide, sandy beach (see **Figure 2.1-7**). The beach is open daily with lifeguards in the summertime. Use of this export cable landfall would require crossing of the existing HVDC Neptune Power Transmission Cable and the FLAG Atlantic Telecoms cable offshore. This export cable landfall may also require crossing of the Dredged Material Disposal area understood to take spoils from the dredging of the nearby Jones Inlet and serves as a source for beach renourishment activities.

Potential onshore cable routes from this export cable landfall to the Oceanside POI are approximately 4.4 mi (7.1 km) long. For construction of an HDD, this export cable landfall appears to be able to offer ample potential workspace for setup and transition to the onshore cables. Access from offshore is mostly unobstructed; however, the associated submarine export cable would need to traverse a dredged disposal area. The distance to deeper offshore contours for offshore HDD setup is the farthest of the sites evaluated.

Although this area has relatively low residential density, the potential impact to beach, recreational users, and use of town open space is likely to be a concern with local stakeholders. Due to the proximity of the site to the beach, construction during the summer months may be limited by the local authorities to allow for beach parking during that timeframe. Empire selected this export cable landfall as one of four preferred options to carry forward in the PDE due to its avoidance of key constraints, such as HDD length and complexity, offshore depths, and the availability of space to successfully complete up to three HDDs.

Lido Beach Town Park (EW 2 Landfall D)

The export cable landfall at Lido Beach Town Park consists of a paved parking lot use for beach access and a ball field, within the Lido Beach Town Park located in the Town of Hempstead, New York. The site extends to the north as a parking area, not quite reaching Lido Boulevard. Access to the area is from the north, off of Lido Boulevard. Immediately to the south is the beach access, a protective dune area, and a wide, sandy beach (see **Figure 2.1-7**). The beach is open daily, with lifeguards in the summertime. Use of this export cable landfall would require crossing of the existing HVDC Neptune Power Transmission Cable and the FLAG Atlantic Telecoms cable offshore. This export cable landfall may also require crossing of the Dredged Material Disposal area understood to take spoils from the dredging of the nearby Jones Inlet and serve as a source for beach renourishment activities.

Potential onshore cable routes from this export cable landfall to the Oceanside POI are approximately 5.4 mi (8.7 km) long. For construction of an HDD, this export cable landfall appears to be able to offer ample potential workspace for setup and transition to the onshore cables. Access from offshore is mostly unobstructed. However, the associated submarine export cable would need to traverse a dredged disposal area. The distance to deeper offshore contours for offshore HDD setup is the furthest of all the sites evaluated.

Although this area has relatively low residential density, the potential impact to beach, recreational users, and use of town open space is likely to be a concern with local stakeholders. Due to the proximity of the site to the beach, construction during the summer months may be limited by the local authorities to allow for beach parking during that timeframe. Empire selected this export cable landfall as one of four preferred options to carry forward in the PDE due to its avoidance of key constraints such as HDD length and complexity, offshore depths, and availability of space to successfully complete up to three HDDs.

2.1.4.4 Onshore Cable Routes

Several options of onshore cable route for EW 2 were assessed, based on various route alternatives from the five evaluated export cable landfall sites, across the Reynolds Channel to the Oceanside POI. Route alternatives are shown in **Figure 2.1-7**. Additional minor variants of these routes were also considered during Empire's onshore cable route evaluation.

The preliminary route evaluated from the potential export cable landfall at the intersection of Laurelton Boulevard and West Broadway is approximately 3.5 mi (5.6 km). The route travels from the export cable landfall north up Laurelton Boulevard and turns east along Park Avenue, reaching the LIRR right-of-way. The route follows the LIRR north and crosses the Reynolds Channel, approximately 0.2 mi (0.4 km) wide, at the railroad bridge. The route continues north along the LIRR right-of-way and crosses a canal. It turns east at the intersection of Daly Boulevard and then south into the Oceanside POI.

Several route segments were also evaluated from the four preferred potential export cable landfalls (EW 2 Landfall A through EW 2 Landfall D). The route segments were evaluated from export cable landfall through Long Beach to the crossing at Reynolds Channel immediately to the left of Long Beach Bridge. From the crossing at Reynolds Channel, the route segments were evaluated through Island Park to the onshore substation sites (EW 2 Onshore Substation A and EW 2 Onshore Substation B).

- **EW 2 Long Beach Route A (LB-A) (Riverside Boulevard):** From the export cable landfall at EW 2 Landfall A (Riverside Boulevard/East Park Avenue/Reverend JJ Evans Boulevard/Park Place), the onshore export cables will traverse up Riverside Boulevard to East Park Avenue. The onshore export cables will then turn west until Reverend JJ Evans Boulevard, when the cables will turn north. The onshore export cables will then continue along Reverend JJ Evans Boulevard, which turns into Park Place, until the crossing at Reynolds Channel.

- **EW 2 Long Beach Route B (LB-B) (Monroe Boulevard):** From the export cable landfall at EW Landfall B (Monroe Boulevard/Shore Road), the onshore export cables will traverse up Monroe Boulevard to East Penn Street. The onshore export cables will turn west until connecting into the EW 2 Route LB-A to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route C (LB-C) (Richmond Road/E Broadway/Lincoln Boulevard):** From the export cable landfall at EW 2 Landfall C (Lido Beach West Park), the onshore export cables will traverse west through the park to Richmond Road. The onshore export cables will continue west on Richmond Rd until turning south on Maple Boulevard and then immediately west on E Broadway. The onshore export cables will then turn north onto Lincoln Boulevard or continue west on the EW 2 Route LB Variant. From Lincoln Boulevard, the onshore export cables will continue north until turning west onto E Harrison Street. The onshore export cables will then cross perpendicular to Long Beach Boulevard and turn north onto Long Beach Road, to the crossing at Reynolds Channel. From the EW 2 Route LB Variant, the onshore export cables will connect into LB-B to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route D (LB-D) (Lido Boulevard/E Park Avenue**): From the export cable landfall at EW 2 Landfall C (Lido Beach West Park), the onshore export cables will connect north into Lido Boulevard and traverse west, as Lido Boulevard turns into E Park Ave. The onshore export cables will turn north Lincoln Boulevard, connecting to EW 2 Route LB-C, and/or continue to Riverside Boulevard, connecting with the EW 2 Route LB-A, to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route E (LB-E) (Lido Boulevard):** From the export cable landfall at EW 2 Landfall D (Lido Beach Town Park), the onshore export cables will connect north into Lido Boulevard and traverse west. The onshore export cables will then connect into either EW 2 Route LB-C and/or LB-D to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route Variant (LB Variant) (E Broadway):** The portion of E Broadway between Monroe Boulevard and Lincoln Boulevard in which the EW 2 Route LB-C could connect to EW 2 LB-B to the crossing at Reynolds Channel.

- **EW 2 Island Park Route A (IP-A):** From the crossing at Reynolds Channel, the onshore export cables will traverse north onto Long Beach Road until turning northwest onto Ladomus Avenue, Sherman Road, and then then connecting into EW 2 Route IP-C.

- **EW 2 Island Park Route B (IP-B):** From the crossing at Reynolds Channel, the onshore export cables will enter into the LIRR and traverse north until connecting onto Sherman Road, continuing onto Ladomus Avenue, Sherman Road, and then then connecting into EW 2 Route IP-C.

- **EW 2 Island Park Route C (IP-C):** From the crossing at Reynolds Channel, the onshore export cables will enter into the LIRR and traverse north until turning east onto Sagamore Road and then immediately north onto Industrial Place. The onshore export cables will then turn east onto Trafalgar Boulevard and then north onto Austin Boulevard before turning northwest onto Ladomus Ave, Sherman Road, and then enter into the EW 2 Onshore Substation B site, where it will connect into the

EW 2 Onshore Substation B or connect with EW 2 Route IP-E (if EW 2 Onshore Substation A is selected).

- **EW 2 Island Park Route D (IP-D):** From the crossing at Reynolds Channel, the onshore export cables will enter into the LIRR and traverse north until turning east onto Sagamore Road and then immediately north onto Austin Boulevard. The onshore export cables will then continue north before turning northwest onto Ladomus Avenue, Sherman Road, and then connecting into EW 2 Route IP-C.

- **EW 2 Island Park Route E (IP-E):** From the end of EW 2 Route IP-C, the onshore export cables will continue through EW 2 Onshore Substation B site, traversing west, perpendicularly to Daly Boulevard. The onshore export cables will then cross the LIRR and then turn north, crossing Daly Boulevard, and connecting into the EW 2 Onshore Substation A.

- **EW 2 Interconnection Cable Route A (IC-A):** From the EW 2 Onshore Substation A site, the interconnection cable will HDD to the Oceanside POI parcel, where the interconnection cables will connect into the Oceanside POI, if EW 2 Onshore Substation A site is selected.

- **EW 2 Interconnection Cable Route B (IC-B):** From the EW 2 Onshore Substation B site, the interconnection cable will connect into the Oceanside POI, if EW 2 Onshore Substation B site is selected.

One additional route from EW 2 Landfall A was considered, in which the onshore export cable route would continue north on Riverside Boulevard, until meeting up with the Reynolds Channel crossing. Based on discussions with the City of Long Beach, this route was eliminated from consideration due to concerns over potential impacts to the local community. This route also had the potential to directly impact the proposed Bayside Development, while crossing Sherman Park, which is listed as a potential project under the City of Long Beach's 5-year and 20-year development proposals.

Two additional routes were also considered from the Lido Beach West Town Park Landfall (EW 2 Landfall C). The first route is approximately 3.9 mi (6.3 km), and begins at the Lido Beach West Town Park where it turns east along Lido Boulevard, then turns north and traverses along the western edge of the Lido Golf Club. The Reynolds Channel crossing would begin at the northwestern corner of the Lido Golf Club and go northwest toward Shell Creek Park in Island Park, using HDDs via the East Channel Islands. From Shell Creek Park, the route would continue northwest along Traymore Boulevard to Austin Boulevard. The route would turn north on Austin Boulevard, continuing north onto Long Beach Road, and turn west onto Daly Boulevard to the Oceanside POI.

The second additional route considered from the Lido Beach West Town Park Landfall (EW 2 Landfall C) is approximately 2.7 mi (4.3 km) long. This route also begins at the Lido Beach Town Park and traverses east along Lido Boulevard before turning north and traversing along the western edge of the Lido Gulf Club. The onshore export cables will then cross the East Channel Islands and nearby waters through a series of HDDs to the Oceanside POI.

Based on the constructability and environmental criteria as described in Section 2.1.2.4, Empire determined that the most suitable onshore export cable routes to the Oceanside POI are the various segments described from the four preferred potential landfalls, which are subsequently referred to as EW 2 LB-A through LB-E, the LB Variant, and IP-A through IP-D. These routes have been retained in the PDE for EW 2 as the preferred alternatives.

2.2 Project Components and Technology

Alternative components and technology considered for the PDE include alternative foundations and alternative export cables.

2.2.1 Foundations

Empire evaluated several potential types of foundations for wind turbines and offshore substations: monopile, piled jacket, gravity base structure (GBS), suction bucket jacket, suction bucket monopile, and floating. A short description of each foundation type is provided in **Table 2.2-1**. Each foundation type was evaluated based on the following criteria:

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

Table 2.2-1 Foundation Under Evaluation

Foundation Type	Description
Monopile	A single vertical, broadly cylindrical steel pile driven into the seabed. A steel transition piece, which may contain secondary structure components (i.e., boat landings and access platforms), will be connected to the monopile.
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, from which piles are inserted and connected through cross-bracing.
GBS	A reinforced concrete structure, consisting of a circular base slab connected to a conical shell and a vertical concrete shaft. A steel transition piece, which may contain secondary structure components (i.e., boat landings and access platforms), will be connected to the vertical concrete shaft.
Suction Bucket Jacket	A vertical steel lattice structure consisting of three or four legs, which contain inverted bucket-like structures at the base, connected through cross-bracing.
Suction Bucket Monopile	A single vertical, broadly cylindrical steel monopile, which contains a single inverted bucket-like structure at the base.
Floating	A floating structure, typically a spar or semi-submersible, which is tethered to the seafloor through a set of anchoring devices.

Suction bucket jackets and floating foundations were removed from additional consideration because the conditions in the Project Area are not suitable. Suction bucket jackets are more typically appropriate for areas with characteristics that allow the buckets to achieve appropriate penetration and the proper soil-structure interaction for the jacket. Survey data has demonstrated that the seabed sediment in most locations (0 to 33 ft [0 to 10 m] below surface) consists of loose marine sand, limiting the holding capacity of the buckets. Floating foundations are generally considered appropriate for installations at much deeper water depths than are present in the Lease Area. Floating foundations are not considered appropriate for the PDE because the water is not deep enough to justify the additional costs and engineering considerations. Suction bucket monopiles were also deemed not to be technically or commercially feasible for the development timescales associated with this Project; however, they will continue to be monitored for future consideration. As such, suction bucket foundations and floating platforms are not considered feasible for the PDE. For the offshore substation, the

GBS foundation was also removed due to design challenges associated with the placement of J-tubes, operational challenges associated with the boat landing, and accommodation of the crew transfer vessel. Placement of the J-tubes could potentially result in thermal issues due to overcrowding at the cable deck as well as challenges for cable pull-in during installation.

Three foundation types were originally deemed suitable for wind turbines against the criteria identified above: monopile, piled jacket, and GBS. As Empire matured the Project, the piled jacket foundation for wind turbines was removed from the PDE. One foundation type is deemed suitable for the PDE for the offshore substation: piled jacket. Design considerations for these foundation types will continue to be focused on foundation suitability with regards to geotechnical conditions. The GBS foundation requires the upper soil layers to have the strength to sustain the heavier load. The surface may require improvements to support distributing such a load and stabilizing the installation. Improvements may include installation of a gravel pad; dredging loose sand to be replaced by rock fill; or the use of skirts. These solutions will vary in depth and height, depending on the stability of the native sediment layers. All of these solutions are currently considered within the PDE based on data collected to date.

While a piled solution (monopile or piled jacket) for a wind turbine or offshore substation may not require the same level of ground preparation for installation, these foundation types do need to consider the drivability relevant to geotechnical conditions. Empire has completed drivability assessments to confirm feasibility. A monopile drivability study on selected (representative) locations for the Project was performed for a 31-ft (9.5-m) diameter monopile with 3-inch (8-centimeter) wall thickness and an embedment of 131 ft (40 m) using an IHC S-4000 hammer, which is representative of the smallest wind turbine size under consideration for the PDE. These analyses provide a general estimate of monopile drivability for locations with high, average, and low cone penetration resistance.

Five representative soil profiles for the Lease Area were selected for drivability analyses based on CPT data from the geotechnical surveys completed for the Project. CPT tip resistance was plotted for wind turbine locations and grouped into three general categories: high, average and low resistance. CPT profiles for static resistance to driving calculations were selected using these plots and soil layering was selected based on a single, specific profile from each of the three groups. A summary of pile and hammer inputs used for the drivability assessment are summarized in **Table 2.2-2**.

Table 2.2-2 Summary of Pile and Hammer Inputs for Preliminary Drivability Tests Conducted by Empire

IHC S-4000, Standard Inputs from GRLWEAP Hammer Database	
Hammer	Ram Weight: 1,977.15 kN, Energy: 3,999.78 kJ
Efficiency	0.9 Constant
Stroke	6.6 ft (2.0 m)
Helmet weight	1,000 kN (assumed)
Pile length	236 ft to 269 ft (131 ft embedment + 89 ft to 121 ft water depth + 16 ft stickup) (72 m to 82 m [40 m embedment + 27 m to 37 m water depth + 5 m stickup])
Pile penetration	131 ft (40 m)
Pile diameter	31 ft (9.5 m)
Pile wall thickness	0.3 ft (0.1 m)

Table 2.2-2 Summary of Pile and Hammer Inputs for Preliminary Drivability Tests Conducted by Empire (continued)

IHC S-4000, Standard Inputs from GRLWEAP Hammer Database	
Tip area	26 ft^2 (2.4 m^2)
Pile Elastic Modulus	21 MPa
Pile specific weight	77 kN/m^3

The total blow count for each profile, using a hammer efficiency of 0.9 for all depths is provided in **Table 2.2-3**.

Table 2.2-3 Hammer Blow Summary

Soil profile	High estimate (WTG 27)	Average estimate (WTG 34)	Low estimate (WTG 47)	EQ19451-BH-04/31	EQ19451-BH-48/22
Pile length	246 ft (75 m)	253 ft (77 m)	262 ft (80 m)	246 ft (75 m)	253 ft (77 m)
Total blows	3,506	845	626	2,906	2,317

From this assessment, Empire can ascertain that geotechnical conditions within the Lease Area are suitable for the maximum dimensioned foundation under consideration within the PDE for the wind turbines and offshore substations.

Final selection and design of foundations is pending detailed soil data, which will be supported with additional geotechnical surveys within the Lease Area. This data will be provided to BOEM in the FDR/FIR. Piled jackets and monopiles are in general robust structures, where bearing capacity and structural integrity may be designed safely with adjusted pile penetration depth, pile diameter, and pile wall thickness. In addition, pile run-off and pile refusal during driving will be checked. Integrity of a GBS foundation under environmental forces is more sensitive to weak horizontal layers across the foundation footings, as the load bearing failure would seek such weak surfaces of any thickness, such as in sediment depositions from old rivers and deltas. The extent of such features will be identified through the site-specific soil investigations, which will then further define the extent of seabed preparation for this foundation type.

2.2.2 Export Cables

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

- Transmission distances;
- Economic considerations; and
- Land required to support onshore electrical facilities.

The submarine export cables are designed to use HVAC rather than HVDC due to the considerably lower costs to connect HVAC into a primarily alternating current system. HVDC is a considerably larger investment than HVAC and is only cost-effective for wind farms with a larger nameplate capacity than is planned for either EW 1 or EW 2, or for long transmission lines carrying very large power capacities. The transmission distance and power rating of the submarine export cable makes it suitable for the more cost-effective HVAC system. Therefore, HVDC transmission was not selected as an option and therefore not carried forward into the PDE.

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

As described in Section 2.1.1, Empire selected two POIs to support the two independent wind farms anticipated as part of the overall development of the Lease Area: Gowanus, New York (EW 1) and Oceanside, New York (EW 2).

Subsequently, based on the analysis presented herein, Empire has selected the siting options summarized in **Table 2.3-1** to carry forward in the PDE, as further discussed in **Section 3**.

Table 2.3-1 Summary of Project Siting Options in the PDE

Project Element	EW 1	EW 2
POI	Gowanus	Oceanside
Submarine Export Cable Route	EW 1 Route B	EW 2 Route C
Onshore Substation	EW 1	EW 2 Onshore Substation A and EW 2 Onshore Substation B
Submarine Export Cable Landfall	EW 1	Riverside Boulevard and East Broadway (EW 2 Landfall A) Shore Road and Monroe Boulevard (EW 2 Landfall B) Lido Beach West Town Park (EW 2 Landfall C) Lido Beach Town Park (EW 2 Landfall D)
Onshore Cable Route	EW 1	EW 2 LB-A through LB-E, LB Variant, and IP-A through IP-E

With regards to technological solutions, Empire will evaluate impacts associated with two foundation types for wind turbines (monopile and GBS) and one foundation type for offshore substations (pile jacket). Electrical transmission will be based on HVAC.

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	https://www.boem.gov/marine-minerals/requests-and-active-leases	N/A
NOAA 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
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

Table 2.4-1 Data Sources (continued)

Source	Includes	Available at	Metadata Link
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
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	
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
NY OPDGIG	Wreck Dive Site	http://opdgig.dos.ny.gov/arcgis/rest/services/NYOPDIG/HumanUseData/MapServer/18	http://opdgig.dos.ny.gov/geoportal/catalog/search/resource/detailsnoheader.page?uuid={4990846B-A419-486B-AA9F-A7D770382832}
NYSDEC	Proposed Artificial Reef	https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/Master-Plan/17-25g-Consideration-of-Potential-Cumulative-Effects.pdf	N/A

BOEM (Bureau of Ocean Energy Management). 2014. BOEM and New York State Sign Agreement to Identify Sand Resources for Coastal Resilience and Restoration Planning. Available online: https://www.boem.gov/press05202014/. Accessed 26 June 2019.

BOEM. n.d. Marine Minerals: Requests and Active Leases. Available online: https://www.boem.gov/marine-minerals/requests-and-active-leases. Accessed 9 February 2021.

City of Long Beach. 2018. Creating Resilience: A Planning Initiative. Available online: https://www.longbeachny.gov/vertical/sites/%7BC3C1054A-3D3A-41B3-8896-814D00B86D2A%7D/uploads/Draft_Comp_Plan_012318_rev.pdf. Accessed 28 July 2020.

MMIS (Marine Minerals Information System). 2019. Available online: https://mmis.doi.gov/arcgis/rest/services/MMIS/PlanningandAdministration/MapServer/5. Accessed 28 June 2019.

NJGWS (New Jersey Geologic and Water Survey). 2019. Survey Programs. Available online: https://njgeology.org/functions/index.htm. Accessed 26 June 2019.

NYC Emergency Management. 2019. NYC's Risk Landscape: A Guide to Hazard Mitigation. Chapter 4.2: Coastal Erosion. Available online: https://www1.nyc.gov/assets/em/downloads/pdf/hazard_mitigation/nycs_risk_landscape_chapter_4.2_coastalerosion.pdf. Accessed 15 February 2021.

NYSERDA (New York State Energy Research and Development Authority). 2017. New York State Offshore Wind Master Plan: Sand and Gravel Resources Study. Available online: https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Studies-and-Surveys.

USACE (U.S. Army Corps of Engineers). 2019. New York and New Jersey Harbor Anchorages Study. Available online: https://www.nao.usace.army.mil/NYNJAnchoragesStudy/. Accessed 25 November 2019.

USACE. 2020. New York and New Jersey Harbor Anchorages Final General Reevaluation Report and Environmental Assessment. April 2020. Available online: https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll7/id/14379. Accessed 20 August 2020.

3. PROJECT DESCRIPTION

This section provides a Project description, which is comprised of components proposed as part of the PDE (see **Section 1.3**). Activities associated with the construction and installation, operations 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:

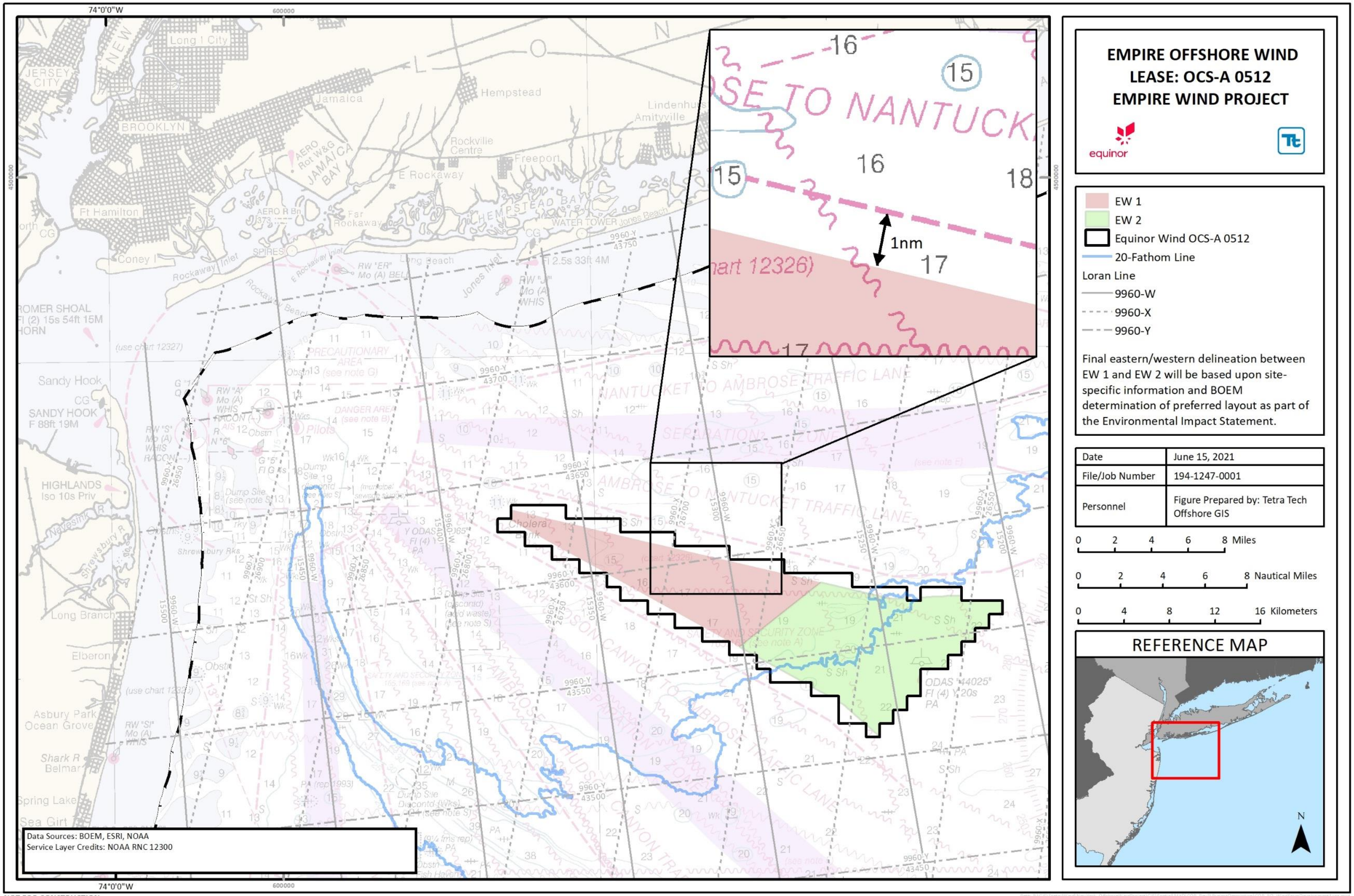
- A summary of the Wind Farm Development Area (WFDA) within Lease OCS-A 0512;
- A summary of the Lease Area Development approach;
- A summary of both the offshore and onshore Project infrastructure, including the anticipated operational footprint associated with each component;
- A summary of both the 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 Wind Farm Development Area within Lease OCS-A 0512

The Project includes offshore and onshore components. The wind turbines and offshore substations will be located offshore in the WFDA, which is a subset of the Lease Area. Based on the outputs of preliminary assessments and the Navigation Safety Risk Assessment (NSRA), Empire has committed to maintaining a minimum 1-nm (1.85-km) separation between the southern and northern periphery structures and the bordering TSS lanes. This is built into the Layout Rules (see Section 3.3.1.3) and has been discussed with key stakeholders; this separation distance is also supported by the NSRA completed for the Project (see Appendix DD). On this basis, the area within which structures can be built within the Lease Area is shown in **Figure 3.1-1** and is equal to 63,559 ac (25,721 ha) (or approximately 80 percent of the total Lease Area). This does not include sub-seabed structures such as submarine export cables and interarray cables, which may still be installed within the Lease Area, WFDA and easements, per 30 CFR § 585.300. A summary of key parameters for Lease OCS-A 0512 is provided in **Table 3.1-1**.

Table 3.1-1 OCS A-0512

OCS A-0512 Lease Area	79,350 ac (32,112 ha)
Wind Farm Development Area (total)	65,458 ac (26,490 ha)
EW 1	27,095 ac (10,965 ha)
EW 2	38,363 ac (15,525 ha)
Water Depths (total range)	75 ft to 135 ft (23 m to 41 m)
EW 1	76 ft to 118 ft (23 m to 36 m)
EW 2	108 ft to 135 ft (33 m to 41 m)



NOT FOR CONSTRUCTION

Figure 3.1-1 Wind Farm Development Area within Lease OCS-A 0512

3.2 Lease Area Development

Empire is proposing to develop the Lease Area in two wind farms in accordance with 30 CFR § 585.629. EW 1 and EW 2, being electrically isolated and independent from each other, will each be connected to their own POIs via individual export cable routes. EW 1 and EW 2 were selected as the winning bidders in New York State's competitive solicitation for Offshore Wind Renewable Energy Credits in 2019 and 2021, respectively.

The Lease Area is being assessed and included as part of this COP submission. The western portion of the Lease Area will be the area for EW 1, with the eastern portion of the Lease Area to be the area for EW 2.

As discussed in **Section 1**, in order to assess impacts to resources using the design envelope approach, the Maximum Design Scenario is defined as the complete build-out of the Lease Area. The options in the PDE apply for all of the Lease Area and for both EW 1 and EW 2. Empire has surveyed and/or assessed resources and effects to the same level for the entire Lease Area for the purposes of this COP.

3.3 Project Infrastructure Overview

Empire 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 describes the offshore infrastructure and the components proposed in the PDE. Section 3.3.2 describes the onshore infrastructure and the components proposed in the PDE. The conceptual project design drawings are provided for reference as **Appendix E**.

3.3.1 Offshore Infrastructure

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

As discussed in **Section 1.3 Design Envelope Approach** and **Volume II, 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. 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.

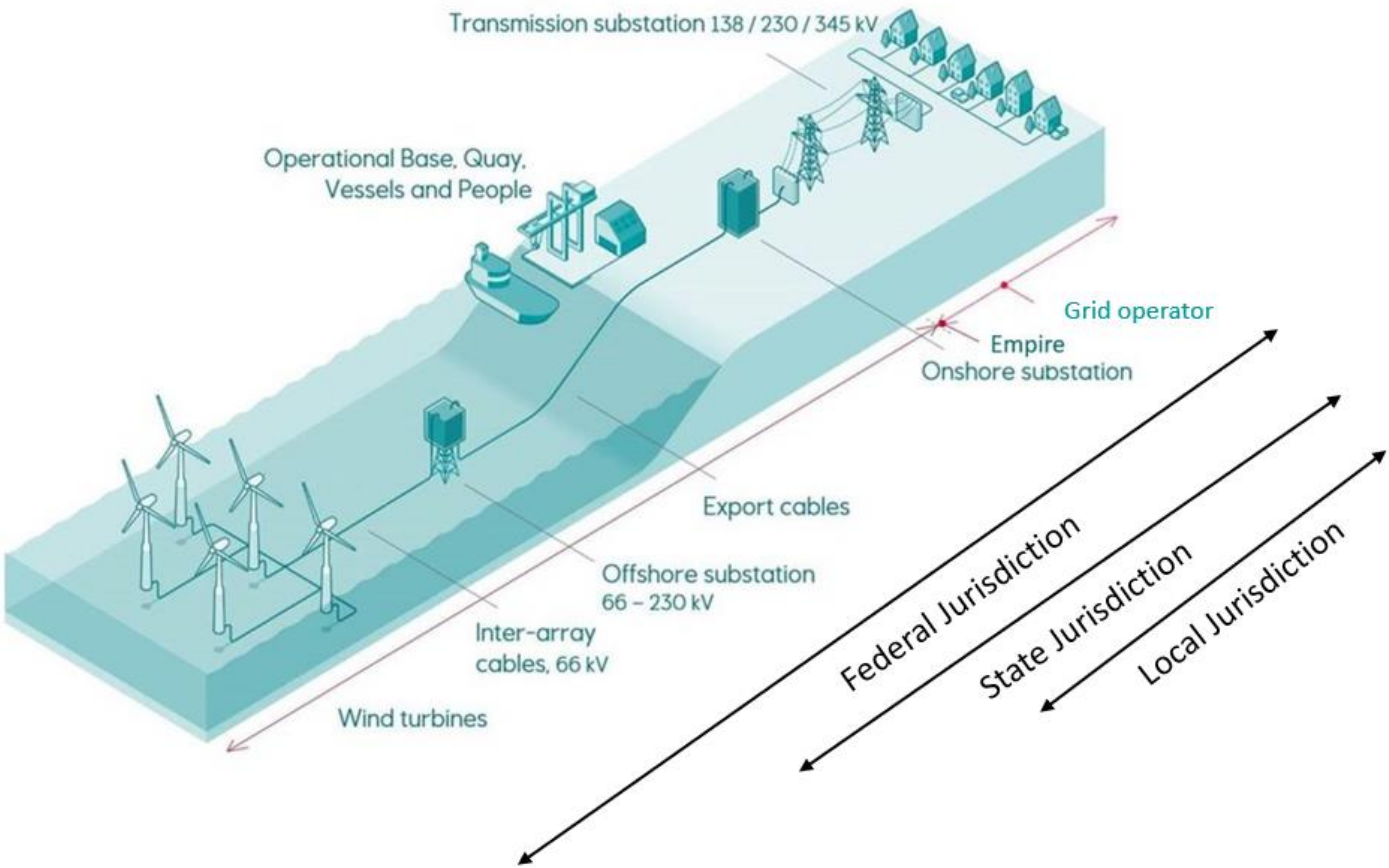


Figure 3.3-1 Overview of the Project Offshore and Onshore Infrastructure

Table 3.3-1 details the parameters for the wind turbines proposed in the PDE.

Table 3.3-1 Summary of Wind Turbine Maximum PDE Parameters

Parameter	EW 1	EW 2
Approximate Total Number	71	103
Hub Height above Highest Astronomical Tide (HAT)	525 ft (160 m)	
Upper Blade Tip above HAT	951 ft (290 m)	
Lower Blade Tip above HAT	98 ft (30 m)	
Rotor Diameter	853 ft (260 m)	

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

- **Tower:** Steel tubular section that supports the rotor and nacelle, in addition to providing the height required to efficiently capture wind energy. The tower is the piece connected to the foundation and typically holds some control and electrical components within or at the base while also providing access to the nacelle for servicing.

- **Nacelle:** Box-like structure at the top of the tower that houses the electro-mechanical components of the wind turbine. The nacelle may also contain other equipment, such as transformers, yaw systems, and gearboxes.

- **Rotor:** Consists of the three blades and the hub (where the blades connect into). The rotor is responsible for the extraction of wind energy, which is then converted into electricity by the generator. Rotors 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 the dimensions for the maximum-sized wind turbine in the PDE.

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 that contain them, will be disposed of in accordance with industry guidelines and regulatory requirements. **Table 3.3-2** below 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.

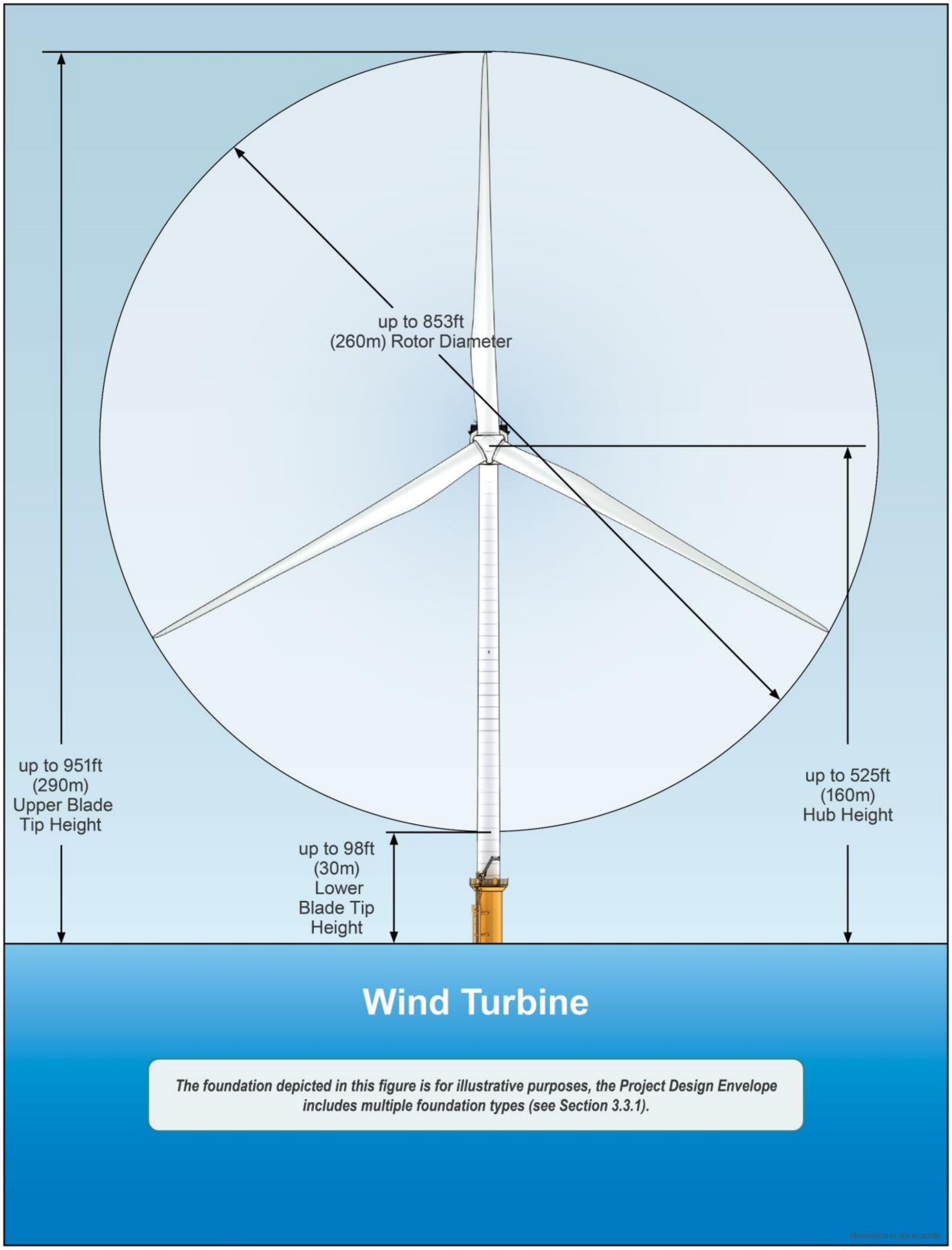


Figure 3.3-2 Representative Wind Turbine

Table 3.3-2 Summary of Wind Turbine Oil/Grease/Fuel Maximum PDE Parameters

Oil/Grease/Fuel	EW 1	EW 2
Transformer Oil	2,378 gal (9,000 l)	
Main Bearing Grease	95 gal (360 l)	
Yaw Grease	32 gal (120 l)	
Yaw Gear Oil	95 gal (360 l)	
Main Bearing Grease	95 gal (360 l)	
Hydraulic Oil	264 gal (1000 l)	
Cooling (Water/Glycerol)	872 gal (3300 l)	
Pitch Lubrication (Grease)	53 gal (200 l)	
Pitch System Hydraulic Accumulators (Nitrogen)	17,171 gal (65,000 l)	
Pitch Gearbox Oil	18 gal (70 l)	
Gearbox Oil (Gear Oil)	1,057 gal (4,000 l)	
Sulfur Hexafluoride (SF_6 Gas)	287 pounds (130 kg)	

The wind turbines selected 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.

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 FAA guidelines and regulations (see Section 3.5.3 for additional information on marking and lighting).

In addition to the marking and lighting measures described in Section 3.5.3, Empire proposes to include an 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, as a base case, pending commercial availability, technical feasibility, and agency review and approval (see **Section 8.6 Aviation** for additional details).

3.3.1.2 Foundations

Foundations are required to secure the wind turbines and offshore substations 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 offshore substations. Descriptions of the foundation types proposed are:

- **GBS**: a reinforced concrete structure, consisting of a circular base slab connected to a conical shell and a vertical concrete shaft. A transition piece (TP), which may contain secondary structure components (i.e., boat landings and access platforms), will be connected to the vertical concrete shaft.

- **Monopile**: a single vertical, broadly cylindrical steel pile driven into the seabed. A steel TP will be connected to the monopile.

- **Piled Jacket**: a vertical steel lattice structure consisting of three or four legs connected through cross bracing, which is secured to the seabed through the installation of piles.

An illustration of the foundation types included in the wind turbine foundation PDE is presented in **Figure 3.3-3**. A summary of parameters from the wind turbine foundation PDE is included in **Table 3.3-3**.

The PDE for the wind turbine foundation includes GBS and monopile. The PDE for the offshore substation foundation includes the piled jacket.

All foundation types remaining in the PDE have been determined to be technically feasible for installation within the Lease Area, based upon the data available and collected to date (including the results of the geotechnical data collected within the Lease Area; see **Section 2 Project Design Development** and **Appendix H Marine Site Investigation Report** for additional information). Empire is in the process of collecting and reviewing the site-specific data in support of its FDR/FIR. This additional field data, combined with other studies (e.g., tank testing for erosion and scour design, drivability and pile capacity checks) will help determine the final foundation type for EW 1 and EW 2.

Table 3.3-3 Summary of Wind Turbine Foundation PDE Parameters

Foundation Parameter	EW 1	EW 2
Gravity Base Structure		
Base diameter	180 ft (55 m)	
Seabed penetration	23 ft (7 m)	
Seabed footprint (without scour protection) a/	25,575 ft^2 (2,376 m^2)	
Seabed footprint (with scour protection) b/	395,864.3 ft^2 (36,777 m^2)	
Diameter at mean sea level (MSL)	39 ft (12 m)	
Monopile		
Base diameter	49 ft (15 m)	
Seabed penetration	180 ft (55 m)	
Seabed footprint (without scour protection) a/	1,905 ft^2 (177 m^2)	
Seabed footprint (with scour protection) b/	33,857 ft^2 (3,147 m^2)	
Diameter at MSL	39 ft (12 m)	

Notes:
a/ Per foundation
b/ Per foundation if scour protection is required

An illustration of the foundation types included in the offshore substation foundation PDE is presented in **Figure 3.3-4**. A summary of parameters from the offshore substation foundation PDE are included in **Table 3.3-4**.

As shown in the above and below tables, scour protection is proposed to be installed around all foundation types, for the purpose of a maximum design assessment (see Section 3.3.1.6 for additional information on scour protection).

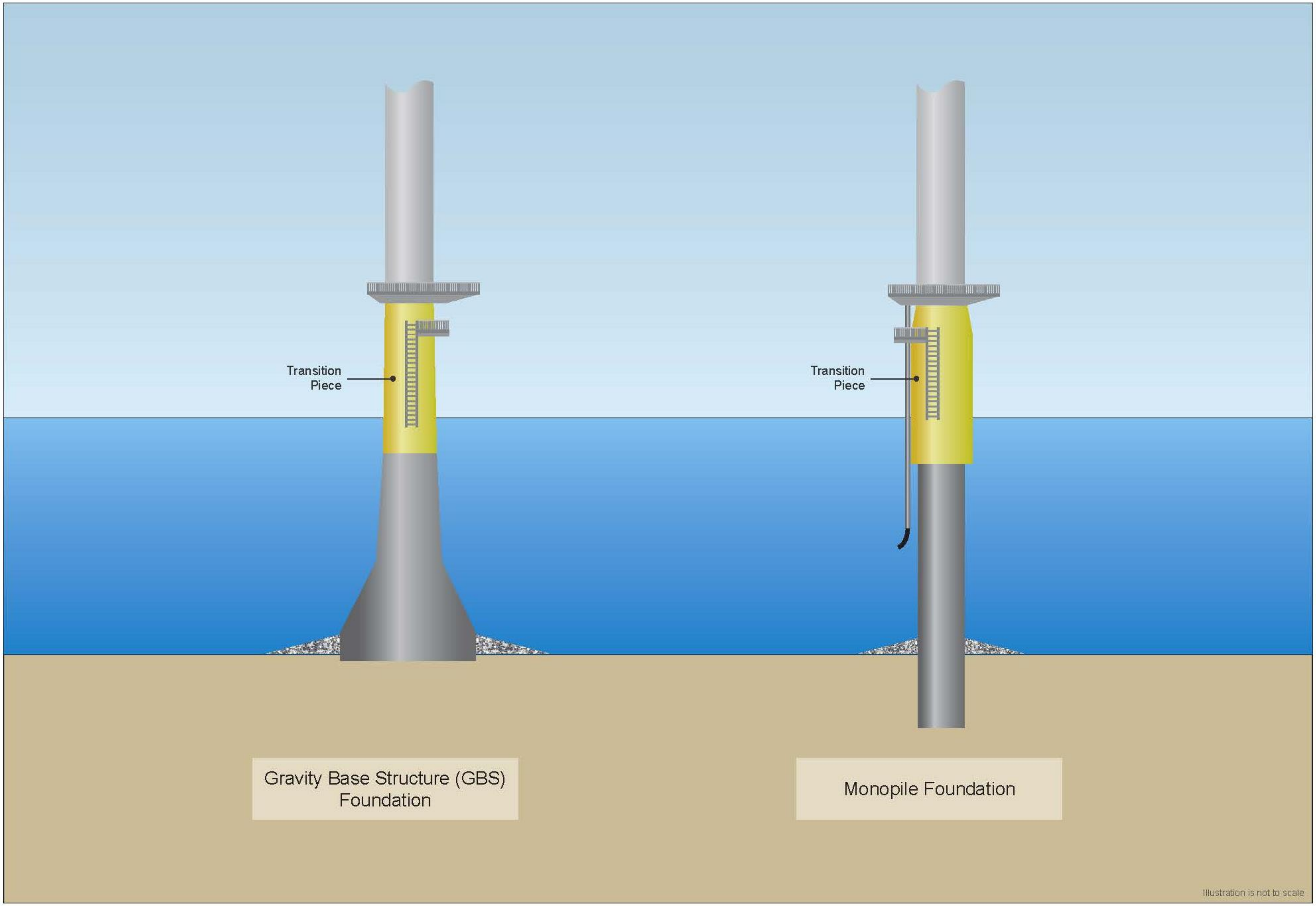


Figure 3.3-3 Wind Turbine Foundation Types

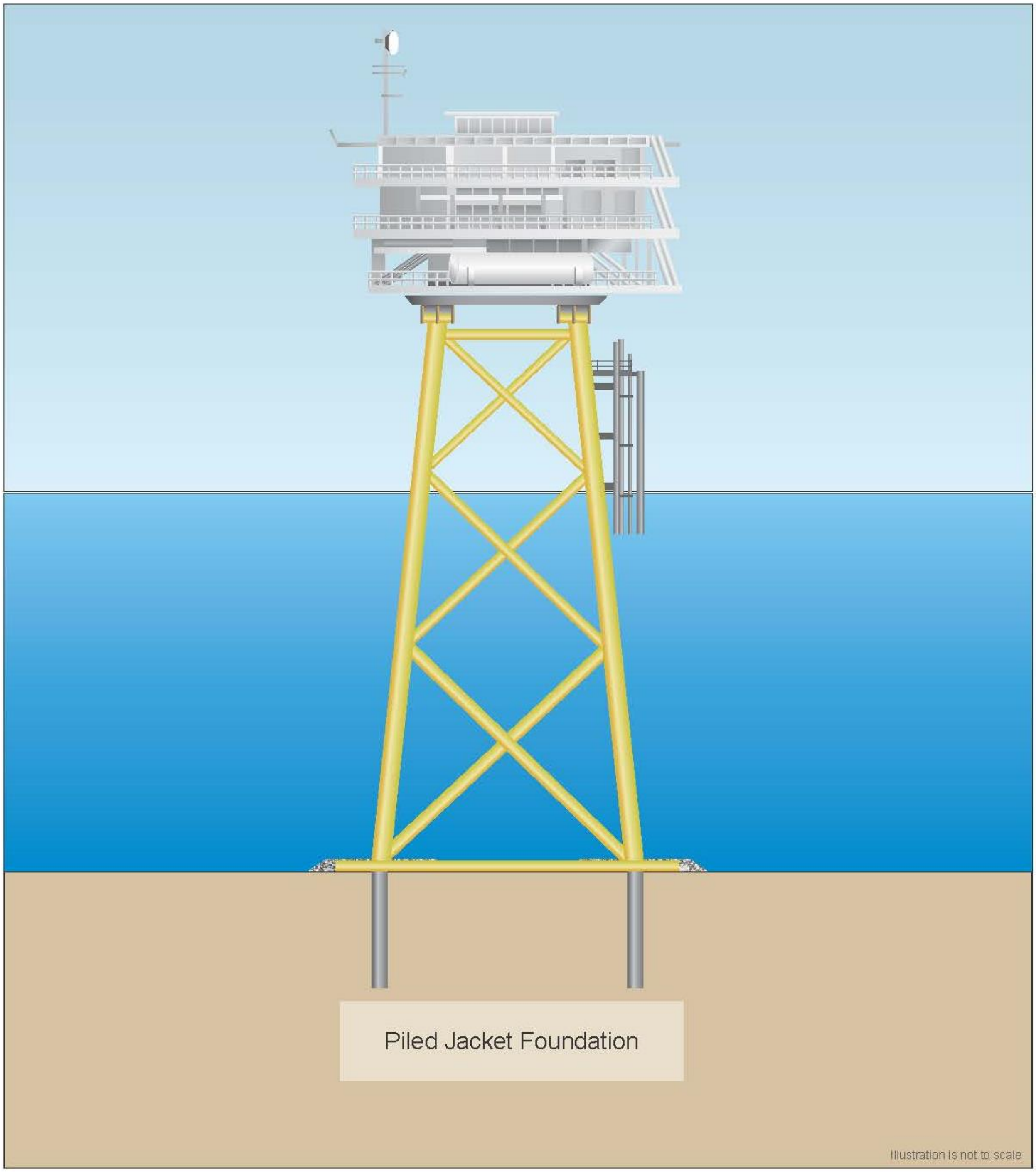


Figure 3.3-4 Offshore Substation Foundation Type

Table 3.3-4 Summary of Offshore Substation Foundation Maximum PDE Parameters

Foundation Parameter	EW 1	EW 2
Piled Jacket a/		
Leg spacing at seabed	197 ft x 148 ft (60 m x 45 m)	
Pile diameter	13 ft (4 m)	
Seabed penetration	295 ft (90 m)	
Seabed footprint (without scour protection) b/	29,063 ft^2 (2,700 m^2)	
Seabed footprint (with scour protection) c/	93,517 ft^2 (8,692 m^2)	
Leg spacing at MSL	164 ft x 148 ft (50 m x 45 m)	

Notes:
a/ For piled jackets designed with up to 4 legs, 3 piles per leg. For piled jackets designed with 6 to 8 legs, up to 2 piles per leg
b/ Per foundation
c/ Per foundation if scour protection is required

3.3.1.3 Offshore Substation

The offshore substation will collect power from the wind turbines via the interarray cable systems. 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. The PDE proposes the installation of two offshore substations to support the Project. The details and parameters provided and detailed in this section refer to the topside of the offshore substation; the foundation is discussed in Section 3.3.1.2. **Table 3.3-5** details the parameters for the offshore substation topsides.

Table 3.3-5 Summary of Offshore Substation Topside Maximum PDE Parameters

Offshore Substation Topside Parameter	EW 1	EW 2
Voltage	230 kV	
Width	194 ft (59 m)	
Length	203 ft (62 m)	
Height	92 ft (28 m)	
Base height above HAT (air gap)	108 ft (33 m)	

As with the wind turbines, oils, greases, and fuels will be required for lubrication, cooling, and hydraulic transmission. The precise volumes required will vary depending on the selected topside. The offshore substation 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 that contain them, will be disposed of in accordance with best practice guidelines and regulatory requirements. **Table 3.3-6** 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 3.3-6 Summary of Offshore Substation Oil/Grease/Fuel Maximum PDE Parameters

Oil/Grease/Fuel	EW 1	EW 2
Transformer/Reactor Oil	158,503 gal (600,000 l)	
Sulfur Hexafluoride (SF_6 Gas)	8,818 lbs (4,000 kg)	
Diesel Fuel	7,925 gal (30,000 l)	
UPS Batteries	66,139 lbs (30,000 kg)	

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

The offshore substation will consist of multiple deck levels, which will include the cables, equipment, and utilities. The offshore substation will also be compatible with a gangway system and will feature boat landings (see Section 3.3.1.2 for additional information on the foundation). The layout of the offshore substation will also consider pull-in and hook-up of inter-array and export cables using J-tubes. While the offshore substation will normally 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, and maintenance of the substation (see **Section 3.5 Operations and Maintenance Activities** for additional information on operations). **Figure 3.3-5** shows an example of an offshore substation.

Figure 3.3-5 Example of an Offshore Substation on a Jacket Foundation (Equinor-operated Dudgeon Offshore Wind Farm)

3.3.1.4 Submarine Export Cables

The submarine export cables will be HVAC. The HVAC submarine export cables proposed will consist of three-core cable with copper conductors, cross-linked polyethylene (XLPE) insulation system, and armoring package designed for voltage levels of 230 kV. The conductors will be made of stranded or segmented copper wires and will be protected against longitudinal water ingress by mean of water-blocking compound, yarns, and/or tapes. The power cores will incorporate a lead alloy sheath together with a polymeric sheathing, which will prevent radial water ingress into the power cores. A water swellable tape will be applied under the lead sheath to prevent longitudinal water ingress. The three insulated power cores will be laid together in a trefoil formation together with fiber optic elements and extruded polymeric shaped fillers. The extruded fillers are placed in the interstices between the power cores to give a substantially round shape to the power core bundle. An armoring package made of an armoring bedding and a layer of steel or a combination of steel and polymeric armor wires flushed with bitumen will be applied over the bundle. Finally, an outer serving made of polypropylene yarns will be applied over the armoring package. The submarine export cables will also have integrated optical fibers for communication and temperature measurements. An example of a submarine export cable is found in **Figure 3.3-6**.

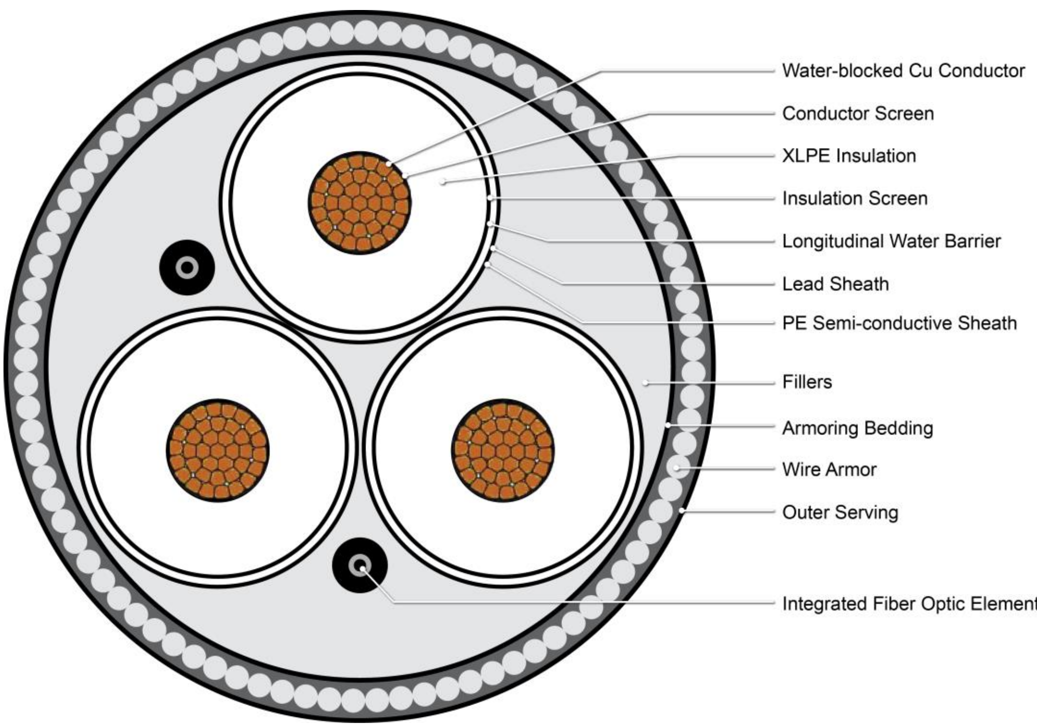
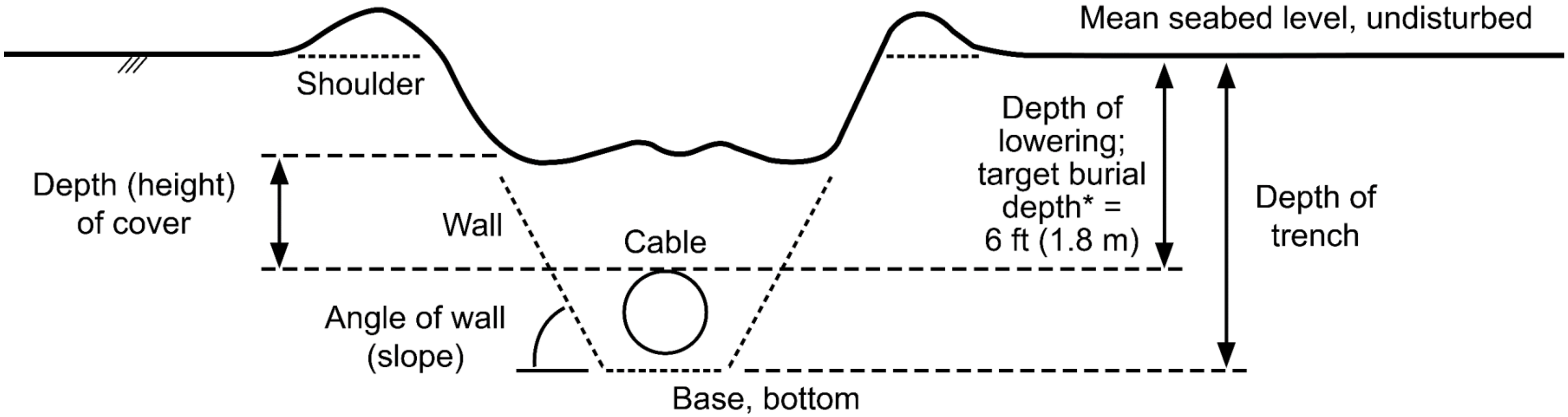


Figure 3.3-6 Representative Cross-Section of Submarine Export Cable

Based upon guidance provided by USACE in a letter dated September 20, 2018, submarine cables will be buried to a minimum target burial depth of 6 ft (1.8 m) below the seafloor outside of federally maintained (e.g., anchorages and shipping channels) areas (see **Figure 3.3-7**). In locations where the cable must cross federally maintained areas, the cable will be buried to a minimum burial depth of 15 ft (4.7 m) below the current or future authorized depth or depth of existing seabed (whichever is deeper) [22]. The scenarios for work within federally maintained areas are depicted in **Figure 3.3-8**.

[22] Empire 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 CBRA and is subject to regulatory approval.



*Note: Target burial depth will be 15 ft (4.7 m) 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).

Figure 3.3-7 Submarine Export Cable Target Burial Depth

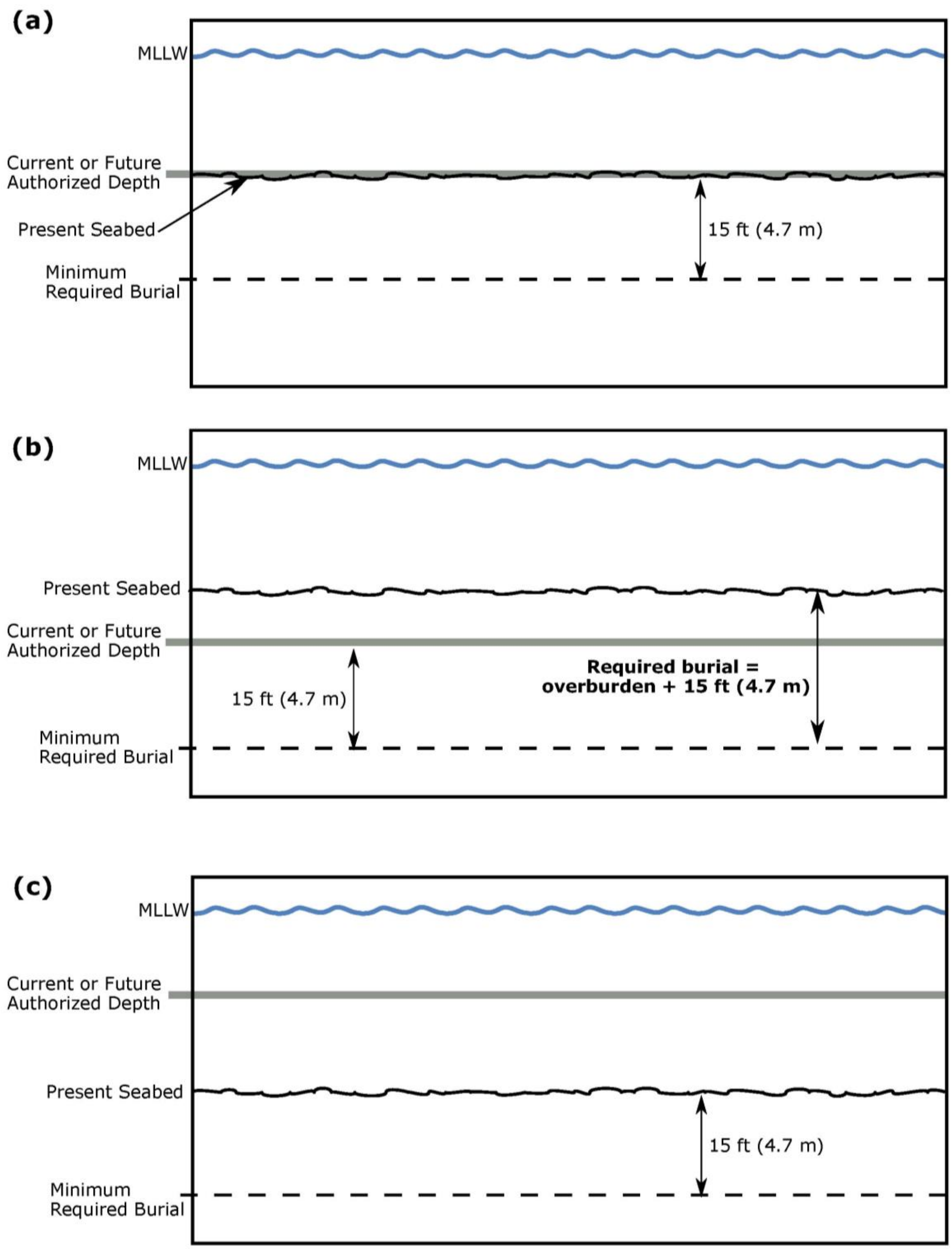


Figure 3.3-8 Diagrammatic representation of USACE minimum cable burial requirements for works within federal navigation projects (including their associated side slopes, based on guidance provided by USACE in a letter dated September 20, 2018) when (a) present seabed and authorized depth are the same; (b) authorized depth is deeper than present seabed; and (c) present seabed is deeper than authorized depth.

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 Sections 3.3.1.6 and 3.3.1.7 for additional information on scour protection and other protection measures).

Other factors that determine minimum target burial depth will be considered during cable burial risk assessments (CBRAs), such as non-regulated anchoring activity (e.g., unofficial Ambrose Anchorage) and seabed impacting fishing (e.g., hydraulic clam dredging).

Table 3.3-7 details the parameters for the submarine export cables.

Table 3.3-7 Summary of Submarine Export Cable Maximum PDE Parameters

Submarine Export Cable Parameters	EW 1	EW 2
Number of Routes	1	1
Number of Cables per Route	2	3
Total Length a/	40 nm (74 km)	26 nm (48 km)
Voltage	230 kV	
Diameter (3 core cable)	300 mm (2,000 mm^2)	
Minimum Target Burial Depth b/	6 ft (1.8 m) 15 ft (4.5 m) c/	
Trench Depth	8 ft (2.4 m) 18 ft (5.5 m) c/	
Trench Width d/	5 ft (1.5 m)	
Anchor Corridor Width e/	1,250 ft (381 m) f/	
Siting Corridor Width g/	500 ft (152 m)	900 ft (274 m)
Permanent Easement Width h/	200 ft (60 m)	

Notes:
a/ The approximate distance along the centerline of the surveyed submarine export cable siting corridor from the edge of the Lease Area to the export cable landfall. Actual length of cables may increase as a result of micrositing and final location of offshore substation. Final installation will be within the surveyed corridor assessed.
b/ Burial depths to be based on CBRA and/or site-specific conditions.
c/ In locations where the submarine export cable will cross federally maintained areas, in accordance with engagement with USACE and other stakeholders. This depth 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.
d/ The width of the trench is defined here as the subsurface width and will vary based upon the final installation method selected; the seabed surface trench width could be up to 10 ft (3 m), based upon the final installation method selected.
e/ 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. Impacts from Project-related vessel anchoring are expected to be in up to 269 square feet (ft^2) (25 square meters [m^2]) area, with a maximum penetration depth of 49 ft (15 m), in up to 1,400 locations.
f/ For EW 1, the anchor corridor will be located in New York and New Jersey state waters only.
g/ The area in which the submarine export cables could be installed. Assumes cables to be laid in parallel. Corridor width may increase or decrease where site constraints exist.
h/ Distance from centerline for each cable.

3.3.1.5 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. The total interarray cable length is not anticipated to exceed 260 nm (481 km; up to 116 nm [214 km] for EW 1 and up to 144 nm [267 km] for EW 2). **Table 3.3-8** details the parameters for the interarray cables. An example of an interarray cable is found in **Figure 3.3-9**.

Table 3.3-8 Summary of Interarray Cable Maximum PDE Parameters

Interarray Cable Parameters	EW 1	EW 2
Total Length	116 nm (214 km)	144 nm (267 km)
Voltage	66 kV	
Diameter	170 mm (800 mm^2)	
Target Burial Depth	6 ft (1.8 m)	
Trench Width a/	5 ft (1.5 m)	
Seabed Footprint	79 ac (32 ha)	99 ac (40 ha)

Note:
a/ The width of the trench will vary based upon the final installation method selected.

Figure 3.3-9 Representative Interarray Cable

The final design, wind turbines per string, and inter-array cable arrangement will depend on a variety of factors, including the wind turbine layout, environmental conditions, detailed electrical design, seabed conditions, and micro-siting 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 Sections 3.3.1.6 and 3.3.1.7 for additional information on scour protection and other protection measures).

3.3.1.6 Scour Protection

Scour protection will most likely be installed around the wind turbine and offshore substation foundations to prevent scouring of seabed material. The locations requiring, the type of protection selected, and the amount placed around each foundation will be based on a variety of factors, including foundation type and water flow and substrate type (hydrodynamic scour modeling). Descriptions of the scour protection types proposed 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.
- Concrete Blocks: the installation of pre-cast blocks of concrete around a structure.

A representative image of the scour protection installed for the GBS foundation is found in **Figure 3.3-10**. **Table 3.3-9** details the parameters for the proposed scour protection measures.

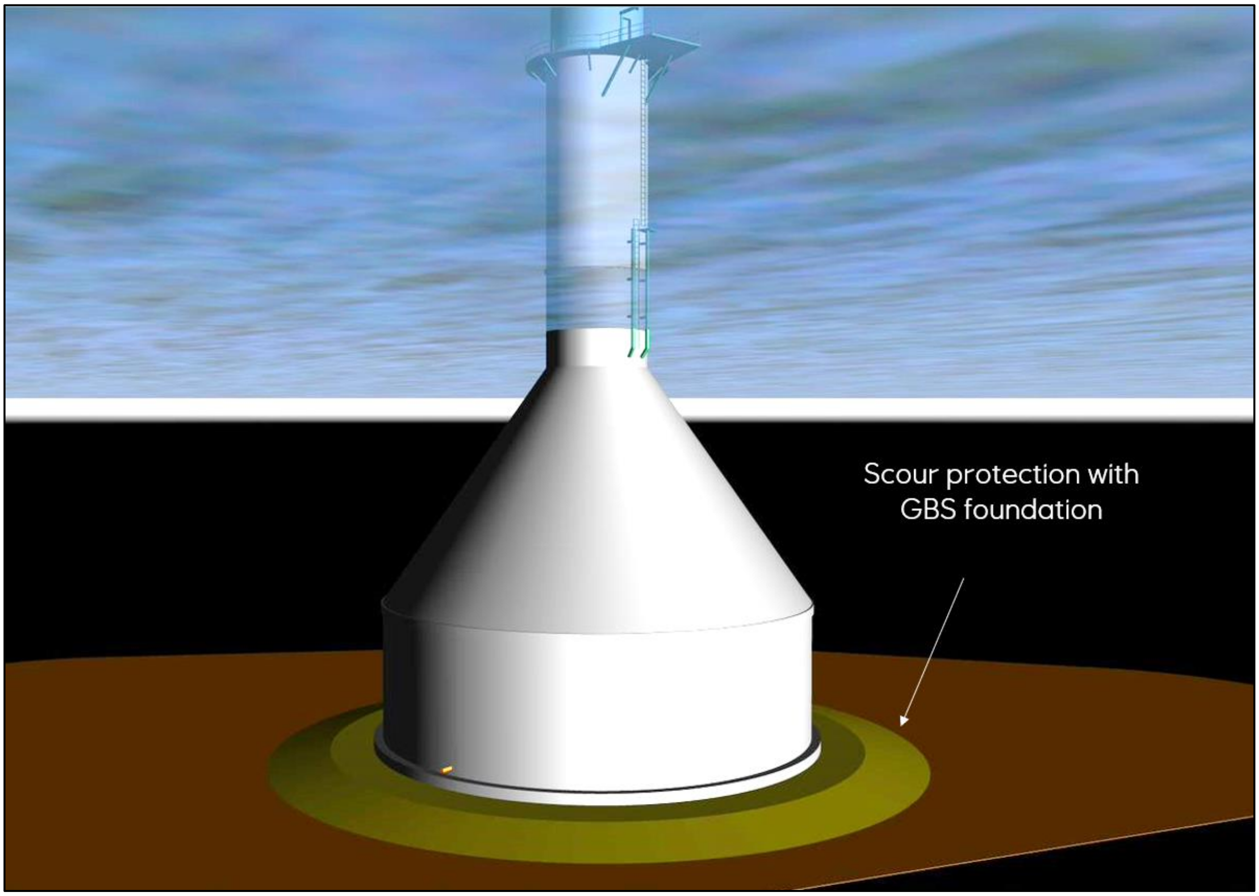


Figure 3.3-10 Example of Scour Protection Installation for GBS Foundation

Table 3.3-9 Summary of Scour Protection Maximum PDE Parameters

Scour Protection Parameters	EW 1	EW 2
Scour Protection (Wind Turbine Foundations)		
GBS		
Depth of scour protection	18.7 ft (5.7 m)	
Depth of filter layer a/	2.3 ft (0.7 m)	
Diameter (including foundation)	609 ft (186 m)	
Diameter with filter layer (including foundation) a/	676 ft (206 m)	
Volume for GBS a/ b/	145,037 yd^3 (110, 884 m^3)	
Volume for GBS with filter layer b/	158,350 yd^3 (121,063 m^3)	
Monopile		
Depth of scour protection	8.2 ft (2.5 m)	
Diameter for monopile (including foundation)	226 ft (69 m)	
Volume for monopile b/	17,511 yd^3 (13,387 m^3)	
Scour Protection (Offshore Substation Foundations)		
Depth for piled jacket	6.6 ft (2 m)	
Diameter for piled jacket (per leg (4), including foundation)	105 ft (32 m)	
Volume for piled jacket b/	30,698 yd^3 (23,470 m^3)	

Notes:
a/ An approximately 65.6-ft (20-m) filter layer is proposed to be installed around 75 percent of the GBS foundation scour protection boundary to facilitate the use of jack-up vessels during construction and operations and maintenance.
b/ Per foundation if scour protection is required

3.3.1.7 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, 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 potential conflicting uses (i.e., commercial fishing). Descriptions of the cable protection types are 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
- Geotextile Mattress: filled with rock or similar.

In addition, at cable and pipeline crossings, tubular sections may be installed on the submarine export cable 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. Empire notes that surficial use of mattresses is not a favored method of cable protection based on feedback during the consultation process; however, this approach may be the preferred solution at certain asset crossings in order to reduce shoaling. 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.[23] **Table 3.3-10** details the parameters for the proposed cable protection measures.

Table 3.3-10 Summary of Cable Protection Maximum PDE Parameters

Cable Protection Parameters	EW 1	EW 2
Submarine Export Cables		
Width at Base	15 ft (4.5 m)	
Width at Top	5 ft (1.5 m)	
Depth	5 ft (1.5 m)	
Interarray Cables		
Width at Base	16 ft (5 m)	
Width at Top	3 ft (1 m)	
Depth	3 ft (1 m)	
Cable and Pipeline Crossings		
Width at Base	46 ft (14 m)	
Width at Top	6.6 ft (2 m)	
Depth	6.6 ft (2 m)	

Note:
a/ Provided per cable within each siting corridor

Representative images of certain cable protection types are found in **Figure 3.3-11**.

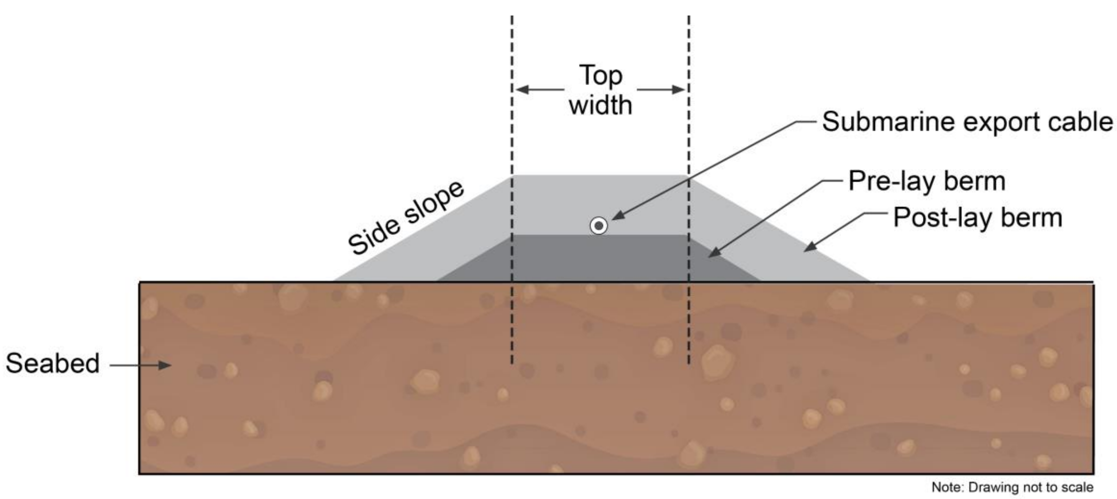


Figure 3.3-11 Representative Example of Cable Protection: Rock Dumping, for use in areas where burial depth cannot be achieved.

[23] Actual extent of cable protection will be refined including completion of the CBRA and maturity of EW 1 and EW 2, but shall not exceed 10 percent.

3.3.1.8 Layout Rules

During the development of the Project, Empire has worked to create Layout Rules, which were generated through engagement with regulatory agencies and maritime stakeholders, that will be used to shape the final proposed array layout(s), and that restrict the array patterns employed in order to address particular navigational issues, stakeholder concerns, or environmental sensitivities. Empire has opted to apply these rules on the Project in an effort to develop an outcome that promotes both safety and the shared use of the surrounding waterways, while maintaining design flexibility to apply the best available technology at the time of investment decisions and the ability to adapt to stakeholder requirements during the regulatory process. Empire further modified its Layout Rules as part of its experience developing wind farms in the United Kingdom and has found them to be effective in providing future clarity to stakeholders concerning wind farms layouts under consideration. The Layout Rules, the description, and the Project-specific reasoning behind them are described in detail in **Table 3.3-11** and discussed further in Volume II in relevant COP sections and appendices (such as **Section 8.7 Marine Transportation and Navigation**, **Appendix DD Navigation Safety Risk Assessment**). For the COP, a layout has been developed in accordance with these Layout Rules, which supports the assessments presented in Volume II and Volume III[24] and is shown in **Figure 3.3-12**. In addition, **Section 8.8 Commercial and Recreational Fishing** describes a layout under consideration that was developed with additional input from various stakeholders.

[24] The final layout will reflect stakeholder and agency feedback, as well as the micro-siting process.

Table 3.3-11 Layout Rules

Rule	Description	Significance to Navigation and Search and Rescue (SAR)	Relevance to Fisheries
Rule 1: Layout Pattern and Regularity	The position of all wind turbines and substation platforms (except those covered by Rule 2 below) shall, so far as is practicable, be arranged in straight and easily understandable patterns within individual wind farm site layouts, avoiding structures which break this pattern and without any dangerously projecting peripheral structures.	To facilitate safe navigation, aid location of casualties or incidents during emergency response, and to avoid creating an isolated hazard in or around the wind farm, while allowing the flexibility to optimize wind turbine arrays with consideration for issues such as local geology, seabed obstacles, and energy capture.	This supports existing fishing practices where tows are predominantly in straight lines. The regularity of layouts reduces an otherwise introduced pressure on the fisher to set different courses while trawling in the operational wind farm. In addition, some fishing vessels transit through the Lease Area. It is considered that this approach will reduce the risk and burden to set different courses on transiting fishing vessels, reducing allision risk.
Rule 2: Perimeter-Type Layouts	The position of all wind turbines and substation platforms forming a line of perimeter structures around a Lease Area shall, so far as is practicable, be arranged in straight or curved lines in an understandable pattern, avoiding structures which break this pattern and without any dangerously projecting or peripheral structures.	To facilitate safe navigation, aid location of casualties or incidents during emergency response, and to avoid creating an isolated hazard in or around the wind farm, while allowing the flexibility to optimize wind turbine arrays with consideration for issues such as local geology, seabed obstacles, and energy capture.	Consistent, easily recognizable perimeters to the wind farms are of benefit to the wider maritime community that use the adjacent waters and in particular the TSSs into and out of the ports of New York and New Jersey, with this measure reducing the risk of allisions with the perimeter wind turbines in comparison to no set perimeter rule. By also reducing the risk of disorientation of larger commercial vessels at sea, this may indirectly reduce the risk of interactions, for example collisions, with fishing vessels. Moreover, the clearly distinguishable perimeter of the wind farms reduces the risk of disorientation to fishing vessels, which Empire has been advised may start trawl tows outside the wind farm and finish inside; start outside, tow through, and finish outside the other end; or start inside and finish outside.

Table 3.3-11 Layout Rules (continued)

Rule	Description	Significance to Navigation and SAR	Relevance to Fisheries
Rule 3: Layout Clarity	Any changes in wind turbine size and separation distance within the Lease Area will be introduced so as to minimize potential visual confusion for any vessel navigating through the wind farm. For example, should the Lease Area be built out as individual wind farms, a future wind farm with larger wind turbines should be designed to be distinguishable from, but not significantly different in orientations as compared to earlier wind farms within the Lease Area with smaller turbines.	To facilitate safe navigation for vessels which are working within the Empire Lease Area, (noting an assumption of no significant levels of passing traffic within the zone other than fishing, small commercial, tugs and barges, and recreational craft).	This supports consistency and minimizes potential disorientation to fishers in later wind farms. For example, if a fisher gets accustomed to towing in a set heading in the first wind farm, the same tow heading will apply for the subsequent wind farms. Likewise, the same principal applies for transiting fishing vessels. It should be noted that although orientations will be consistent, spacing between wind turbines may differ in later wind farms, for example increasing as larger wind turbines become commercially available. The “distinguishable” marking or lighting will facilitate identification of the specific wind farm and associated spacing.
Rule 4: Boundary Clarity	Opposing wind farm site boundaries within the Lease Area, which approach closer than 2 nm (3.7 km) to each other (for example Project 1 and Project 2) shall be aligned broadly parallel with one another and marked to distinguish between separate wind farms, for example an early wind farm followed by a later wind farm.	To facilitate safe navigation for vessels which are working within the Wind Farm (noting an assumption of no significant levels of passing traffic within the zone other than fishing, small commercial, tugs and barges and recreational craft).	This supports safer navigation of fishing vessels within the Lease Area, with an increased understanding of which charted wind farm they are in, and the associated spacing considerations of that wind farm, in what could otherwise be potentially disorientating.
Rule 5: Proximity to Project Boundaries	All wind farm surface and sub-surface structures, including rotor swept areas, will be located wholly within the relevant wind farm or cable corridor lease area boundaries. No permanent above seabed infrastructure will be located in the export cable corridors, save for cable protection where appropriate.	To ensure all aspects of the development are within the assessed and permitted areas.	This provides fishers with the assurance that there will be no uncharted or unassessed hazards related to the wind farm development outside of the prescribed Project limits.
Rule 6: Turbine Spacing	Where feasible, wind turbine spacing should be consistent and as far apart as possible, with maximum spacing in the dominant trawl tow direction where feasible, with minimum spacing no less than 0.65 nm (1.2 km).	To ensure adequate space in rows for SAR activity and to facilitate continued fishing opportunities within the operational Projects.	As above, the principal reason is to ensure the space between wind turbine rows facilitates continued fishing opportunities within the offshore wind energy development where increased spacing reduces restricted access.

Table 3.3-11 Layout Rules (continued)

Rule	Description	Significance to Navigation and SAR	Relevance to Fisheries
Rule 7: Rows	There should be at least one line of orientation of rows of turbines with a clear line of sight and heading from one entrance at the perimeter to an exit at the opposite perimeter. Where there is a dense perimeter, but fewer turbines in the wind farm, there should be an ability to conduct SAR flights and trawl tows entering and exiting at the perimeters and maintaining a fixed heading.	To allow for safe navigation of fishing vessels or small craft within the offshore wind energy development area and to ensure potential requirements for SAR activities are met (for example, the search patterns of SAR helicopters).	This facilitates existing mobile fishing practices with the ability to maintain a fixed heading from start to finish of trawl tows, including from starting or ending tows outside of the offshore wind energy developments.
Rule 8: Orientation of Rows	Where feasible, align turbines with rows that are sympathetic to the dominant trawl directions of most active and potentially impacted fisheries. For example, for the Lease Area, a southwest to northeast orientation in line with bathymetry.	To facilitate continued opportunities for fishing vessels to tow trawls within operational Projects, minimizing modifications to existing practices (for the Lease Area, this is a southwest to northeast orientation in line with bathymetry).	This avoids the need for mobile fishers to modify existing practices and reduces the negative impact that may occur as a result from loss of efficient practices.
Rule 9: Burial of Cables	Interarray and export cables to be buried to a target burial depth of at least 6 ft (1.8 m) where feasible. Deeper burial depths to be targeted as appropriate to CBRAs and regulatory requirements (for example in federally managed channels, anchorage areas and areas fished by bottom impacting gear).	To minimize the risk of mariners interacting with offshore wind energy development cables.	As above, this minimizes the potential risk of snagging mobile trawl gears on submarine cables.
Rule 10: Lower Tip Heights	Blade lower tip heights should equal or exceed 85 ft (26 m) above HAT.	To ensure safe clearance of recreational and small commercial vessels.	As above, this ensures safe clearance of recreational and small commercial vessels.

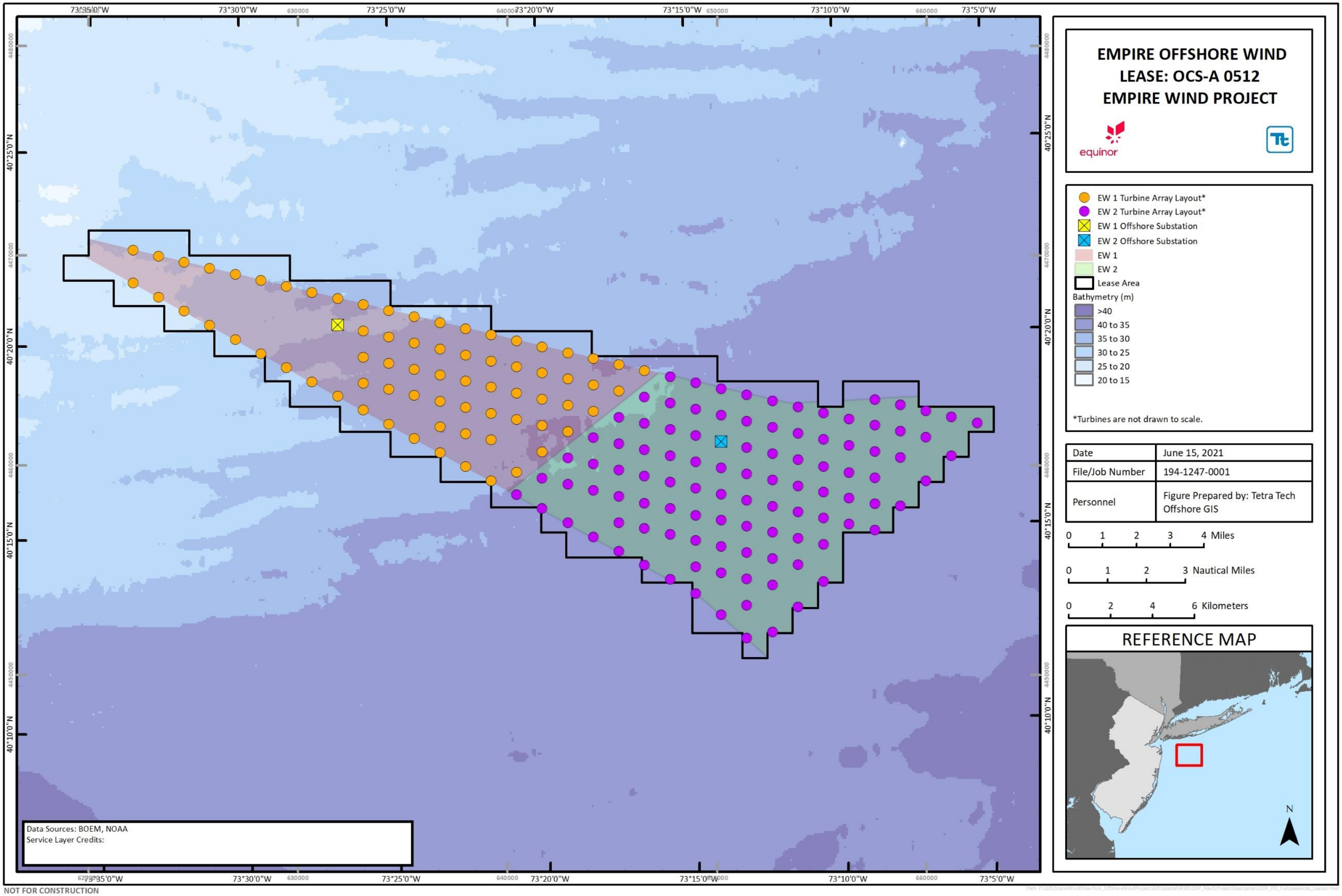


Figure 3.3-12 Layout for Full Lease Area Build-Out, Maximum Number of Structures

3.3.2 Onshore Infrastructure

3.3.2.1 Export Cable Landfall

At the EW 1 export cable landfall location, the submarine export cable will most likely connect directly into the onshore substation, as the onshore substation is proposed to be located at the export cable landfall location. At the export cable landfall location for EW 2, the submarine export cables will be joined to onshore export cables at export cable landfall. Empire is evaluating four options for the EW 2 export cable landfall; up to two export cable landfall locations may be required.

A brief description of each export cable landfall location is provided by POI and shown in **Figure 3.3-13** and **Figure 3.3-14**.

- **EW 1**: The export cable landfall for the EW 1 export cable will occur at the SBMT site, located along the Brooklyn Waterfront and adjacent to 1st Avenue/2nd Avenue. The parcel is owned by New York City, leased to the NYCEDC, and is the same parcel in which the onshore substation is located (see Section 3.3.2.3 for additional information).

- **EW 2 Landfall A**: This export cable landfall for the EW 2 export cable will occur within the City of Long Beach public ROW at Riverside Boulevard. HDD operations will be staged in a vacant privately owned parcel adjacent to Riverside Boulevard and East Broadway.

- **EW 2 Landfall B**: This export cable landfall for the EW 2 export cable will occur at an existing paved parking lot to the north of Shore Road and east of Monroe Boulevard in the City of Long Beach. HDD operations will be staged in a vacant privately owned parcel adjacent to Monroe Boulevard and East Broadway.

- **EW 2 Landfall C**: This export cable landfall for the EW 2 export cable will occur at an existing paved parking lot at the Lido West Town Park in Lido Beach, Town of Hempstead. The parking lot is owned by the Town of Hempstead.

- **EW 2 Landfall D:** This export cable landfall for the EW 2 export cable will occur at Lido Beach Town Park, within an existing paved parking lot or the open field in Lido Beach, Town of Hempstead. The parking lot and open field are owned by the Town of Hempstead.

At landfall, the submarine export cable will connect directly into the onshore substation or will be jointed to the onshore cables in a jointing location. The joint location is expected to be backfilled or installed in a concrete chamber, and will not require a manhole; however, final design is ongoing. A link box chamber may be required at the surface level. All components will be buried underground. A representative example of export cable transition components is provided in **Appendix E Conceptual Project Design Drawings**.

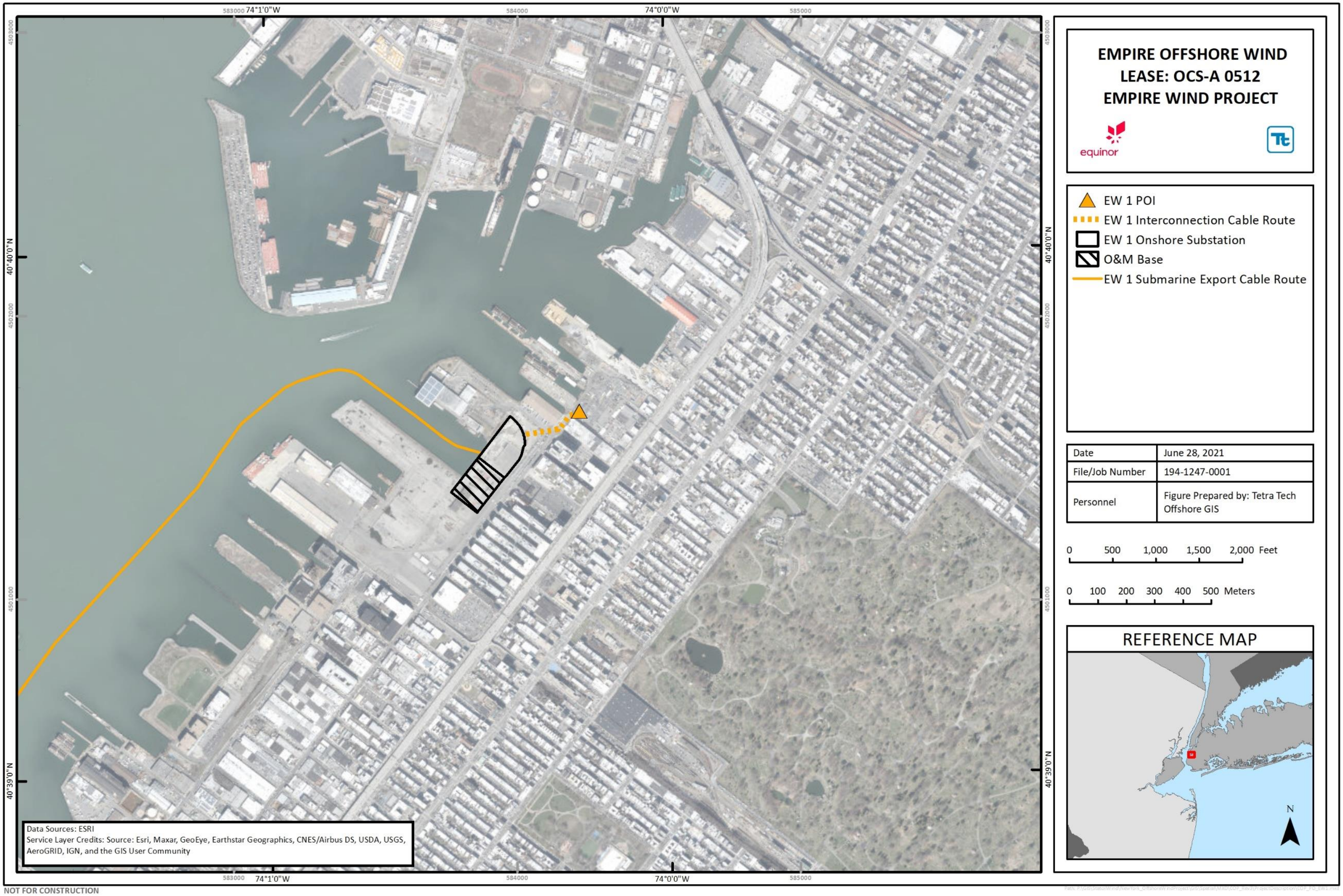


Figure 3.3-13 EW 1 Submarine Export Cable Route and Interconnection Cable Route

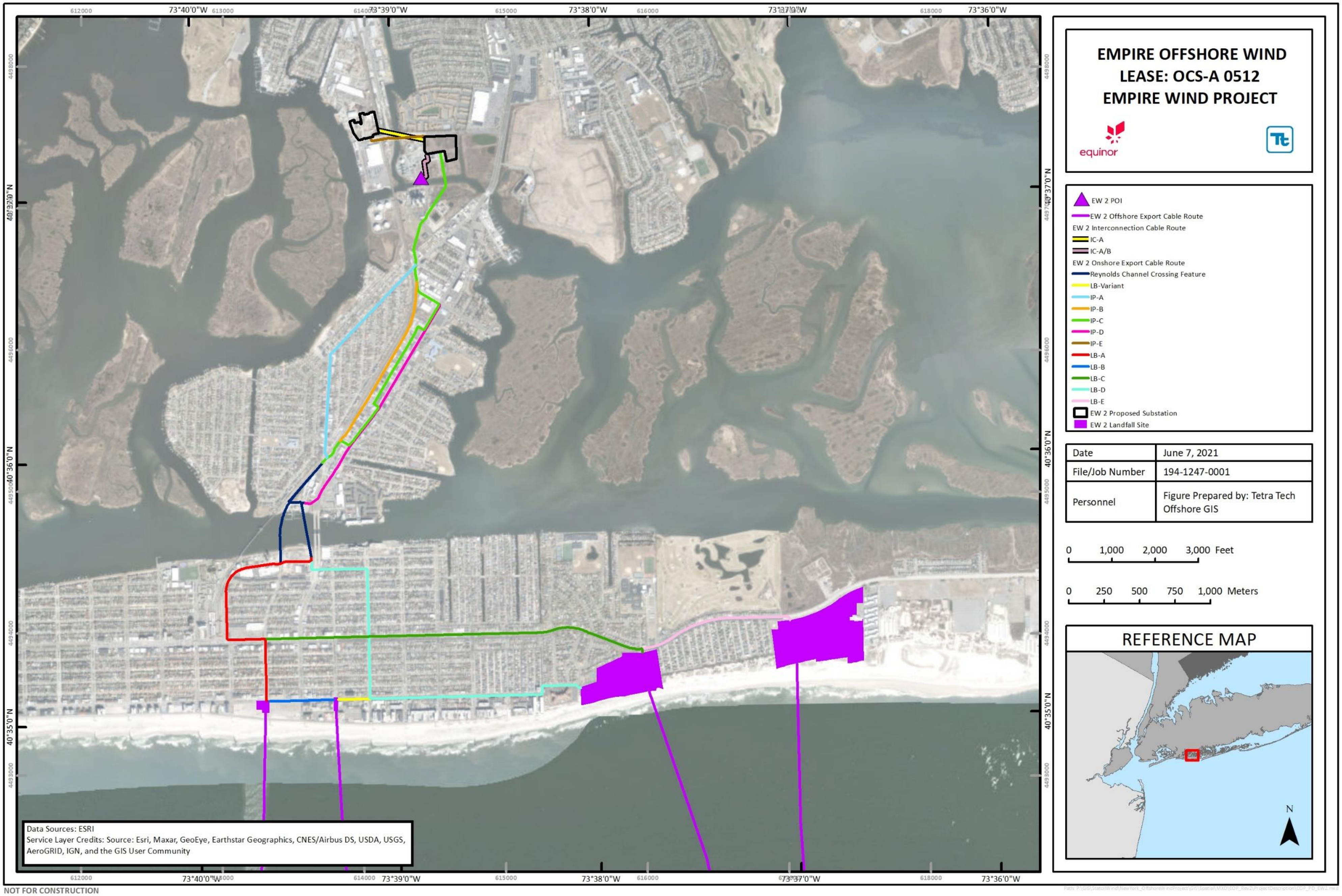


Figure 3.3-14 EW 2 Submarine Export Cable Route and Onshore Export and Interconnection Cable Route

3.3.2.2 Onshore Export and Interconnection Cables

The onshore export cables will connect into the onshore substation at EW 2; the EW 1 submarine export cable will most likely connect directly into the onshore substation, with no onshore export cable required, due to the short distance from landfall to the onshore substation. The EW 2 submarine export cable will be jointed to the onshore export cable at landfall. An onshore interconnection cable will then connect the onshore substation to the POI. A brief description of the onshore export and interconnection cable is provided below, with typical design and installation parameters detailed in **Table 3.3-12** and **Table 3.3-13**.

Onshore Export Cable: The HVAC onshore export cable will consist of two circuits for EW 1 and three circuits for EW 2 of three single core cables with a copper or aluminum conductor and XLPE insulation designed for voltage levels of 230 kV. Each circuit will consist of three onshore export cables. Fiber optic cables for communication and temperature measurements will also be installed alongside the onshore export cable. An example of an onshore export cable is found in **Figure 3.3-15**.

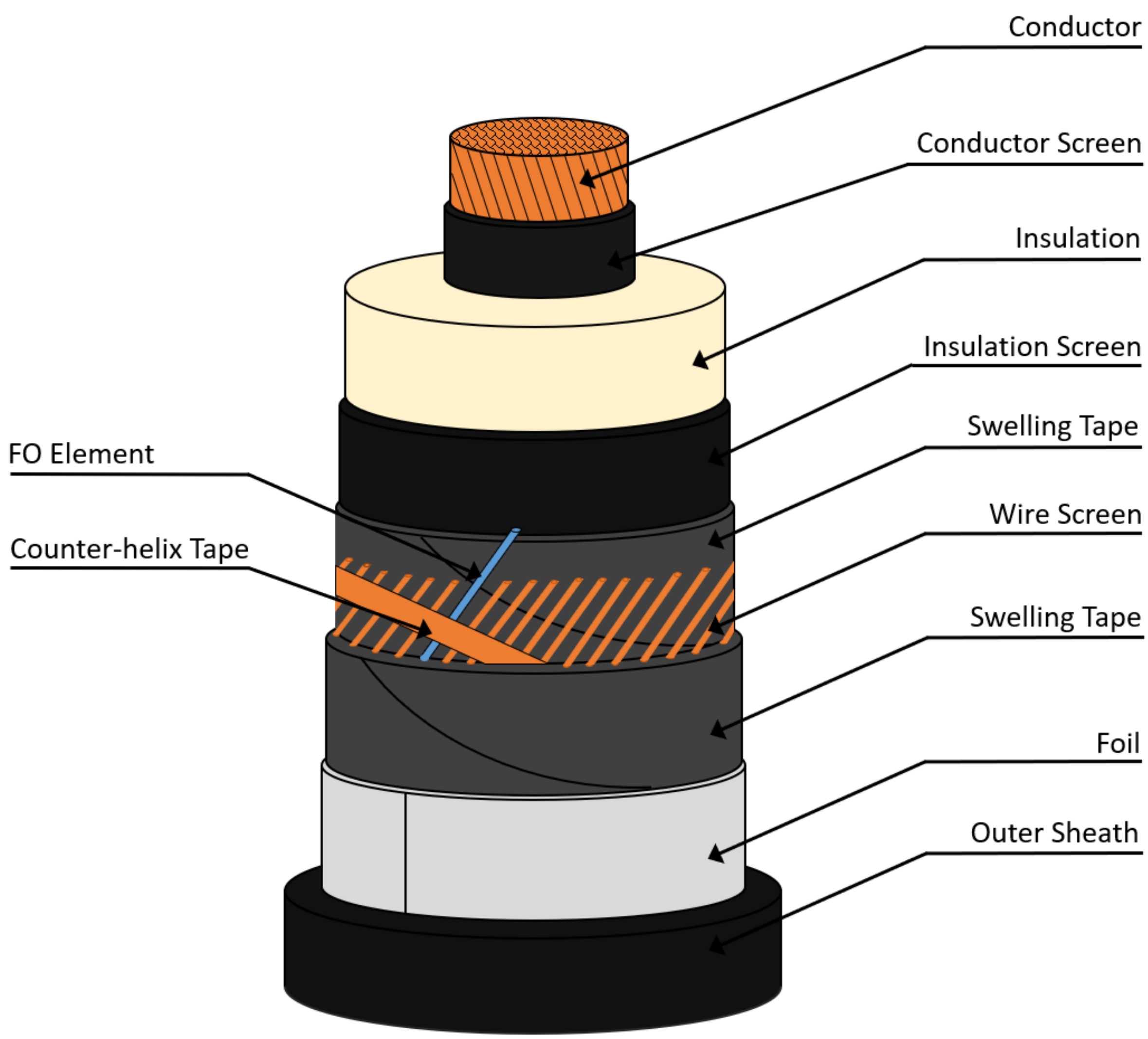


Figure 3.3-15 Representative Cross-Section of Onshore Export Cable

Table 3.3-12 Summary of Onshore Export Cable Maximum PDE Parameters

Onshore Export Cable Parameters	EW 1	EW 2
Onshore Export Cable		
Number of Cables	N/A	9 + 3 fiber optic cables
Route Length a/	N/A	5.3 mi (8.5 km)
Number of Routes	N/A	2
Voltage	N/A	230 kV
Diameter	N/A	0.4 ft (133 mm)
Construction Corridor Width (open cut)	N/A	150 ft (46 m) b/
Operational Corridor Width c/	N/A	25 ft (8 m)

Note:
a/ Represents maximum route length for a single onshore export cable route. For EW 2, up to two routes may be used.
b/ Where constrained by existing development, the onshore export cable construction corridor width may be less than 100 ft; the maximum width is included herein, as part of the PDE.
c/ 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.

Interconnection Cable: The HVAC interconnection cable will consist of two circuits with six cables for EW 1 and three circuits with 18 cables for EW 2, with copper or aluminum conductors enclosed in XLPE insulation, designed for voltage levels from 138 kV for EW 2 to 345 kV for EW 1, depending upon the voltage of the POI. 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 3.3-16**.

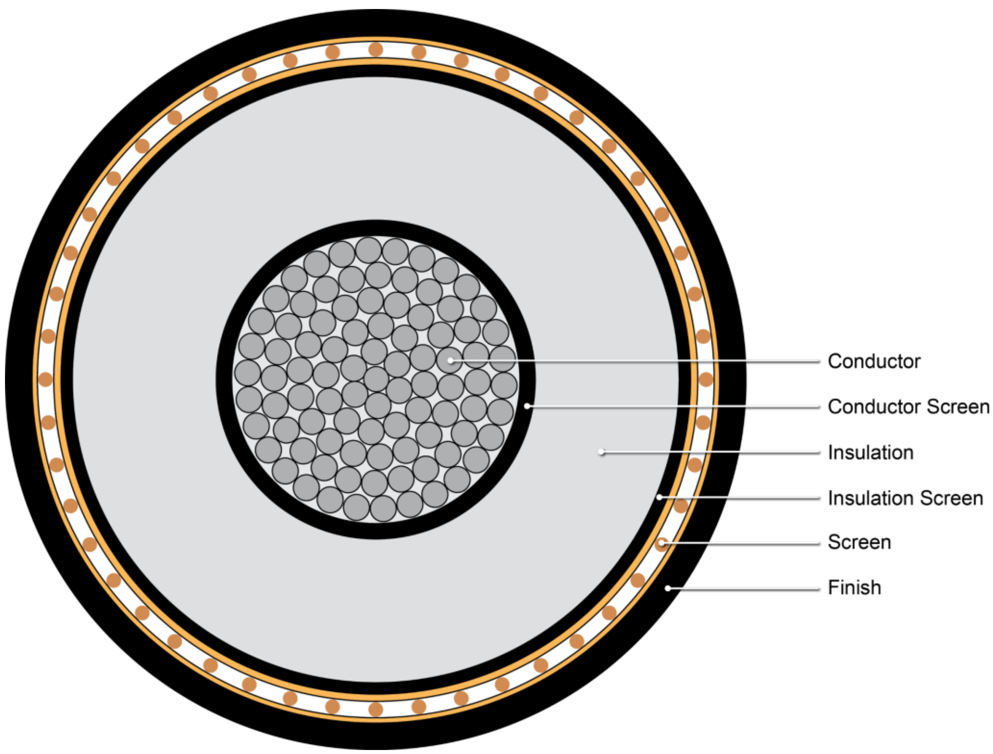


Figure 3.3-16 Representative Cross-Section of Onshore Interconnection Cable

Table 3.3-13 Summary of Interconnection Cable Maximum PDE Parameters

Interconnection Cable Parameters	EW 1	EW 2
Onshore Interconnection Cable		
Number of Cables per Route	6 + 2 fiber optic cables	18 + 3 fiber optic cables
Total Length	0.2 mi (0.4 km)	0.4 mi (0.6 km)
Voltage	345 kV	138 kV
Diameter	0.4 ft (132 mm)	
Construction Corridor Width (open cut)	50 ft (15 m)	100 ft (30 m) a/
Operational Corridor Width b/	25 ft (8 m)	

Notes:
a/ Where constrained by existing development, the onshore interconnection cable construction corridor width may be less than 100 ft; the maximum width is included herein, as part of the PDE.
b/ 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.

Both the onshore export cables and the interconnection cables will be housed in concrete duct banks and will be buried to a minimum target depth of 3 ft (0.9 m) beneath the surface along the onshore cable route (see **Appendix E** for indicative duct bank layouts). Joint pits (manholes) will be located approximately every 500 ft (152 m) for EW 1 and every 1,500 to 2,500 ft (457 to 762 m) for EW 2, to provide access to the onshore export and interconnection cables. The actual length between joint pits will vary due to site-specific and cable installation constraints.

For EW 1, the 230-kV HVAC submarine export cables will connect directly into the onshore substation from the landfall at SBMT. The onshore substation will increase the voltage, to allow for the 345-kV HVAC interconnection cable to connect into the Gowanus POI. The interconnection cables will then traverse 2nd Avenue to reach the Gowanus POI (see **Figure 3.3-13**).

For EW 2, the 230-kV HVAC submarine export cables will transition into the 230-kV onshore export cables within a transition bay at landfall. The proposed onshore export cable routes will then traverse through Long Beach, cross at Reynolds Channel, and then traverse through Island Park to the onshore substation in Oceanside. Up to two onshore export cable routes may be required for the installation of the onshore export cables. The onshore substation will decrease the voltage, to allow for the 138-kV HVAC interconnection cable to connect into the Oceanside POI.

Eleven onshore export cable route segments are considered: six onshore export cable route segments from landfall to the Reynolds Channel crossing and five onshore export cable route segments from the Reynolds Channel crossing to the onshore substation. These segments will be used to mature the development of up to two complete onshore export cable routes, from landfall to the onshore substation, as required to facilitate the three onshore export cables. Two interconnection cable routes are also considered, where only one will be needed, depending on which onshore substation location is selected (see **Figure 3.3-14**). The following onshore export cable route segments from the landfall to the Reynolds Channel crossing (Long Beach routes) are included in the PDE:

- **EW 2 Long Beach Route A (LB-A) (Riverside Boulevard/East Park Avenue/Reverend JJ Evans Boulevard/Park Place)**: From the landfall at EW 2 Landfall A (Riverside Boulevard/East Broadway), the 230-kV HVAC onshore export cables will traverse up Riverside Boulevard to East Park Avenue. The onshore export cables will then turn west until Reverend JJ Evans

Boulevard, when the cables will turn north. The onshore export cables will then continue along Reverend JJ Evans Boulevard, which turns into Park Place, until the crossing at Reynolds Channel.

- **EW 2 Long Beach Route B (LB-B) (Monroe Boulevard)**: From the landfall at EW Landfall B (Monroe Boulevard/Shore Road), the 230-kV HVAC onshore export cables will traverse up Monroe Boulevard to East Penn Street. The onshore export cables will turn west until connecting into the EW 2 Route LB-A to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route C (LB-C) (Richmond Road/E Broadway/Lincoln Boulevard)**: From the landfall at EW 2 Landfall C (Lido Beach West Park), the 230-kV HVAC onshore export cables will traverse west through the park to Richmond Road. The onshore export cables will continue west on Richmond Road until turning south on Maple Boulevard and then immediately west on E Broadway. The onshore export cables will then turn north onto Lincoln Boulevard or continue west on the EW 2 Route Variant. From Lincoln Boulevard, the onshore export cables will continue north until turning west onto E Harrison Street. The onshore export cables will then cross perpendicular to Long Beach Boulevard and turn north onto Long Beach Road, to the crossing at Reynolds Channel. From the EW 2 Route LB Variant, the onshore export cables will connect into EW 2 Route LB-B to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route D (LB-D) (Lido Boulevard/E Park Avenue)**: From the landfall at EW 2 Landfall C (Lido Beach West Park), the 230-kV HVAC onshore export cables will connect north into Lido Boulevard and traverse west, as Lido Boulevard turns into E Park Avenue. The onshore export cables will turn north Lincoln Boulevard, connecting to EW 2 Route LB-C, and/or continue to Riverside Boulevard, connecting with the EW 2 Route LB-A, to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route E (LB-E) (Lido Boulevard)**: From the landfall at EW 2 Landfall D (Lido Beach Town Park), the 230-kV HVAC onshore export cables will connect north into Lido Boulevard and traverse west. The onshore export cables will then connect into either EW 2 Route LB-C and/or LB-D to the crossing at Reynolds Channel.

- **EW 2 Long Beach Route Variant (LB Variant) (E Broadway)**: A The portion of East Broadway between Monroe Boulevard and Lincoln Boulevard in which the EW 2 Route LB-C could connect to EW 2 LB-B to the crossing at Reynolds Channel.

The following onshore export cable routes from the crossing at Reynolds Channel to the onshore substation site (Island Park Routes) are included in the PDE:

- **EW 2 Island Park Route A (IP-A)**: From the crossing at Reynolds Channel, the onshore export cables will traverse north onto Long Beach Road until turning northwest onto Ladomus Ave, Sherman Road, and then connecting into EW 2 Route IP-C.

- **EW 2 Island Park Route B (IP-B)**: From the crossing at Reynolds Channel, the onshore export cables will enter into the LIRR and traverse north until connecting onto Sherman Road, continuing onto Ladomus Ave, Sherman Road, and then connecting into EW 2 Route IP-C.

- **EW 2 Island Park Route C (IP-C)**: From the crossing at Reynolds Channel, the onshore export cables will enter into the LIRR and traverse north until turning east onto Sagamore Road and then immediately north onto Industrial Place. The onshore export cables will then turn east onto Trafalgar Boulevard and then north onto Austin Boulevard before turning northwest onto Ladomus Ave, Sherman Road, and then enter into the EW 2 Onshore Substation B site, where it will connect into the EW 2 Onshore Substation B or connect with EW 2 Route IP-E (if EW 2 Onshore Substation A is selected).

- **EW 2 Island Park Route D (IP-D)**: From the crossing at Reynolds Channel, the onshore export cables will enter into the LIRR and traverse north until turning east onto Sagamore Road and then immediately north onto Austin Boulevard. The onshore export cables will then continue north before turning northwest onto Ladomus Ave, Sherman Road, and then connecting into EW 2

- **EW 2 Island Park Route E (IP-E)**: From the end of EW 2 Route IP-C, the onshore export cables will continue through EW 2 Onshore Substation B site, traversing west, perpendicularly to Daly Boulevard. The onshore export cables will then cross the LIRR and then turn north, crossing Daly Boulevard, and connecting into the EW 2 Onshore Substation A.

The following interconnection cable routes from the onshore substation site to the POI are included in the PDE:

- **EW 2 Interconnection Cable Route A (IC-A)**: From the EW 2 Onshore Substation A site, the interconnection cable will HDD to the Oceanside POI parcel, where the interconnection cables will connect into the Oceanside POI, if EW 2 Onshore Substation A site is selected.

- **EW 2 Interconnection Cable Route B (IC-B)**: From the EW 2 Onshore Substation B site, the interconnection cable will connect into the Oceanside POI, if EW 2 Onshore Substation B site is selected.

3.3.2.3 Onshore Substation

Two onshore substations are to be constructed and installed in support of the Project. The onshore substations will be used to transform and prepare the power received by the export cables for connection to the POIs in New York. The SBMT has been identified as the location for the EW 1 onshore substation. The EW 2 onshore substation will be located at one of two sites: EW 2 Onshore Substation A or EW 2 Onshore Substation B. The final selection of EW 2 Onshore Substation A or EW 2 Onshore Substation B will depend upon the ability for Empire to acquire land access agreements and other site considerations.

- **EW 1**: The onshore substation will be located in a portion of SBMT, adjacent to 1st Avenue/2nd Avenue. The parcel is owned by NYC, leased to the NYCEDC, and is the same parcel in which the export cable landfall is located (see Section 3.3.2.1 for additional information). The onshore substation will connect 816 MW into the Gowanus POI owned and operated by ConEd. SBMT is a large, paved terminal used for a variety of uses. The onshore substation will be constructed within an approximately 4.8 ac (1.9 ha) portion of the SBMT property, with a maximum main building height of 49 ft (15 m)[25].

- **EW 2 Onshore Substation A**: The onshore substation will be located on a property at the corner of Daly Boulevard and Hampton Road, in Oceanside, New York. The parcel is privately owned. The onshore substation will be constructed within an approximately 6.4-ac (2.6-ha) portion of the property, with a maximum main building height of 60 ft (18 m)[5]. The parcel is currently support industrial uses and contains minor temporary infrastructure that would need to be removed for the construction of

[25] Subsequent to initial efforts, Empire continues to refine the design of the onshore substation. This is informed by analysis including visual simulations, acoustic modeling, and other field surveys, as well as engagement with municipalities and other stakeholders.

the onshore substation. The onshore substation will connect into the Oceanside POI owned by National Grid and operated by PSEG Long Island.

- **EW 2 Onshore Substation B**: The onshore substation will be located at 4005 Daly Boulevard, in Oceanside, New York. The parcel is owned by National Grid. The onshore substation will connect into the Oceanside POI owned by National Grid and operated by PSEG Long Island. The parcel currently contains an existing power station. The onshore substation will be constructed within an approximately 7.4-ac (3.0-ha) portion of the property, with a maximum main building height of 60 ft (18 m)[5].

The onshore substation will contain enclosed buildings and/or walled structures that will contain various equipment, such as switchgears, control equipment, batteries, reactive compensation equipment and harmonic filters, and a designated outside area to house outdoor equipment like transformers and reactors. These facilities will be designed to comply with applicable New York building codes, electrical standards, and environmental conditions to the greatest extent practicable. Final configurations and equipment specifications are being matured based on technical requirements and stakeholder engagement and will be submitted as part of the state and local permitting processes.

3.4 Construction and Installation Activities

During construction, Empire will receive equipment and materials to be staged and loaded onto installation vessels at one or more existing third-party port facilities. Empire 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. As described in Section 3.3.2.1, SBMT has been selected as the location for export cable landfall and the onshore substation for EW 1. Empire also proposes to lease portions of SBMT for EW 1 and EW 2 for laydown and staging of wind turbine blades, turbines, and nacelles; foundation transition pieces; or other facility parts during construction of the offshore wind farm. During this time, Empire would receive, store, assemble, and export Project components via marine vessels and onshore cranes and other equipment.

In the event that the GBS foundation are utilized for EW 1 and/or EW 2, SBMT may also be used to add a concrete extender (CE) piece to the GBS foundations prior to final vessel transport to the Lease Area. Installation of the CE pieces would occur on one GBS foundations at a time, on barges moored to SBMT pier. The CE piece would be lifted from the barge using the SBMT crane and installed directly to the GBS foundation.

Howland Hook Marine Terminal (Howland Hook), Staten Island, New York. In the event that the GBS foundations are utilized for EW 1 and/or EW 2, Howland Hook may be selected as the staging port for the GBS foundation, and would therefore be the starting point for GBS transit.

Homeport Pier, Staten Island, New York. In the event that the GBS foundations are utilized for EW 1 and/or EW 2, Empire is considering using the waters adjacent to Homeport Pier or the pier itself to temporarily moor the GBS foundations prior to deployment and installation within the Lease Area. Such temporary mooring would only be required in the event that weather delays or other logistical challenges prevent Empire from directly transporting the foundations to the assembly port or to the offshore Project site. This temporary mooring concept could consist of one of two concepts: moored directly to the existing Homeport Pier and/or seated on flat-top or submerged barges that are tethered to the existing pier.

Up to ten GBS foundations would be temporarily moored at a given time, for approximately one to four weeks each. The temporary mooring concept is anticipated to be used for approximately 25 to 35 months total for storage. During this time, Empire would utilize a security vessel to guard the temporary mooring areas, prevent local marine users from interacting with the GBS foundations, and to make sure the GBS foundations remain securely stored.

The final port selection for staging and construction will be determined based upon whether the ports are able to accommodate Empire's schedule, workforce and equipment needs. In order to contribute to development and build-out of the offshore industry in the State of New York, the owner/operator of SBMT is proposing to conduct upgrades to the port facility that would allow offshore wind developers (including Empire) to utilize the facility as a construction and staging area. Homeport Pier is owned by the NYCEDC and is the home of a New York Fire Department posting at the nearshore portion of the pier. The pier otherwise is unused except for the annual July 4th fireworks presentation and for temporary mooring of vessels during Navy events such as Fleet Week, which typically occurs in May. The pier is not expected to require any upgrades to accommodate any of the temporary mooring scenarios described above.

Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities. As part of the PDE, the offshore infrastructure will consist of foundations, wind turbines, offshore substations, interarray cables, submarine export cables, and scour protection. It is estimated that the Project will require approximately 18 vessels for construction of EW 1 and approximately 18 vessels for construction of EW 2. **Table 3.4-1** summarizes the types and number of offshore vessels to be used during construction. Helicopters are currently being considered to support the Project; Empire is continuing to evaluate construction logistics and the relevant impact assessments will be updated pending the final decision.

Table 3.4-1 Preliminary Summary of Offshore Vessels for Construction

Vessel	Description	Foundations			Wind Turbines	Offshore Substation Topside & Foundation	Submarine Export Cables	Interarray Cables	Scour Protection
		GBS	Monopile	Piled Jacket					
Heavy Lift Vessel	Vessel for installation of foundations (0-10 kts)	X	X	X		X			
Monopile Supply Vessel	Vessel for transport of monopile foundations (0-10 kts)		X						
Wind Turbine Installation Vessel	Vessel for installation of Wind Turbine components (0-10 kts)				X				
Wind Turbine Supply Vessel	Vessel for transport of Wind Turbine components (0-10 kts)				X				
Cable Lay Vessel/Barge	Vessel for installation of submarine cables (0-10 kts)						X	X	
Heavy Transport Vessel	Vessel for transport of offshore substation topside (0-10 kts)	X	X	X		X			
Cable Lay Support Vessel	Support vessel for cable lay operations (0-10 kts)						X	X	
Pre-Lay Grapnel Run Vessel	Vessel for seabed clearance along cable routes (0-10 kts)						X	X	
Fall Pipe Vessel	Vessel for installation of scour protection (0-10 kts)	X	X	X			X	X	X
Crew Transfer Vessel	Vessel for transporting workers to and from shore (0-10 kts)	X	X	X	X		X	X	
Construction Support Vessel	Vessel for general construction support (0-10 kts)	X	X	X			X	X	
Tugboat	Vessel for transporting and maneuvering barges (0-5 kts)	X	X	X	X	X	X		
Barge	Vessel for transport of construction materials (0-5 kts)	X	X	X	X	X			
Safety Vessel	Vessel for protection of construction areas (0-10 kts)	X	X	X			X	X	

Empire is also proposing to temporarily moor a metocean buoy within the Lease Area during construction and installation operations to provide real-time weather conditions. The metocean buoy will be the same make and model as approved in the SAP and will be appropriately permitted with the USCG[26]. The location proposed for deployment will be cleared by the QMA and sited to avoid sensitive benthic habitat. Following completion of construction and installation activities in the Lease Area, the metocean buoy will be recovered; conditions are expected to return to normal shortly thereafter.

In accordance with 30 CFR § 585.626(b)(9), Empire has provided a list of wastes expected to be generated during the Project in **Table 3.4-2**.

Table 3.4-2 List of Wastes Expected to be Generated During the 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	N/A	N/A
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	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	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.

[26] Empire will contact the USCG Sector New York Private Aids to Navigation Officer at 718-354-4117, as appropriate.

3.4.1 Construction and Installation: Offshore Infrastructure

3.4.1.1 Wind Turbines

The wind turbine components will be pre-assembled at a port location or transported separately and assembled offshore at the foundation location. The installation methodology will generally be the same, however, and will consist of the following sequence:

1. Following installation of the foundation, the assembled wind turbine/wind turbine components are transported to the foundation location (see **Table 3.4-1** for information of the types of vessels proposed);
   a. If the wind turbines are not pre-assembled at a port location, they will be transported separately and assembled offshore;
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	EW 1	EW 2
Seafloor footprint of wind turbine installation vessels a/ b/	0.5 ac (0.2 ha)	
Estimated time per component (hours/wind turbine)	48 hours/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; operational footprint is the long-term impacts as detailed in Section 3.4.1.2.

3.4.1.2 Foundations

The installation methodology utilized for the foundation PDE described in Section 3.3.1.2 will depend upon the foundation type(s) 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 3.3-3**. A preliminary list of the vessels proposed to be utilized during construction and installation can be found in **Table 3.4-1**.

For certain foundation types (most commonly GBS solutions), seabed preparation may need to be completed prior to installation of the foundation. This is to ensure every foundation is laid on a surface capable of supporting the structure adequately, and that the wind turbine stands vertical and in accordance with verticality tolerances. The need for seabed preparation will be further assessed during the detailed design stage and will be documented in the FDR/FIR. Seabed preparation can include one or all of the following options: removal of soft, mobile or uneven sediments; level of the seabed without removal of sediment; and/or installation of a stone or aggregate foundation bed, such as a skirt, as an alternative leveling/stabilizing strategy. A skirt is a steel plate that is attached to the bottom of the GBS foundation or installed separately underneath the GBS foundation to improve the ground condition and secure the required minimum bearding capacity of the seabed. Seabed preparation, if required, will be completed prior to transport of the foundation to the Lease Area, as early as one season prior to initiation of foundation installation activities. Following seabed preparation, and prior to installation of the proposed foundation components, the following sequence is typically conducted:

1. The foundation component is transported to the foundation location, and
2. The installation vessel(s) positions itself at the location and holds position.

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

Monopile

Once the installation vessel is in place, the steel pile is lifted into a vertical position and lowered onto the seabed. The steel pile is then pile 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, and driving it into the ground (see **Table 3.4-1** for information of the types of vessels proposed). The hammer energy and duration are dependent on geological soil conditions, pile type and diameter and most suitable technology. Should the pile reach a point of refusal, drilling out of the 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 driving and drilling 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. Only one foundation is proposed to be installed via pile driving at a given time for the Project (i.e., there will be no overlap in pile driving activities between EW 1 and EW 2).

Table 3.4-4 Summary of Monopile Foundations Parameters

Parameter	EW 1	EW 2
Wind Turbine		
Seafloor footprint of installation vessel a/ b/	0.5 ac (0.2 ha)	
Seafloor penetration of installation vessel a/ b/ c/	5 to 33 ft (1.5 to 10 m)	
Pile hammer size	5,500 kJ	
Maximum blows per minute per pile at maximum energy setting	40	
Soft start duration	0.5 hour	
Soft start hammer energy	825 kJ	
Maximum piling time per pile	5 hours	
Estimated duration of installation (hours/foundation)	~ 2 days/wind turbine (inclusive of TP) d/	

Notes:
a/ Accounts for jack-up installation vessels
b/ Seafloor footprint will be short-term, operational footprint is detailed in Section 3.3.1.2.
c/ Range is dependent on soil type.
d/ Only one foundation is proposed to be installed via pile driving at a given time for the Project (i.e., there will be no overlap in pile driving activities between EW 1 and EW 2).

Piled Jacket (Pre-Piled)

Once the installation vessel is in place, the jacket structure is lifted from the vessel and lowered onto the seabed. The support piles are placed in the jacket structure and then driven into the seabed. The piles will be driven using the same methodology as described for monopiles. Subject to commercial and technical availability, jacket piles may be in one single piece, or multiple sections. Parameters proposed as part of the piled jacket PDE are summarized in **Table 3.4-5**. Following pile driving of the support piles, the jacket structure is secured to the driven piles. Only one foundation is proposed to be installed via pile driving at a given time for the Project (i.e., there will be no overlap in pile driving activities between EW 1 and EW 2).

Table 3.4-5 Summary of Piled Jacket Foundation Parameters

Parameter	EW 1	EW 2
Offshore Substation		
Seafloor footprint of piled jacket installation vessel (per jacket) a/ b/	0.5 ac (0.2 ha)	
Seafloor penetration of installation vessel a/ b/ c/	33 ft (10 m)	
Pile hammer size	4,000 kJ	
Maximum blows per minute per pile at maximum energy setting	40	
Soft start hammer energy	600 kJ	
Soft start duration	0.5 hour	
Maximum piling time per pile	5 hours	
Estimated duration of installation (hours/foundation)	~ 2 days/foundation d/	

Notes:
a/ Accounts for jack-up installation vessels
b/ Seafloor footprint will be short-term, operational footprint is detailed in Section 3.3.1.2.
c/ Range is dependent on soil type.
d/ Only one foundation is proposed to be installed via pile driving at a given time for the Project (i.e., there will be no overlap in pile driving activities between EW 1 and EW 2).

Gravity Base Structure

Prior to the installation of the GBS foundation, seabed preparation may be required (**Table 3.4-6**). Seabed preparation includes the smoothing of the foundation location to allow for the secure placement of the GBS. In some cases, subject to ground conditions and GBS size and weight, there may also be a requirement for the removal and/or relocation (dredging) of surficial sediments, and application of gravel material, such as a skirt, to ensure stable footings. Only one foundation is proposed to be installed at a given time for the Project (i.e., there will be no overlap in GBS installation activities between EW 1 and EW 2).

Once the GBS foundation is positioned over the installation location, the structure will be filled with a mixture of ballast water and sand, gravel, and/or olivine rock and slowly lowered onto the seabed; this method does not require the use of a secondary installation method to achieve secured installation. Suction pumps or water jets may be utilized to assist in installation for a more uniform placement. In deeper waters, ranging from 111.5 to 207 ft (34 to 63 m), a CE piece may be installed onto the GBS foundation prior to transportation to the Lease Area.

Table 3.4-6 Summary of GBS Installation Parameters

Parameter	EW 1	EW 2
Wind Turbine		
Depth of seabed preparation	23 ft (7 m)	
Diameter of seabed preparation	577 ft (176 m)	
Volume of sediment removal (per foundation, if required)	190,923 yd^3 (145,971 m^3)	
Estimated duration of installation including seabed preparation (days/foundation)	~5-7 days/GBS a/	

Note:
a/ Only one foundation is proposed to be installed at a given time for the Project (i.e. there will be no overlap in GBS installation activities between EW 1 and EW 2).

3.4.1.3 Offshore Substation

The offshore substation 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, which will be similar to the installation of wind turbine foundations, the offshore substation topside is transported to the foundation location (see **Table 3.4-1** 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.

3.4.1.4 Submarine Export Cables

The submarine export cables will be installed from specialized installation vessels/barges, which will install the cables from a turntable on the lay vessel/barge. One or several vessels might be used for the installation of the cables depending on a number of factors, such as seabed depth, depth of cable protection, 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 cables, some during the installation of the cables, and some after the installation of the cables. Cable pre-lay activities may include pre-installation grapnel run, route clearance and boulder removal, pre-sweeping, dredging and pre-trenching. The cable burial methods being considered as part of the PDE are plowing, jetting, trenching, and dredging. The final cable burial method(s) will be selected prior to the FDR/FIR. The equipment selected will depend on seabed conditions, 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 and has the potential to be used pre-installation, during installation, and/or post-installation. The maximum estimated seabed disturbance resulting from the installation methods of the submarine export cables 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 3.4-1**.

The typical key stages of submarine cable installation have been defined as:

1. UXO clearance and pre-installation activities[27];
2. Pre-sweeping, and pre-trenching activities (if required);
3. Cable lay and burial;
4. Cable and pipeline crossings;
5. Post-installation survey; and
6. Remedial cable protection (if required).

Burial of the submarine export cables will terminate before the offshore substation 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 close to the offshore substation location. This wet storage concept would be required should the offshore substation be installed after the submarine export cables are buried along the cable route, and would consist of temporarily burying the remainder of the submarine export cables until they could be pulled into the offshore substation. Once reaching the offshore substation location, 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.

Installation of the submarine export cables is expected to take approximately four months for the EW 1 submarine export cables and approximately four months for the EW 2 submarine export cables. The actual installation schedule will be subject to seabed characteristics, installation vessel availability, seasonal restriction windows for protected species, and weather. Installation of the EW 1 and EW 2 submarine export cables may occur at the same time; however, any overlap in installation activities would not occur at the same stage (i.e., the UXO clearance and pre-installation activities may commence for EW 2 while the cable lay and burial for EW 1 is being completed).

UXO Clearance and Pre-Installation Activities

Prior to the installation of cables, survey campaigns may be completed including debris and boulder clearance, UXO clearance, pre-lay grapnel run, and pre-installation surveys. This is to ensure that the submarine export cable and burial equipment will not be impacted by any debris or hazards, both natural and man-made, during the burial process, which may cause equipment damage and/or delays, and to ensure sufficient burial depth.

In some areas, existing, out of service cables and pipelines may be cut-away and removed in order to install the submarine export cables. This removal will only be completed upon pre-determined cables and pipelines in which written agreement is received from the owners and/or appropriate agencies. Should this be required, details of the cutting or removal will be agreed upon by all associated parties and will be consistent with sound engineering practices and relevant requirements. (Additional details on crossing existing submarine assets are provided within the Cable and Pipeline Crossings subsection).

It is anticipated that portions of the submarine export cable route(s) will be surveyed and cleared for UXO. Where this is not feasible, the cable will be re-routed slightly within the surveyed corridor to avoid these features

[27] 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. Empire understands that any found UXO must be reported to USCG Sector New York Command Center on VHF Channel 16 or 718-354-4088.

or they will be managed in accordance with applicable regulations. A pre-lay grapnel run may be completed to remove seabed debris (abandoned fishing gear, wires, etc.) from the siting corridor, where feasible.

Pre-Sweeping

In certain limited areas of the submarine export cable siting corridor, where underwater megaripples and sandwaves are present on the seafloor, pre-sweeping may be necessary prior to cable lay activities. Pre-sweeping involves smoothing the seafloor by removing ridges and edges, where present. The primary pre-sweeping method will involve using a suction hopper dredge vessel and/or mass flow excavator from a construction vessel to remove the excess sediment on the seafloor along the footprint of the cable lay; however, other types of dredging equipment may be used depending on environmental conditions and equipment availability. Where required, pre-sweeping activities will occur in up to an approximately 164-ft (50-m) width along the length of the megaripples and sandwaves; the length of clearance will vary along the submarine export cable route, ranging from approximately 197 ft (60 m) to 5,577 ft (1,700 m). Megaripple and sandwave height vary depending on localized seabed and current characteristics. Approximately 119,262.2 yd^3 (91,182.5 m^3) of sediment is anticipated to be side-casted as a result of these pre-sweeping activities along the EW 1 submarine export cable route.

Should a suction hopper dredge vessel or similar equipment be used to complete these activities, Empire anticipates that dredged material generated from the Project may either be sidecasted near the site of installation or removed for beneficial reuse or proper disposal. The actual method of dredged material management will be based on sampling and consultation with regulatory agencies.

Mass flow excavation equipment, if used for pre-sweeping, will not generate dredge material requiring disposal; rather, the material will be sidecast. Within areas subject to pre-sweeping by either dredging or mass flow excavation, the submarine export cables will be installed to the target depth via jetting or other cable burial techniques described in the Cable Lay and Burial subsection.

Pre-Trenching

Pre-trenching activities will be required in select locations along the EW 1 submarine export cable route in areas where deeper burial depths may be required and/or seabed conditions are not suitable for traditional cable burial methods; pre-trenching activities may also be required in select locations along the EW 2 submarine export cable route. Pre-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. This activity helps facilitate an easier burial process in areas of greater depth. The impacts associated with this pre-trenching method are anticipated to be the same as those described in the Cable Lay and Burial subsection.

Localized Dredging

At locations where the EW 1 submarine export cable crosses other assets, local dredging may be needed in order to reduce the shoaling of the crossing design. This crossing design would consist of the removal of approximately 4 ft (1.2 m) of sediment within a 33 ft by 52.5 ft (10 m by 16 m) area at each crossing; utilizing a 3:1 side slope, the upper bounds of this area will be approximately 59 ft by 79 ft (18 m by 24 m). Approximately 679 yd^3 (519 m^3) of material is anticipated to be removed by suction hopper dredge and/or mass flow excavation at each crossing. 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 need to be approved by the asset owners through a crossing agreement. See **Figure 3.4-1** for a representative illustration of this proposed crossing methodology.

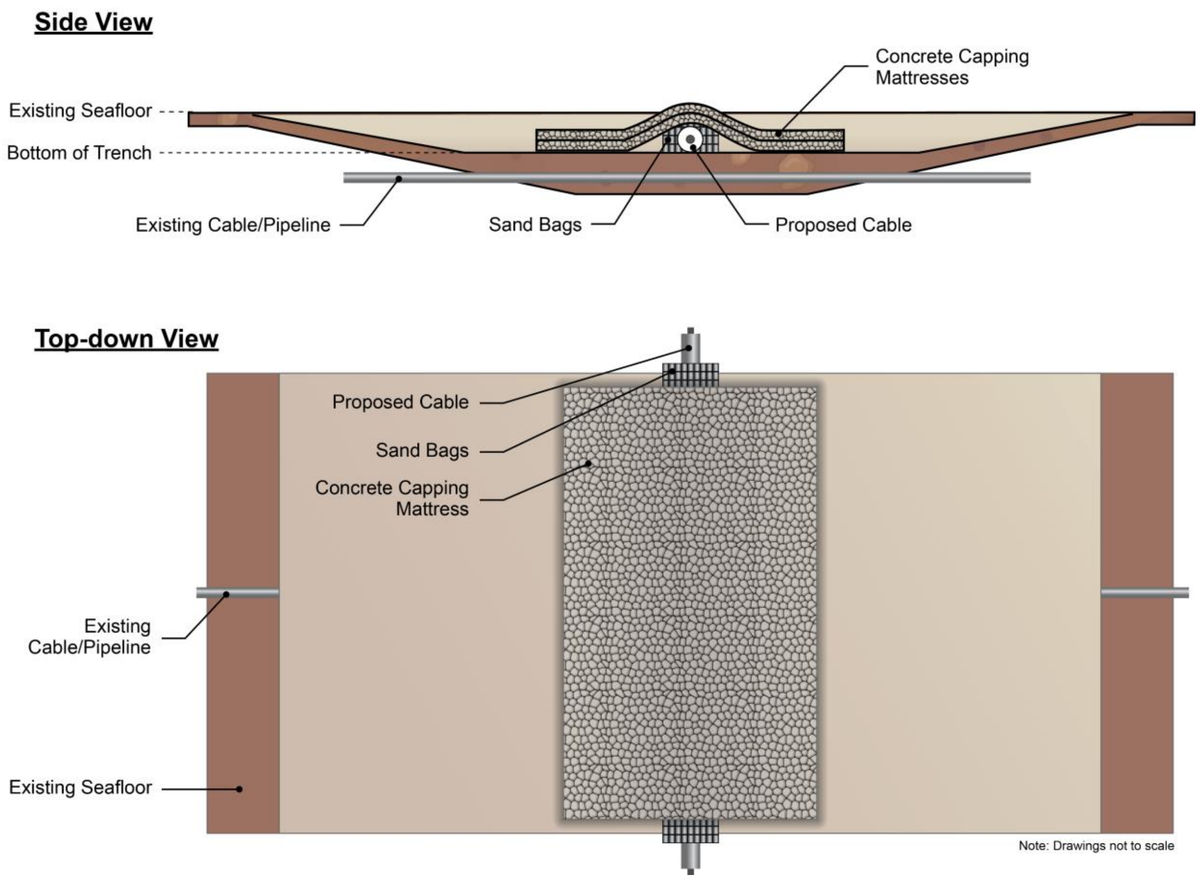


Figure 3.4-1 Representative Option for Locally Dredged Asset Crossing Methodology

Local dredging may also be required to facilitate the required burial depth along the EW 1 submarine export cable route within the Bay Ridge Channel and SBMT. Within the existing piers at SBMT, an area of approximately 36,147 yd^2 (30,207 m^2) may require dredging of up to approximately -26.5 ft (-8.0 m) below MLLW plus 2 ft (0.6 m) overdredge for access of the cable installation vessel. In addition, an area of approximately 0.6 ac (0.2 ha) at the base of the cable landfall may need to be dredged to -26 ft (-7.0 m) MLLW plus 2 ft (0.6 m) overdredge.

Additionally, dredging may be required within an approximately 17.6-ac (7.1-ha) area in the Bay Ridge Channel, as the EW 1 submarine export cable route makes its approach into SBMT. This area overlaps with the area proposed for maintenance dredging by the USACE in a Public Notice issued on March 11, 2021. Empire is currently consulting with the USACE on the anticipated channel maintenance activities and does not anticipate conducting additional dredging within these USACE-managed channel reaches prior to construction and installation activities. However, dredging in this area could be required if sedimentation or shoaling decreases the water depth prior to or during construction. Sedimentation over the cables during operations may also result in an exceedance of the depth limitations of the cables over time. In that case, maintenance dredging may be required during operations.

Empire anticipates that dredged material generated from the Project will be removed for either reuse or proper disposal at a licensed facility. The actual method of dredged material management will be based on sediment sampling and consultation with regulatory agencies.

Cable Lay and Burial

Following the pre-installation grapnel run and route clearance, the cables will be brought to the appropriate section of the submarine export cable siting corridor on the cable laying vessel. From there, the cables 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 along the Rockaway sandbank in New York Harbor, the submarine export cable may need to be floated into place for burial, as water depths along this stretch are inadequate for the cable lay vessel. Should this floating installation method be implemented, the cable lay vessel will be located approximately 1,312 ft (400 m) from the burial location. The cable burial machine will then assist in lowering and burying the submarine export cable in place, as it moves along these shallower areas. The burial machine may also be run out of a separate construction vessel.

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

- **Plowing:** As the cable plow is dragged along the seabed, a small trench is created. The submarine export cable is then placed in the trench and displaced sediment is either mechanically returned to the trench and or backfills naturally under hydrodynamic forcing. An example of a cable plow is depicted in **Figure 3.4-2**. Plowing is generally less efficient than jetting methods but may be used in limited site-specific conditions.

- **Jetting:** Jetting involves the use of pressurized water jets into the seabed, creating a trench. As the trench is created, the submarine export cable is able to sink into the seabed. The displaced sediment then resettles, naturally backfilling the trench. An example of jetting is depicted in **Figure 3.4-2**. Jetting is considered the most efficient method of submarine cable installation. It minimizes the extent and duration of bottom disturbance for the significant length and water depths along the submarine export cable route.

- **Trenching (cutting):** Trenching (cutting) is used on seabed containing hard materials not suitable for plowing or jetting, as the trenching machine is able to cut through the material using a chain or wheel cutter fitted with picks. Once the cutter creates a trench, the submarine export cable is laid into it. An example of trenching is depicted in **Figure 3.4-2**.

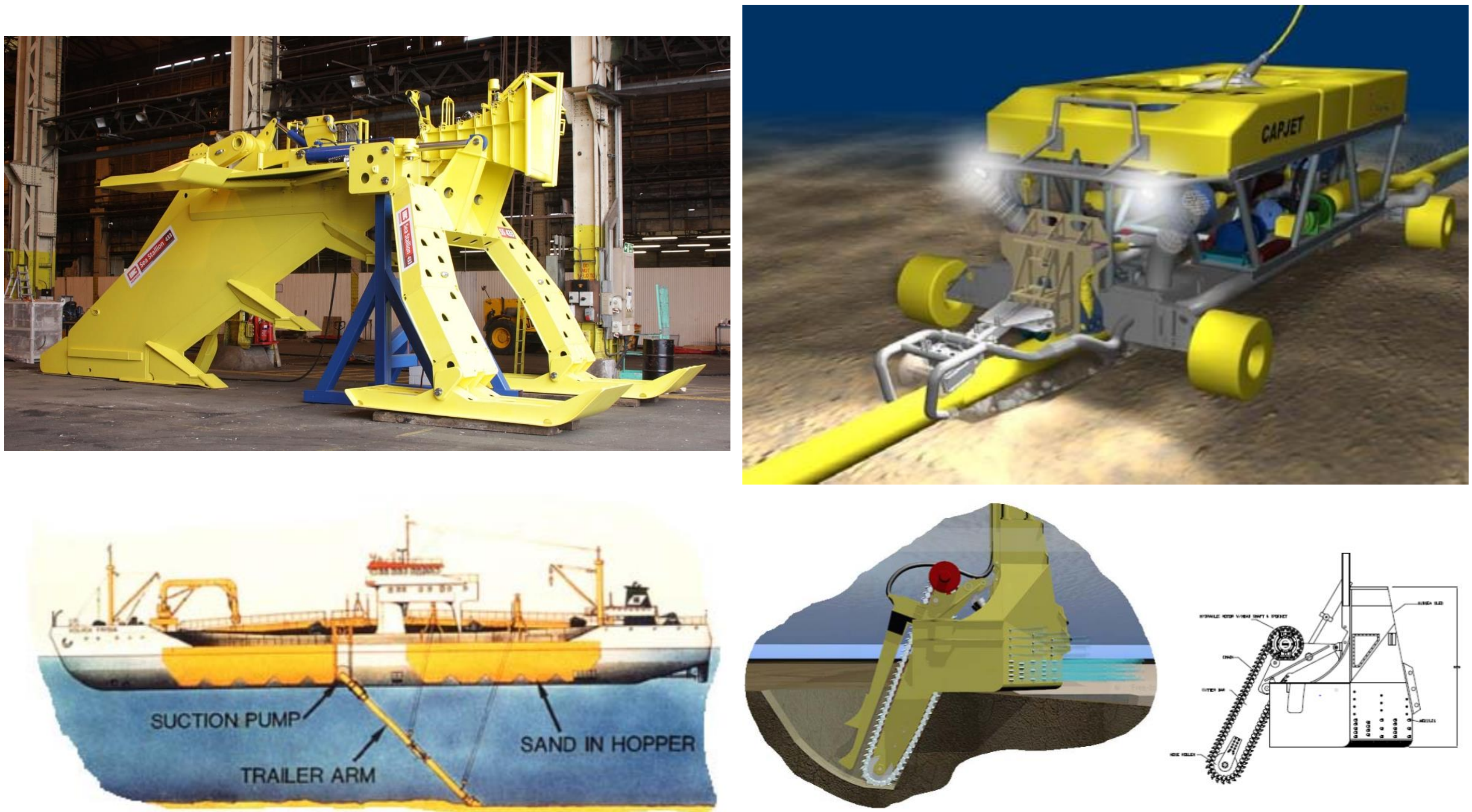


Figure 3.4-2 Examples of Cable Installation Methods

From top left, clockwise: plowing[28], jetting[29], trenching (cutting)[30], and suction hopper dredging[31].

[28] https://www.royalihc.com/en/products/offshore/subsea-equipment/subsea-cable-ploughs
[29] http://docplayer.nl/58313179-Aanvraaggegevens-aanvraagnummer-net-op-zee-hollandse-kust-zuid-ingediend-op-gefaseerd-blokkerende-onderdelen-weglaten.html
[30] http://www.miahtrenchers.com/page6.html
[31] https://www.epd.gov.hk/eia/register/report/eiareport/eia_2512017/html/Ch%2006%20Hazard%20to%20Life%20Assessment.htm

Cable and Pipeline Crossings

There are existing cables and pipelines, both in and out of service, located within the Lease Area and the submarine export cable routes proposed for the Project. While the submarine export cables have been sited to avoid cables and pipelines, a number of crossings will still be required. Where crossings within the Lease Area or 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 Empire 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 submarine export cables 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 the "Pre-Sweeping and Pre-Trenching subsection" 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 3.4-3**.

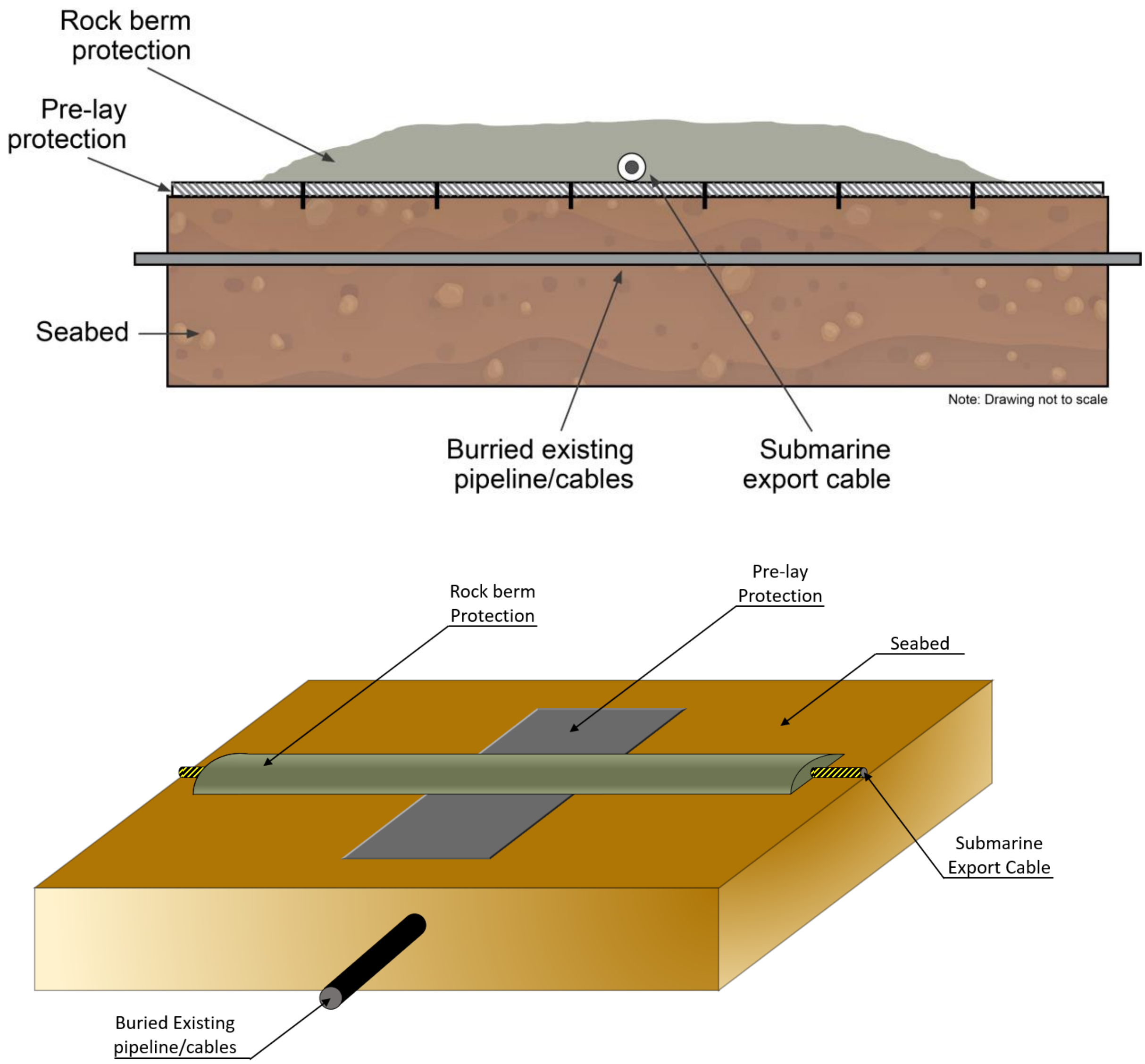


Figure 3.4-3 Typical Cable Crossing Design

Post-Installation Survey

After cable burial, a post-installation survey 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.

3.4.1.5 Interarray Cable Installation

The installation methodology for the interarray cables will be largely the same as the submarine export cables, described in Section 3.3.1.4. 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 3.4-1**.

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 up to six months for EW 1 and approximately up to six months for EW 2, subject to seabed conditions, vessel availability, methodology, and weather.

3.4.1.6 Scour Protection Installation

The installation of scour protection, as described in Section 3.3.1.6, will take place following the installation of the foundations. The maximum estimated seabed coverage resulting from the footprint of the installation of scour protection measures are detailed in **Table 3.3-9**. Details on the vessels required for the installation of scour material can be found in **Table 3.4-1**. Examples of scour protection installation methods can be found in **Figure 3.3-10**.

Installation of the scour protection measures are expected to take approximately four days per foundation.

3.4.1.7 Cable Protection Installation

In areas where burial of the cable 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.

Details on the vessels required for the installation of the interarray cables protection can be found in **Table 3.4-1**. Installation of the cable protection measures are expected to take approximately up to six months for the EW 1 submarine export cables and approximately up to six months for the EW 2 submarine export cables; and approximately up to two to three months for the EW 1 interarray cables and approximately up to two to three months for the EW 2 interarray cables.

3.4.2 Construction and Installation: Onshore Infrastructure

3.4.2.1 Onshore Export Cable and Interconnection Cable Routes

As discussed in Section 3.3.2.2, the onshore export and interconnection cables for EW 1 will be within a single corridor and up to two separate corridors may be needed for EW 2. The construction and installation methodology proposed will comply with applicable regulations and guidelines. Based on the existing conditions along the export cable landfall and onshore export and interconnection cable routes, both trenchless (e.g., HDD and jack and bore) and trenched (open cut trench) methods are proposed. A description of each method is detailed, below. A summary of the proposed installation methods being considered for EW 1 and EW 2 is in **Table 3.4-7**.

Table 3.4-7 Summary of Export Cable and Interconnection Cable Installation Methods

Installation Methodology	EW 1	EW 2
Export Cable Landfall /Inland Waterway Crossings		
Trenchless (HDD, jack and bore, or similar)	X	X
Open Cut Trench/Jetting (with or without dredging)	X	X
Open Cut/Jetting (cofferdam)	X	X
Open Cut /Jetting (conduit through bulkhead with or without cofferdam)	X	X
Open Cut/Jetting (conduit over bulkhead with or without cofferdam)	X	X

Table 3.4-7 Summary of Export Cable and Interconnection Cable Installation Methods (continued)

Installation Methodology	EW 1	EW 2
Onshore Export Cable/Interconnection Cable Routes (Upland)		
Open Cut Trench	X	X
HDD	X	X
Other Trenchless (jack and bore)	X	X

Open Cut Alternatives

Landfall and Inland Waterway/Wetland Crossings

Open cut alternatives are currently being considered for the landfall associated with EW 1, as well as inland waterway crossings for EW 2 due to potential limitations of an HDD 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);
- Thermo resistivity characteristics limiting burial depth tolerances of export cables;
- Vessel traffic in proximity to anticipated entrance/exit; and/or
- Limited workspace for HDD entrances/exits (both offshore and onshore).

Open cut alternatives may require open cut trenching/dredging or jetting to facilitate installation at target burial for approach to landside. 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 applicable regulations. No backfilling is proposed for these activities if implemented for the purposes of landfall or waterway/wetland crossing.

At some locations (e.g., EW 1), additional installation methodologies are being considered at the interface of a developed shoreline for landfall and/or inland waterway/wetland crossings (e.g., rip rap, bulkhead or sheetpile) (see **Appendix E** for additional information), these methodologies include:

- **Cofferdam**: 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 cables would be directly laid in this corridor within the cofferdam. One or more cofferdams may be required depending on the solution.

- **Through Bulkhead**: Conduit openings will be installed at the bottom of the bulkhead with approximately 4 ft (1.2 m) depth of cover below the mudline. Steel structure supports for the cable conduits may also be installed within the cofferdam area to support the ends of the conduits, depending on conduit length and the need for stability. Alternatively, sandbags may be placed below and around the conduit to assist in supporting and securing the ends of the conduits.

A temporary dredge pit suitable for the submarine export cable installation equipment will be dredged at the base of the bulkhead adjacent to the conduit openings. Following the installation of any supports at the conduit openings, the temporary sheet piles in the water will be removed. Export cable installation will then commence by pulling the end of each cable from the cable-laying vessel through the conduits and temporarily anchoring them on shore.

After the cable lay, the temporary dredge pit will be backfilled. Backfill will consist of native dredge material if suitable; otherwise, dredged material will be taken to an authorized facility for disposal, and suitable clean backfill material will be used. Once the cables are in place, scour protection will be installed at the toe of the bulkhead around the end of the conduit. Armor stone and bedding will be placed a minimum of 4 ft (1.2 m) above the submarine export cables out to approximately 80 ft (24 m) in front of the cable landfall.

As part of site preparation activities for this method, the exiting bulkhead will be replaced, and at the same time vertical conduits (or J-tubes) will be installed through the bulkhead for cable landfall. The existing bulkhead consists of timber and steel sheet pile with concrete and/or rip-rap armor stone. Pile driving will be conducted along the length of the bulkhead and the anchor wall behind it. This area will then be backfilled and a concrete cap installed over the proposed bulkhead structure.

Around the cable landfall itself, a permanent sheetpile cofferdam will be integrated into the new bulkhead and will surround the J-tubes. Temporary sheet piling may also be installed in the water at the conduit openings during the bulkhead replacement activities, which will stay in place until cable pull and then be removed after installation of the cable landfall is complete.

- **Over Bulkhead**: Export cables routed through mildly sloped steel conduit over the edge of the bulkhead down towards the mudline; export cables supported by steel structure between bulkhead and mudline. Structure could be designed to be structurally independent of the bulkhead. In addition, implementation of a cofferdam may be required to facilitate installation.

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:

1. Prepare the construction corridor;
2. Install ducting;
3. Establish jointing bays
4. Pull onshore export and interconnection cables through the ducts;
5. Join the cables; and
6. Restore the construction corridor.

Based on the existing conditions along each onshore export and interconnection cable routes, Empire proposes to utilize the open cut trench technique as the preferred methodology for the onshore export and interconnection cable routes.

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. The onshore electrical components, including the duct banks and onshore export and onshore interconnection cables are then installed within the trench. Once installation is complete, the trench is backfilled, typically using the excavated soil, if it is suitable and 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 3.4-8** 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 E**.

Table 3.4-8 Summary of Onshore Open Cut Trench Parameters

Parameter	EW 1	EW 2
Depth of Trench	10 ft (3 m)	10 ft (3 m)
Width of Trench	10 ft (3 m)	15 ft (4.5 m)
Construction Corridor Width	50 ft (15 m)	150 ft (46 m) a/
Operational Corridor Width b/	25 ft (8 m)	25 ft (8 m)

Notes:
a/ Where constrained by existing development, the onshore export cable construction corridor width may be less than 150 ft (46 m); the maximum width is included herein, as part of the PDE.
b/ Per cable circuit

Typically, open cut trench operations for an export cable landfall originate from offshore, generally within a cofferdam (see **Appendix E** for an example of a typical cofferdam). The cofferdam, constructed with sheet piles, will be installed via a vibratory sheet pile hammer. An excavator will then create a trench, in which the submarine export cable will be brought to shore. Once installation is complete, the trench will be backfilled. To support this installation, both onshore and offshore work areas are required. The onshore work areas are typically located within the landfall parcels (see **Appendix E** for examples of typical onshore work areas).

Horizontal Directional Drilling

Landfall and Inland Waterway/Wetland Crossings

HDD is used to install cables in ducts under sensitive coastal and nearshore habitats, such as dunes, beaches, waterways, and submerged aquatic vegetation (SAV). HDD can also be used to cross under major infrastructure, including railroads and highways. **Table 3.4-9** provides a summary of the HDD parameters proposed for the Project.

Table 3.4-9 Summary of HDD Parameters

Parameter	EW 1	EW 2
Submarine Export Cable Landfall HDD		
Onshore (entry) Work Area Footprint	200 ft x 200 ft (61 m x 61 m)	246 ft x 246 ft (75 m x 75 m)
Offshore (exit) Work Area Footprint	100 ft x 100 ft (30 m x 30 m)	
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)	246 ft x 246 ft (75 m x 75 m) x 2 (entry/exit)

Typically, HDD operations for an export cable landfall originate from an onshore landfall location and exit a certain distance offshore, which is determined by the water depth contour, as well as 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 that drills a borehole underneath the surface (a typical HDD schematic can be found in **Figure 3.4-4**). Once the drill for both HDDs (i.e., two circuits for EW 1 and three circuits for EW 2) exits onto the seafloor, the ducts in which the submarine cable will be installed are floated out to sea and then pulled back pulled back onshore within the drilled borehole.

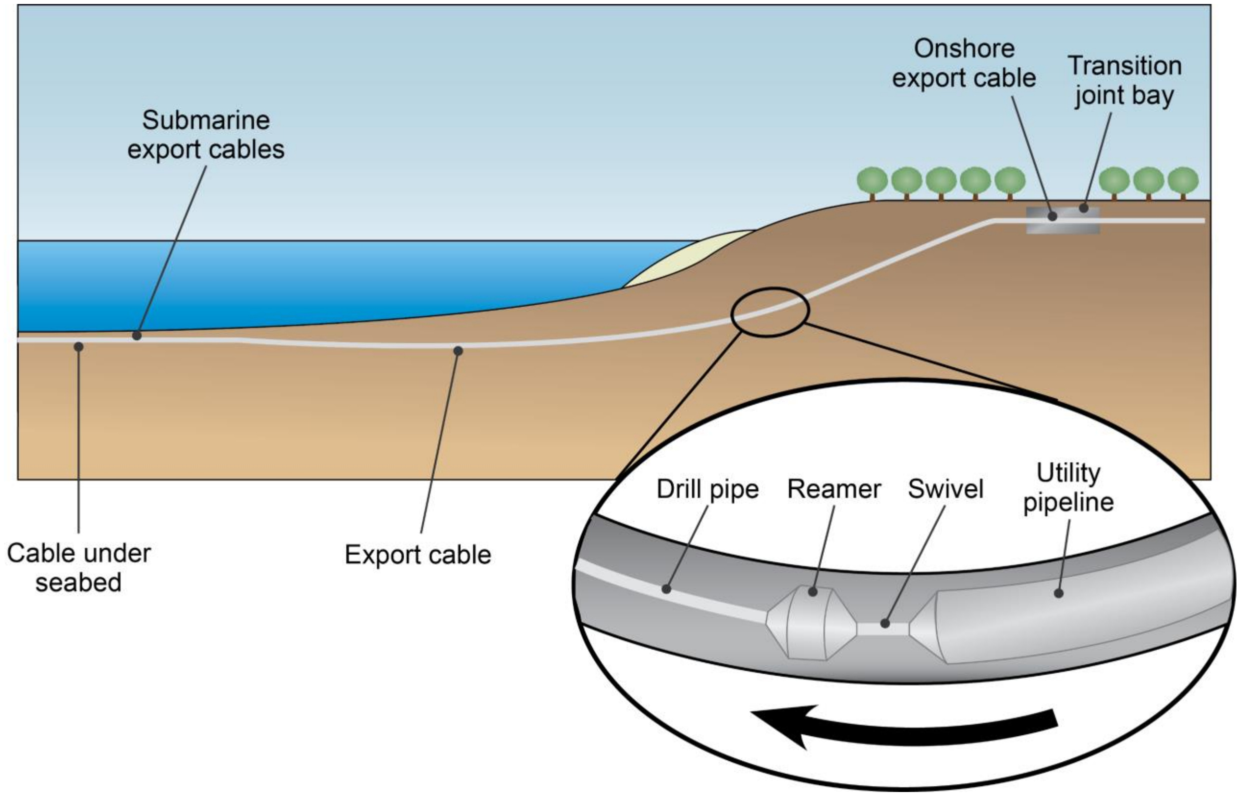


Figure 3.4-4 Typical Onshore HDD Landfall

The offshore exit location will require some seafloor preparation in order to collect any drilling fluids that localize during HDD completion. Preparation may include installation of a cofferdam or excavation (wet or dry). Offshore work can also be completed by utilizing a pipe that marks and keeps the borehole in place. Marine support is needed (e.g., vessels, barges, divers) to support HDD drilling operations.

Onshore

HDD is also the proposed to be utilized to cross sensitive habitats, waterways, utilities, and infrastructure onshore. Similar to the onshore HDD landfall, onshore crossings HDD utilizes a rig that drills a borehole underneath the surface (a typical HDD schematic can be found in **Figure 3.4-5**). Once the rig exits onshore, the ducts in which the cable will be installed are then pulled back pulled back within the drilled borehole. Onshore crossings require two onshore work areas to support the activities.

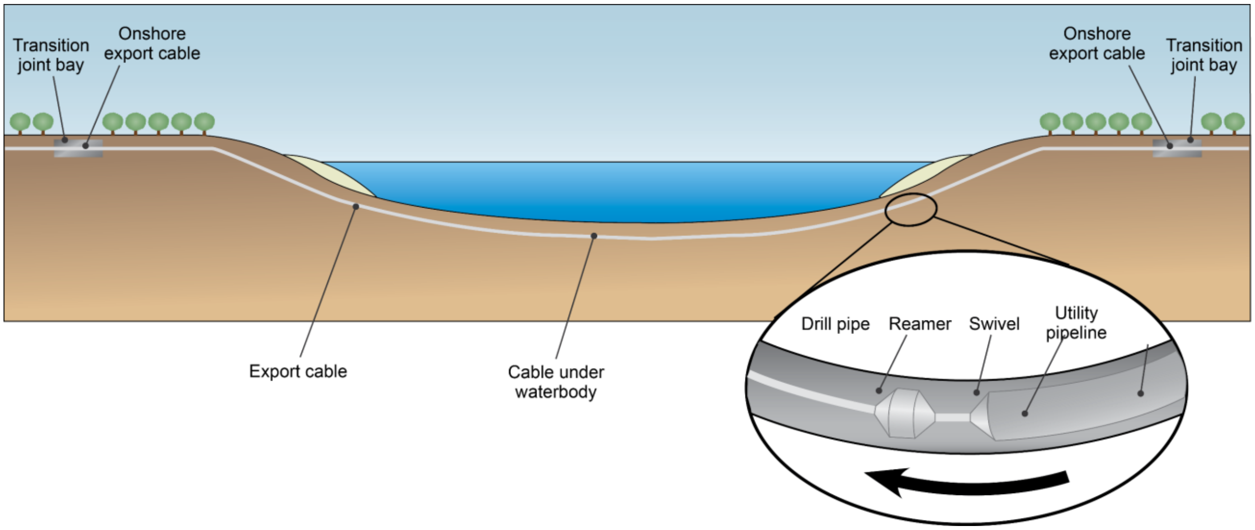


Figure 3.4-5 Onshore Crossing HDD

Other Trenchless Crossings (non-HDD)

The onshore export cables and/or interconnection cables may also be installed using the jack and bore methodology or other non-HDD trenchless technologies. While jack and bore is not the preferred onshore installation methodology, Empire is proposing it as part of the PDE to be utilized in the event that HDD and open cut trench methodologies are not technically or commercially feasible to complete installation activities. Jack and bore is completed by installing a steel pipe or casing under existing roads, railways, 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 then jacks a casing pipe through the earth while at the same time removing earth spoil from the casing by means of rotating auger inside the casing. The onshore cable will then be pulled through the crossing.

Table 3.4-10 provides a summary of the jack and bore parameters proposed for the Project. A representative drawing of this installation methodology is provided in **Appendix E**.

Table 3.4-10 Summary of Other Trenchless Crossing (non-HDD) Parameters

Parameter	EW 1	EW 2
Work Area Footprint	50 ft x 50 ft (15 m x 15 m)	
Bore Pit Footprint	60 ft x 20 ft (18 m x 6 m)	
Receiving Pit Footprint	30 ft x 20 ft (9 m x 6 m)	

Known onshore crossings include:

- The railroad crossing along the EW 1 interconnection cable route in Brooklyn, New York; and
- The railroad crossing along the EW 2 onshore export routes in Oceanside, New York.

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

3.4.2.2 Onshore Substation

As discussed in Section 3.3.2.3, the construction and installation of two onshore substations is proposed to support the Project. For both EW 1 and EW 2, the construction and installation methodology is proposed to be similar 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 stormwater management system;
- Installation of the foundation;
- Installation of the electrical infrastructure and other associated structures and services including connection to local utilities; and
- Land reinstatement and landscaping.

Conceptual plans for the proposed onshore substations are provided in **Appendix E**.

3.5 Operations and Maintenance Activities

The commercial lifespan of EW 1 and EW 2 is expected to be 35 years, based on the design life of the Project components. Consistent with BOEM's regulations and applicable guidance, Empire intends to pursue 35-year Operations Terms for EW 1 and EW 2 at the appropriate time[32].

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. Empire intends on constructing and maintaining a staffed O&M Base. A location for this facility has not yet been finalized; however, a location at SBMT is under evaluation. This O&M Base will monitor operations and include office, control room, warehouse, shop, and pier space. The final selection will be determined upon whether the facility will be able to accommodate Empire's workforce and equipment needs.

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.

An O&M Plan will be developed and finalized during the FDR/FIR phase and prior to the commencement of construction. Based on Empire's previous O&M experience in offshore wind, however, a brief summary of the anticipated offshore and onshore activities is provided. An Incident Management Plan, Oil Spill Response Plan, and Safety Management System will also be developed and implemented during O&M activities (see **Appendix F Oil Spill Response Plan** and **Appendix G Safety Management System**, for preliminary versions of these that will continue to be developed as the Project matures in consultation with BOEM and the Bureau of Safety and Environmental Enforcement).

In accordance with 30 CFR § 585.626(b)(9), Empire has provided a list of wastes expected to be generated during the Project in **Table 3.4-2**.

[32] Empire will request an extension to the 25-year Operations Term, in accordance with 30 CFR § 585.235

3.5.1 Offshore O&M

All offshore components will require routine maintenance and inspections. It is anticipated that Service Operations Vessels (SOVs) and Crew Transfer Vessels (CTVs) will be used to support operations and maintenance activities offshore. Helicopters are currently being considered to support the Project; Empire is continuing to evaluate logistics, and the relevant impact assessments will be updated pending the final decision.

Empire will conduct a complete as-built survey of the Project, following the completion of the offshore installation activities. This as-built survey will provide the baseline conditions for future survey campaigns. In addition, Empire proposes to implement a risk-based approach to the scope of the post-construction survey campaigns. The risk-based approach will allow Empire to survey those areas of the Project Area determined to be at the highest risk at the time.

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;
- Inspections of up to 10 percent of foundation scour protection in order to monitor and document habitat disturbance and recovery, every three years starting at year three;
- Inspections and maintenance of the wind turbine and offshore substation electrical components/equipment;
- Surveys of the submarine export cables and interarray cables routes, to confirm the cables have not become exposed or that the cable protection measures have not worn away. Following the full coverage as-built survey, annual, risk-based inspections will be conducted for the first three years. For the remainder of the Operations Term, risked-based bathymetric surveys will be conducted every two years. Risk-based burial depth surveys will be conducted every five years, with coverage to be determined through the use of Distributed Temperature and Distributed Acoustic/Vibration Sensing (DAS/DVS) systems. Additional survey activities will be completed on an as-needed basis, determined based upon various factors, such as extreme weather events.;
- 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 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). The submarine export cables will be monitored through Distributed Temperature Sensing and DAS/DVS equipment. The Distributed Temperature Sensing system will be able to provide a real time monitoring of temperature along the submarine export cable route, alerting Empire should the temperature change, which often is the result of scouring of material and cable exposure. The DAS/DVS system will provide real time acoustic/vibration monitoring indicating potential dredging activities or anchor drag occurring close to the submarine export cables.

In the event of a fault or failure of the offshore components, Empire will repair and replace the Project component in a timely manner. Unplanned maintenance and repair of the wind turbines and offshore substations will occur within the component. Should the submarine export or interarray cables fault, the portion of the cable will be spliced and replaced with a new, working segment. 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 substation(s) will be equipped with monitoring equipment. The onshore substation(s) will also be regularly inspected during the Operations Term, which may result in routine maintenance activities, including the replacement of and/or update to electrical components/equipment. The onshore export cables will require periodic testing, with readings taken from access chambers, but should not require maintenance, though occasional repair activities may be required should there be a fault or damage caused by a third party or unanticipated events.

3.5.3 Offshore Marking and Lighting

The wind turbines will be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. In addition to adhering to FAA filing requirements for the wind turbines, Empire will light and mark all wind turbines in accordance with FAA Advisory Circular 70/7460-1L, BOEM's Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development (2021), and *International Association of Marine Aids* (IALA) *to Navigation and Lighthouse Authorities Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA 2013), as detailed below (and shown in **Figure 3.5-1** and **Figure 3.5-2**):

- All foundation structures will be painted yellow from the level of Highest Astronomical Tide (HAT) up to 50 ft (15.3 m) and utilize retro reflective material, as shown on **Figure 3.5-2**.
- Wind turbine towers will have alphanumeric marking in black, approximately 10 ft (3 m) high and will be visible in all directions in both daytime and nighttime. Unique alphanumeric marking scheme will be subsequently determined, in coordination with the USCG. Letters shall be easily visible by using either illumination or retro-reflecting material as shown on **Figure 3.5-2**.
- 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 3.5-2**.
- All wind turbines in excess of 699 ft (213 m) above ground level (AGL) level will require two synchronized flashing red lights (with medium intensity L-864 and LED color between 800 and 900 nanometers) placed on the back of the nacelle on opposite sides.
- Additionally, mid-level lighting (model L-810) will be required at a half-way point on the tower between the top of the nacelle and ground level. Mid-level lighting should be flashing red lights configured to flash in unison with the nacelle lighting and should contain a minimum of three of the L-810 lights.

In accordance with IALA 0-139 and USCG Local Notice to Mariners (LNM) entry 44-20, the following will also apply:

- Each turbine should 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 turbine structures and visible throughout a 360-degree arc from the water's surface.
- Corner Towers/Significant Peripheral Structures will have quick flashing yellow lights energized at a 5 nm (9.3 km) range.

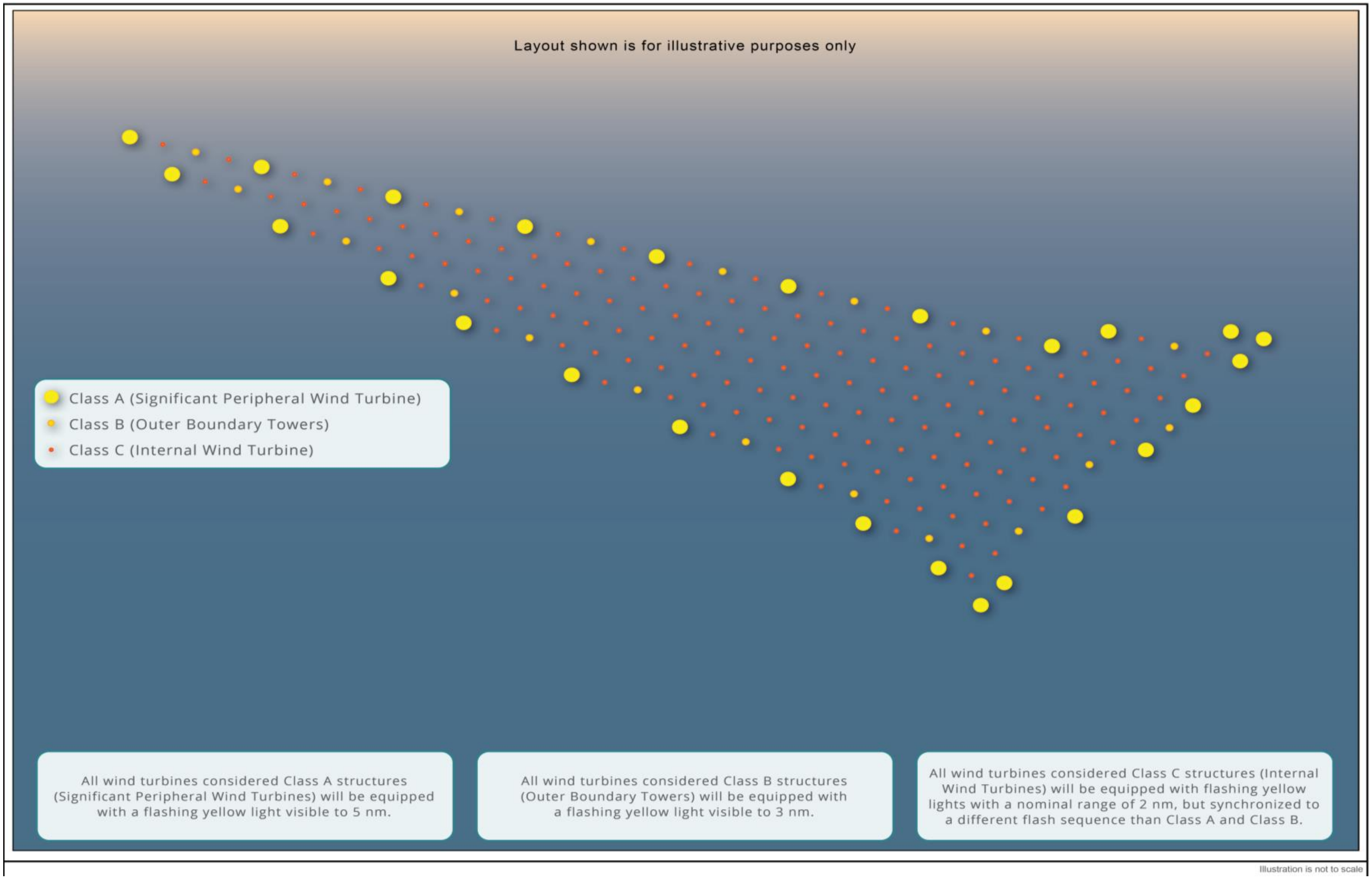


Figure 3.5-1 Navigation Lighting Requirements for Wind Turbines

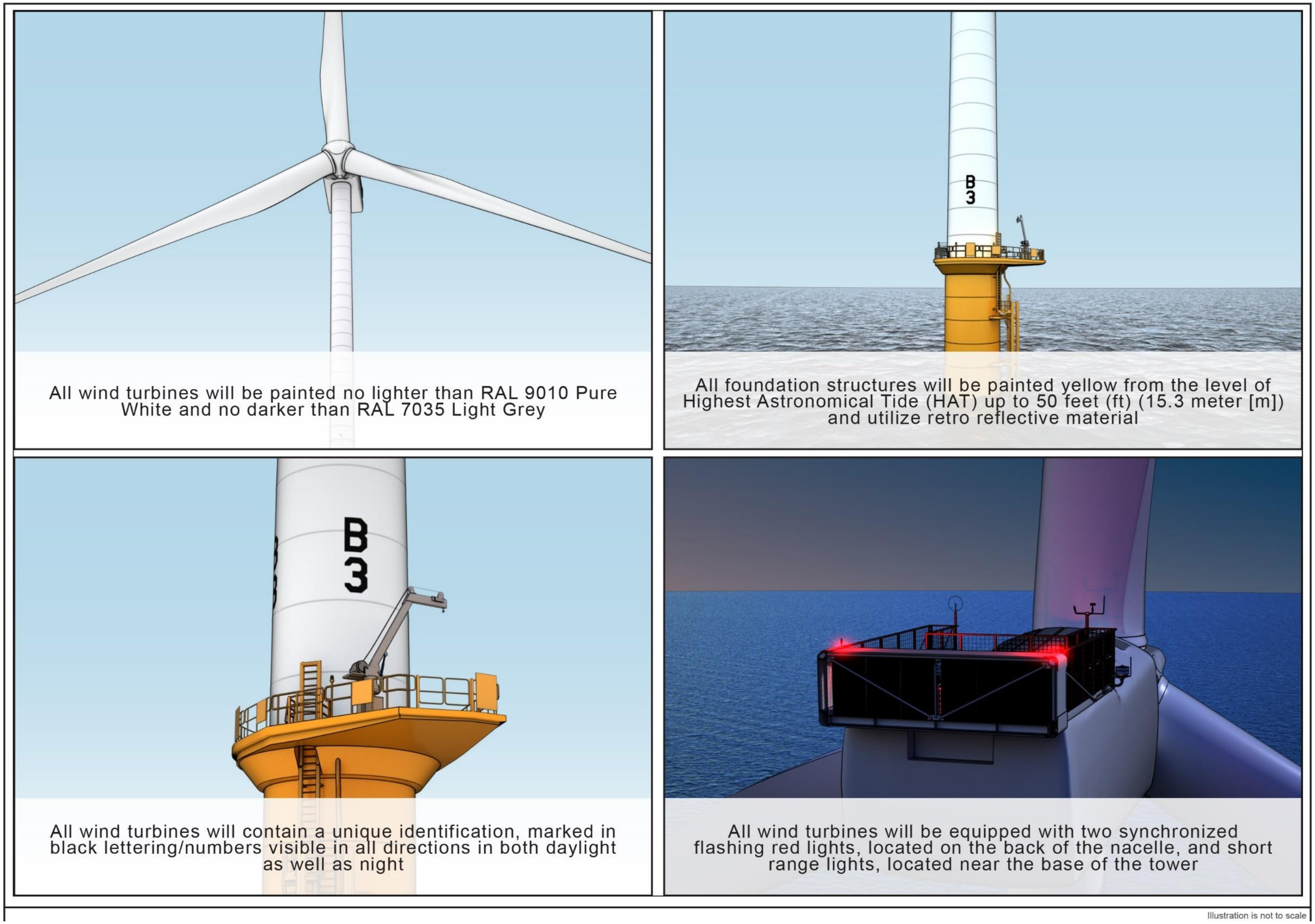


Figure 3.5-2 Paint Color and Marking Requirements for Wind Turbines

- Outer Boundary Towers will have yellow 2.5 second lights (FL Y 2.5s) energized at 3 nm (5.6 km) range.
- Interior Towers 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.
- Also noting that all temporary base, tower and construction components preceding the final structure completion must 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.
- The aids to navigation on each 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/Significant Peripheral Structures 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 VHF Radio frequency 83A five times within ten seconds.
- Sound signals will be timed to energize for 45 minutes from last VHF activation.
- Aeronautical obstruction lights, which when fitted to the tops of turbines are not visible below their horizontal plane.
- Aeronautical obstruction lights will be night vision imaging system compliant.

In addition, Empire proposes to include an ADLS (or a similar system) to turn the aviation obstruction lights on and off in response to detection of nearby aircraft, as a base case, pending commercial availability, technical feasibility and agency review and approval.

3.6 Decommissioning Activities

In accordance with 30 CFR Part 585 and other BOEM requirements, Empire 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, foundations, 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; Empire would need to obtain separate and subsequent approval from BOEM to retire any portion of the Proposed Action in place. Project components will be decommissioned using a similar suite of vessels, as described in **Table 3.4-1**. Environmental impacts are anticipated to be similar to those experienced during construction and installation activities, as described in **Section 3.4**. 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 EW 1 and EW 2 have an assumed a lifetime of approximately 35 years for the purposes of this COP, some installations and components may remain fit for continued service after such time, where Empire may seek to repower such installations if extension is authorized by BOEM. Upon initiation of decommissioning activities, Empire will complete decommissioning within two years of termination of the Lease and either reuse, recycle, or responsibly dispose of all materials removed, unless otherwise authorized by BOEM. 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, Empire will compile an inventory of Project components and detail the methods proposed to decommission the Project components. As Project components are decommissioned, Empire 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 described in **Section 3.3**.

The types of vessels and total vessel trips required for decommissioning are expected to 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 3.6-1 provides additional detail on likely removal methods and assumptions that would be applicable based on present day understanding of available decommissioning approaches.

Table 3.6-1 Summary of Decommissioning Methods and Assumptions

Item	Removal Method	Comments and Assumptions
Wind Turbine	Removal of the wind turbines are 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 revers installation order.	Materials brought onshore to U.S. port for recycling and disposal. Steel in the tower is assumed to be recycled. The blades are assumed to be disposed at an approved location.
GBS Wind Turbine Foundation	Removal of the GBSs are done using a reversed installation method. Steel TP lifted off by heavy lift vessel, GBS foundations would be de-ballasted (removal of the chosen ballast material) via suction. After removal of the ballast, the GBS foundations would be lifted onto a barge and returned to shore, or wet-towed by conventional tugboats, and be fully recycled.	GBSs and ballast material, it is assumed that it needs to be removed and brought to an approved dedicated disposal location (onshore/offshore). Steel TP is assumed to be recycled. GBS de-ballasted and transported to U.S. port for recycling.
Monopile foundation and TP	Removal of the monopile TP foundations are 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. Removal of the monopile is assumed to be cut off 15 ft (4.6 m) below the mudline and be lifted off by a heavy lift vessel to a barge prior to decommissioning.	Monopile to be cut below mudline and transported to U.S. port 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.

Table 3.6-1 Summary of Decommissioning Methods and Assumptions (continued)

Item	Removal Method	Comments and Assumptions
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 in one piece by a heavy lift vessel to a barge prior to decommissioning.	Transported to Europe or U.S. port for recycling and disposal. Removed fluids would be brought to U.S. port for recycling and disposal. Steel from the topside is assumed to be recycled.
Jacket with piles	The piles are assumed to be cut 15 ft (4.6 m) below the mudline, 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 to U.S. port 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.
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 be disconnected from wind turbines and the offshore substation before removal. J-tubes will be removed.	Total removal of cable and 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	Removal of the all buildings and equipment, unless suitable for future use.	Materials to be recycled. 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 at the fence site below ground level, this on both sides. 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 of 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 re-used, if possible, or transported to U.S. port for disposal.

3.7 National Historic Preservation Act – Section 106 Area of Potential Effect

As defined by 36 CFR § 800.16(d), the area of potential effect (APE) is "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist". This COP includes three subsets of historic properties, which are described in Volume 2c Cultural Resources and within their own appendices:

- Marine Archaeological Resources (Section 6.1 and Appendix X);
- Terrestrial Archaeological Resources (Section 6.2 and Appendix Y); and
- Historic Properties and Architectural Properties (Section 6.3 and Appendix Z).

Throughout this COP, the APE for these historic properties will be referred to as the Marine Archaeological APE, the Terrestrial Archaeological APE, and the Analysis of Visual Effects to Historic Properties (AVEHP) APE. A summary of each APE, including descriptions and illustrations, is provided below.

3.7.1 Marine Archaeological APE

The Marine Archaeological APE includes the entire Lease Area and submarine export cable siting corridors and anchor corridors for EW 1 and EW 2. Empire has characterized the full Lease Area and submarine export cable siting corridors and anchor corridors for EW 1 and EW 2 to allow for micro-siting of Project facilities. The results of this characterization will be provided in **Appendix X Marine Archaeological Resource Assessment**. A summary of the Marine Archaeological APE is provided in **Table 3.7-1**. A summary of the Project activities proposed to be conducted within the Lease Area and submarine export cable siting corridors and anchoring corridors for EW 1 and EW 2 is provided in **Table 3.7-2**. The Marine Archaeological APE is illustrated in **Figure 3.7-1** and **Figure 3.7-2**.

Table 3.7-1 Summary of the Marine Archaeological APE a/

Project Component	Maximum Horizontal Effect	Maximum Vertical Effect
Lease Area	79,350 ac (32,112 ha)	295 ft (90 m)
EW 1 Submarine Export Cable Siting Corridor (Total length of 40 nm (74 km)	500 ft (152 m)	20 ft (6.1 m) b/
EW 1 Anchor Corridor (Total length of 16 nm [30 km]) c/	1,250 ft (381 m)	49 ft (15 m)
EW 2 Submarine Export Cable Siting Corridor (Total length of 26 nm (48 km)	900 ft (274 m)	20 ft (6.1 m) b/
EW 2 Anchor Corridor (Total length of 16 nm [30 km]) c/	1,250 ft (381 m)	49 ft (15 m)

Notes:
a/ This table details the Marine Archaeological APE associated with construction activities; Project O&M activities will occur within this maximum horizontal and vertical effects, as detailed above.
b/ Maximum vertical effect to be based on CBRA and/or site-specific conditions but will not exceed 20 ft (6.1 m).
c/ 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.

Table 3.7-2 Summary of Activities Proposed within the Marine Archaeological APE a/

Project Component	Maximum Horizontal Effect	Maximum Vertical Effect
Lease Area		
GBS Foundation	180 ft (55 m) b/	23 ft (7 m)
GBS Scour Protection (Including foundation)	609 ft (186 m) b/	0 ft (0 m)
Monopile Foundation	49 ft (15 m) b/	180 ft (55 m)
Monopile Scour Protection (Including foundation)	226 ft (69 m) b/	0 ft (0 m)

Table 3.7-2 Summary of Activities Proposed within the Marine Archaeological APE a/ (continued)

Project Component	Maximum Horizontal Effect	Maximum Vertical Effect
Offshore Substation Foundation	197 ft x 148 ft (60 m x 45 m)	295 ft (90 m)
Offshore Substation Scour Protection (Per leg, including foundation)	105 ft (32 m) b/	0 ft (0 m)
Project-Vessel Area of Disturbance	1,312 ft (400 m) b/	<295 ft (<90 m) c/
Interarray Cables (Total length of 260 nm [481 km])	10 ft (3 m)	8 ft (2.4 m)
Cable Protection d/	46 ft x 6.6 ft (14 m x 2 m)	0 ft (0 m)
Meteorological Buoy	151.8 ft^2 (14.1 m^2)	2 ft (0.6 m)
EW 1 Submarine Export Cable Siting Corridor		
Submarine Export Cable Burial	10 ft (3 m)	8 ft (2.4 m) / 18 ft (5.5 m) e/
Pre-Sweeping f/	164 ft x 5,577 ft (50 m x 1,700 m)	<20 ft (<6.1 m) c/
Dredging (cable and pipeline crossing) f/	33 ft x 52.5 ft (10 m x 16 m)	4 ft (1.2 m)
Dredging (EW 1 landfall)	36,127 yd^2 (30,207 m^2)	20 ft (6.1 m)
Cable Protection d/	46 ft x 6.6 ft (14 m x 2 m)	0 ft (0 m)
HDD Cofferdam	100 ft x 100 ft (30 m x 30 m)	<20 ft (<6.1 m) c/
EW 1 Anchor Corridor		
Anchor Drop g/	269 ft^2 (25 m^2)	49 ft (15 m)
EW 2 Submarine Export Cable Siting Corridor		
Submarine Export Cable Burial	10 ft (3 m)	8 ft (2.4 m) / 18 ft (5.5 m) e/
Pre-Sweeping f/	164 ft x 5,577 ft (50 m x 1,700 m)	<20 ft (<6.1 m) c/
Cable Protection d/	46 ft x 6.6 ft (14 m x 2 m)	0 ft (0 m)
HDD Cofferdam	100 ft x 100 ft (30 m x 30 m)	<20 ft (<6.1 m) c/
EW 2 Anchor Corridor		
Anchor Drop e/	269 ft^2 (25 m^2)	49 ft (15 m)

Notes:
a/ This table details the Project activities associated with construction; Project O&M activities will occur within the maximum horizontal and vertical effects, as detailed above.
b/ Distance provided is the diameter of the Project component.
c/ The maximum vertical effect will be less than the maximum vertical effect analyzed within the Marine Archaeological APE.
d/ 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.
e/ In locations where the submarine export cable will cross federally maintained areas in accordance with engagement with USACE and other stakeholders. This depth 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.
f/ Dredging and pre-sweeping activities will be located in select locations along the submarine export cable routes and vary in the maximum horizontal and maximum vertical extent; see **Section 3** for additional information.
g/ 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. Impacts from Project-related vessel anchoring are expected to be in up to 1,400 locations.

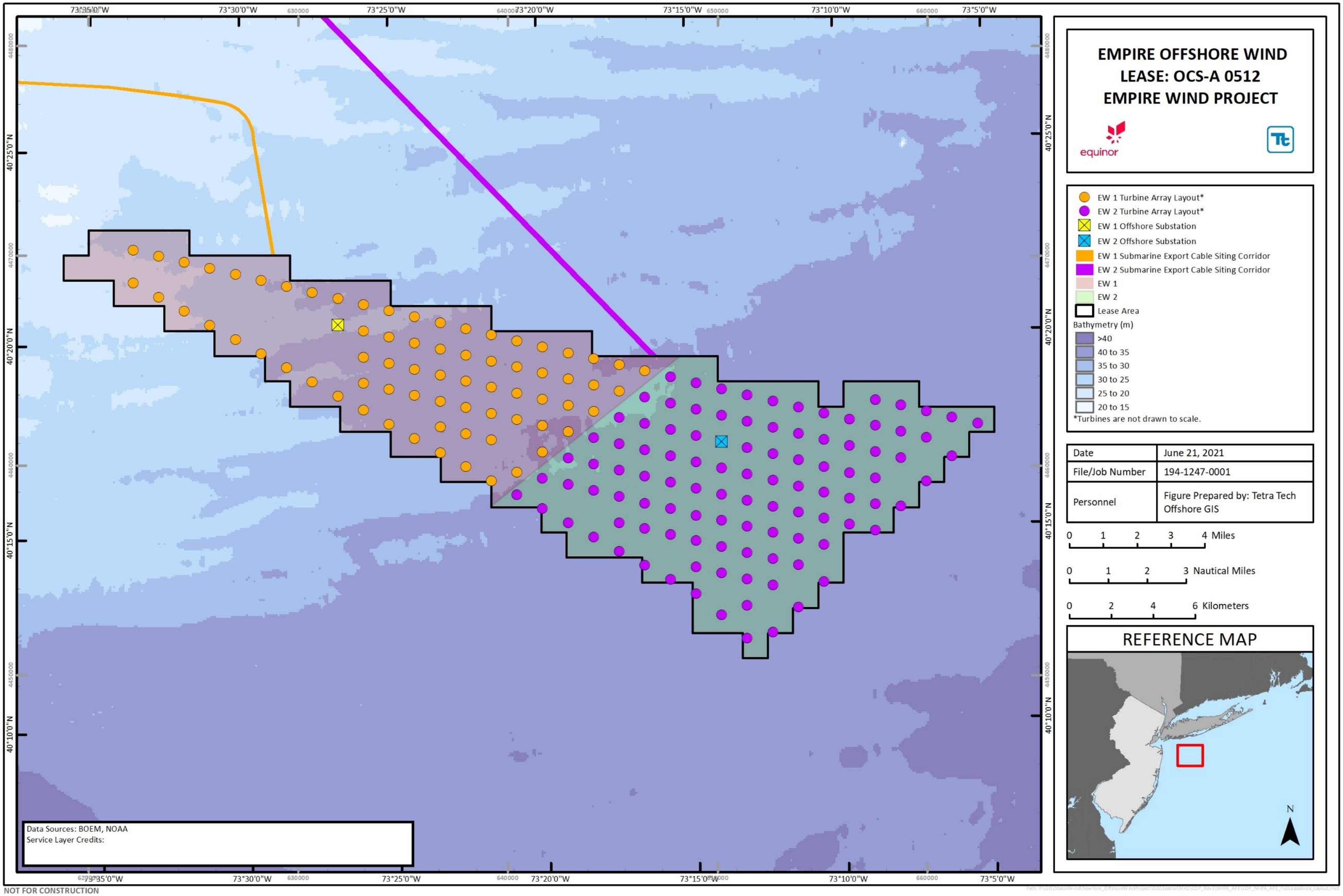


Figure 3.7-1 Marine Archaeological APE within the Lease Area

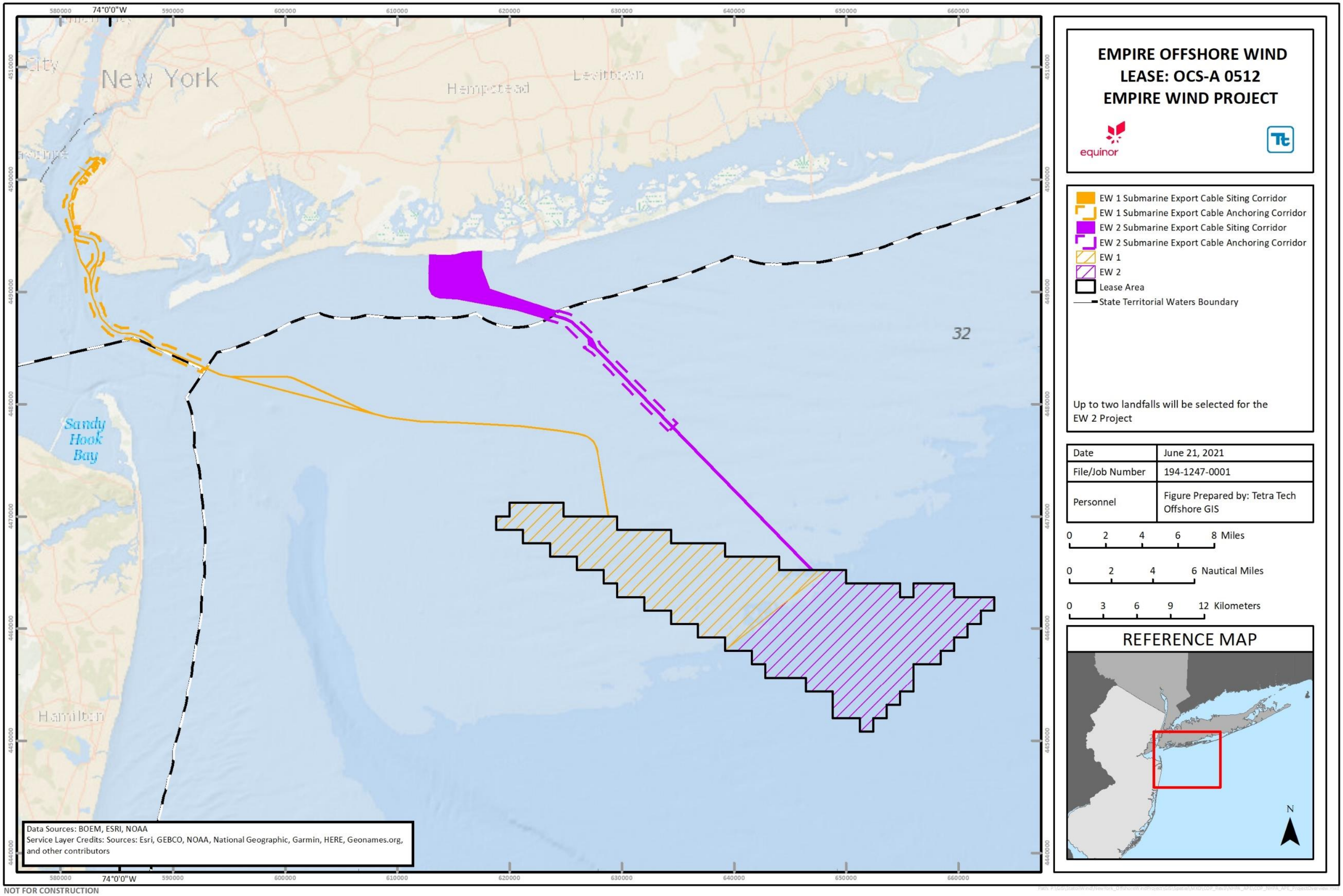


Figure 3.7-2 Marine Archaeological APE along the Submarine Export Cable Siting Corridors and Anchor Corridors

3.7.2 Terrestrial Archaeological APE

The Terrestrial Archaeological APE includes all areas where ground disturbing activities are proposed for EW 1 and EW 2. This includes the export cable landfalls, onshore export and interconnection cable routes, onshore substations, the O&M Base, and the associated construction footprints. Empire has characterized the full onshore Project Area for EW 1 and EW 2, which includes a 0.5-mi (0.8-km) buffer around the EW 1 and EW 2 export cable landfall sites, onshore export and interconnection cable routes, onshore substation parcels, and O&M Base, to allow for micro-siting of Project facilities. The results of this characterization are provided in **Appendix Y Terrestrial Archaeological Resource Assessment**. A summary of the Project activities proposed to be conducted within the Terrestrial Archaeological APE for EW 1 and EW 2 is provided in **Table 3.7-3**. The Terrestrial Archaeological APE is illustrated in **Figure 3.7-3** and **Figure 3.7-4**.

Table 3.7-3 Summary of Activities Proposed within the Terrestrial Archaeological APE

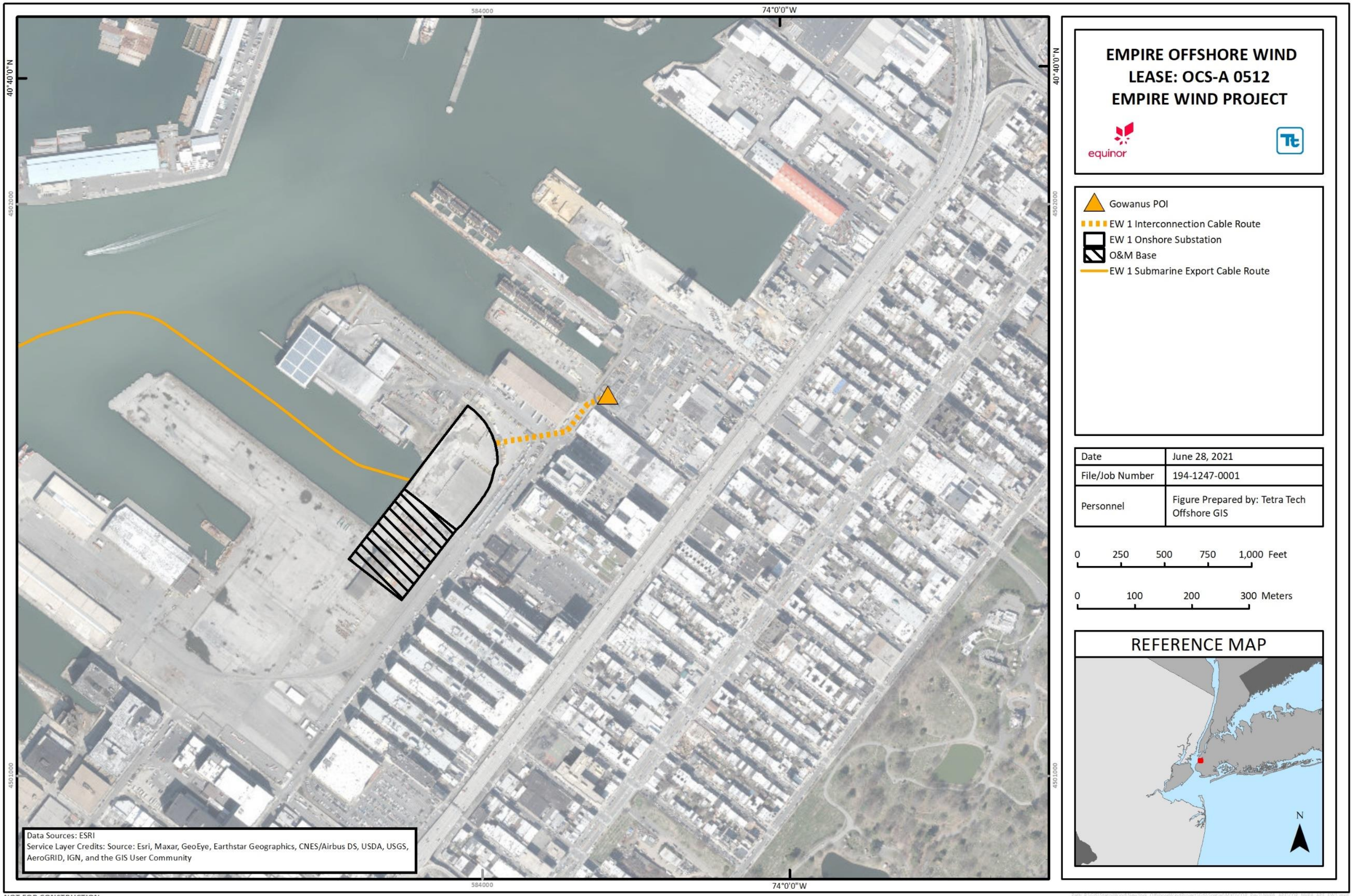
Project Component	Maximum Horizontal Effect	Maximum Vertical Effect
EW 1		
Export Cable Landfall	200 ft x 200 ft (61 m x 61 m)	10 ft (3 m)
Interconnection Cables (Total length of 0.2 m [0.8 km])	50 ft (15 m)	10 ft (3 m)
Onshore Substations	10.8 ac (4.4 ha)	15 ft (4.5 m)
O&M Base	6.5 ac (2.6 ha)	15 ft (4.5 m)
EW 2		
Export Cable Landfall	246 x 246 ft (75 m x 75 m)	10 ft (3 m)
Onshore Export and Interconnection Cables (Total length of 5.7 m [9.2 km])	150 ft (46 m)	15 ft (4.5 m)
Onshore Substations	7.4 ac (3.0 ha)	15 ft (4.5 m)
Onshore HDD Crossing	246 x 246 ft (75 m x 75 m)	10 ft (3 m)

3.7.3 Analysis of Visual Effects to Historic Properties APE

The AVEHP APE includes both the Offshore AVEHP APE and the Onshore AVEHP APE. The Offshore AVEHP APE includes all areas in which the offshore Project components (i.e., wind turbines and offshore substations) are visible. The Onshore AVEHP APE includes all areas in which the onshore Project components (i.e., onshore substations and O&M Base) are visible.

The Offshore AVEHP APE was based on a 35-mi (56-km) buffer area around the Lease Area. The 35-mi (56-km) buffer area was selected based on the maximum height of the wind turbines, the layout, and the surrounding landscape. The preliminary APE was then determined through additional analysis, including the completion of a computer-generated viewshed analysis, which accounted for bare earth and topographic conditions. The preliminary APE is illustrated in **Figure 3.7-5**.

The Onshore AVEHP preliminary APE was based on a 4-mi (6.4-km) buffer area around the onshore substation and O&M Base for EW 1 and the onshore substation for EW 2. The use of a 4-mi (6.4-km) buffer was determined by the location of the EW 1 onshore substation and O&M Base site being adjacent to open water (i.e., Upper Bay). The use of a larger visual study area captures the western shore of the bay, where visual receptors may have unobstructed views toward the Project across open water. The 4-mi (6.4-km) buffer area was then maintained across all onshore substation sites considered for the Project for consistency. The preliminary APE was then determined through additional analysis, including the completion of a computer-generated viewshed analysis, which accounted for bare earth and topographic conditions. The results of the EW 1 Onshore AVEHP preliminary APE is illustrated in **Figure 3.7-6**, the results of the EW 2 Onshore Substation A Onshore AVEHP preliminary APE is illustrated in **Figure 3.7-7**, and the EW 2 Onshore Substation B Onshore AVEHP preliminary APE is illustrated in **Figure 3.7-8**.



NOT FOR CONSTRUCTION

Figure 3.7-3 EW 1 Terrestrial Archaeological APE

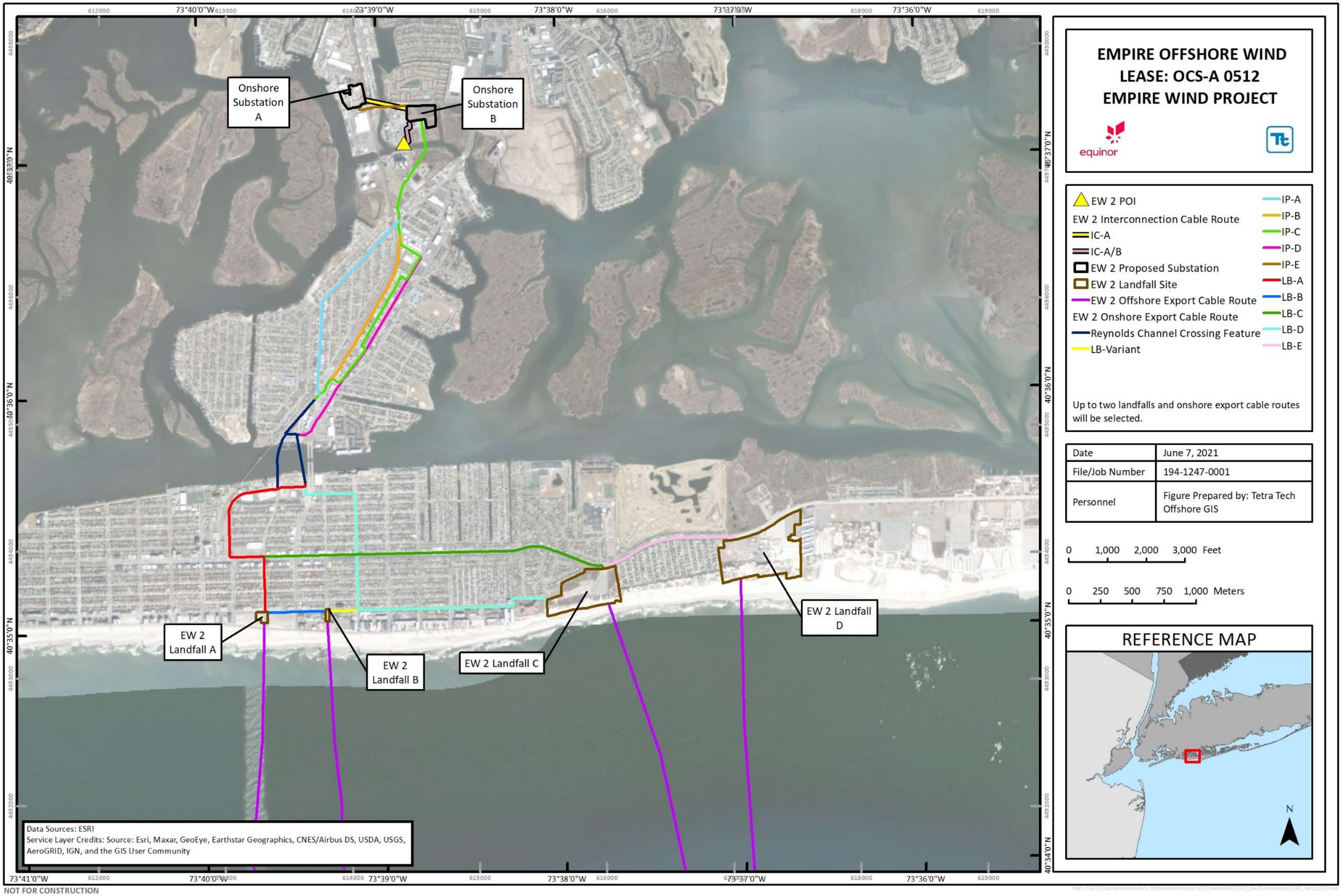


Figure 3.7-4 EW 2 Terrestrial Archaeological APE

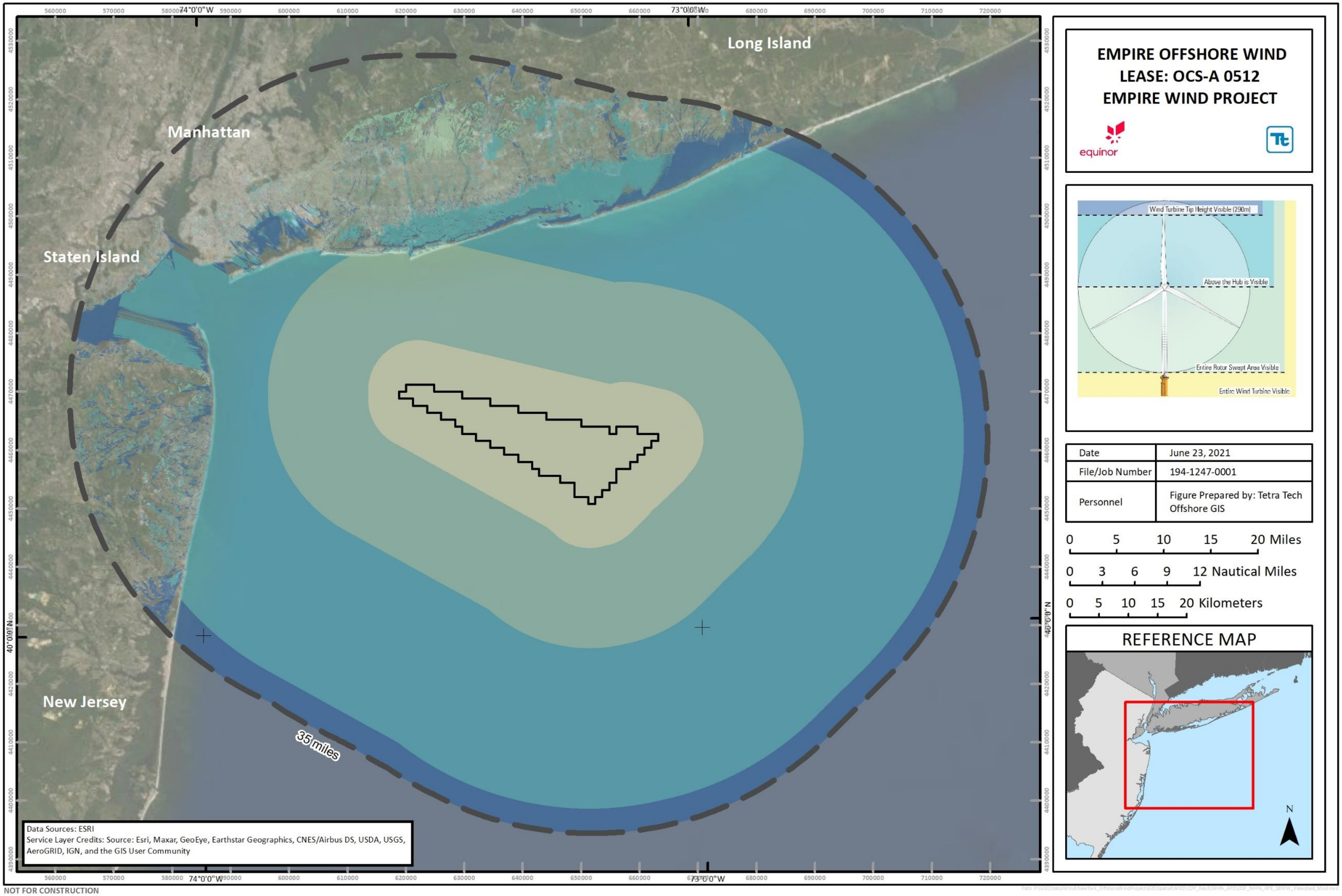


Figure 3.7-5 Offshore AVEHP Preliminary APE

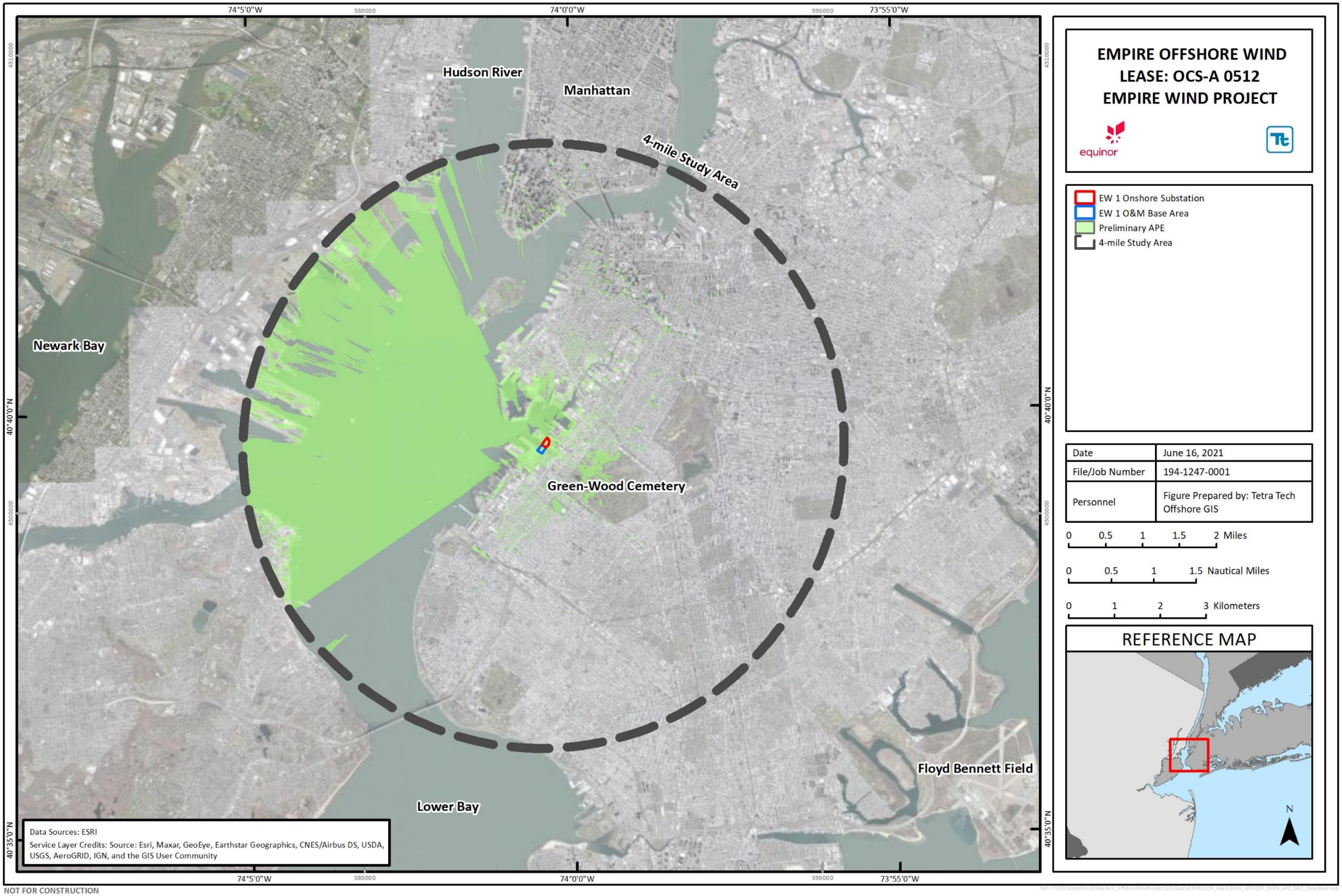


Figure 3.7-6 EW 1 Onshore Preliminary APE

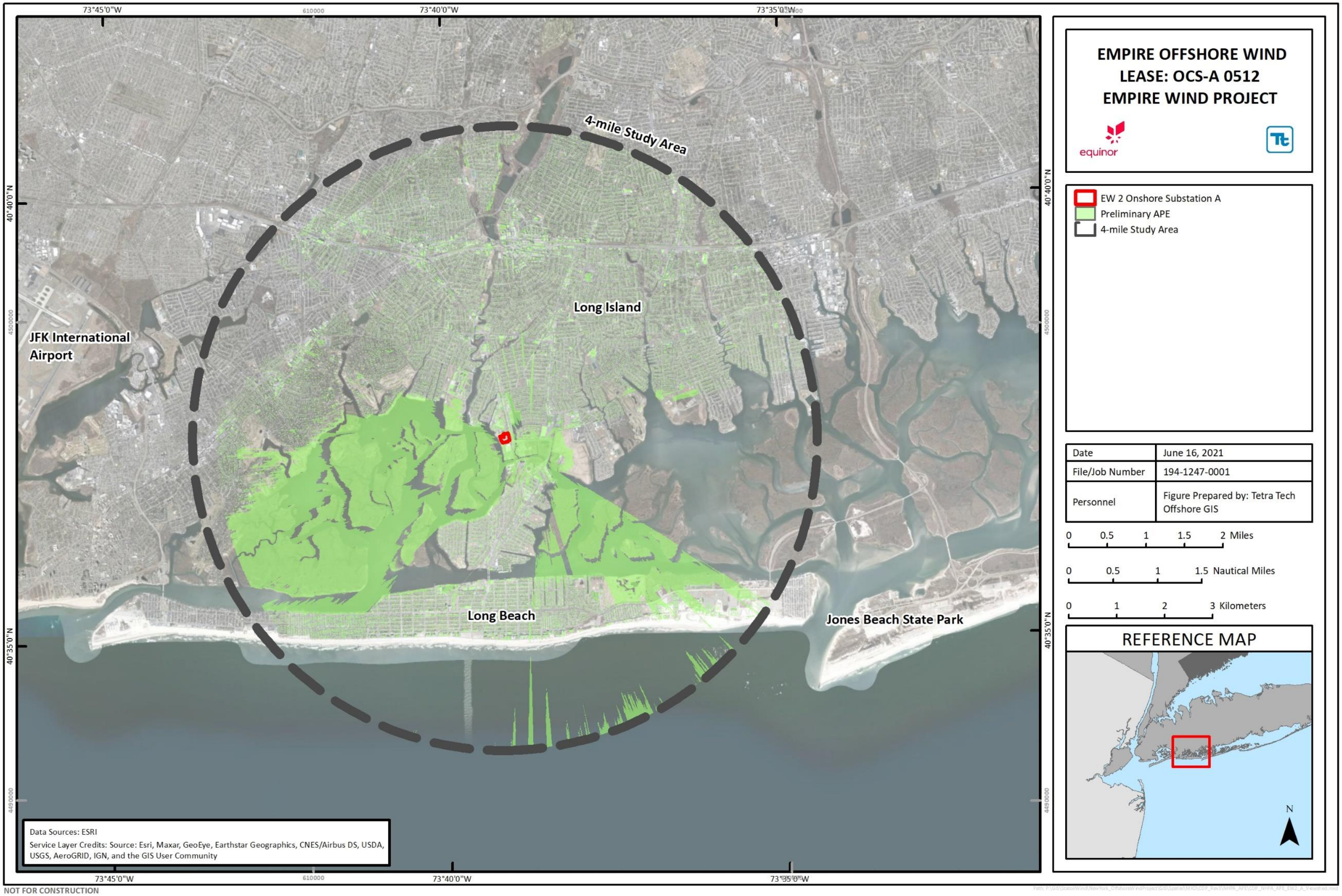


Figure 3.7-7 EW 2 Onshore Substation A Preliminary APE

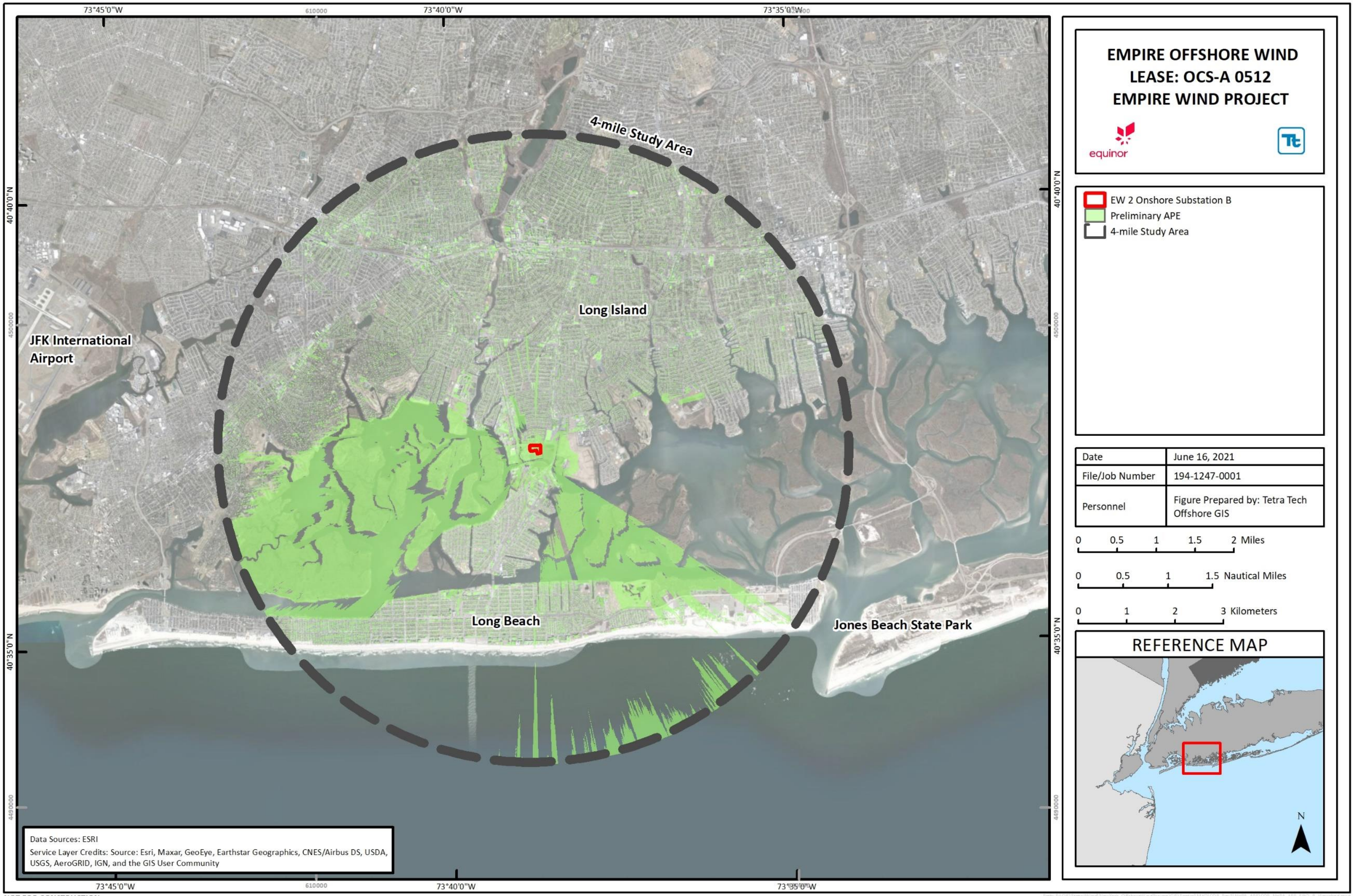


Figure 3.7-8 EW 2 Onshore Substation B Preliminary APE

3.8 References

BOEM (Bureau of Ocean Energy Management). 2021. *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development*. Available online at: https://www.boem.gov/sites/default/files/documents/renewable-energy/2021-Lighting-and-Marking-Guidelines.pdf.

IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities). 2013. *The Marking of Man-Made Offshore Structures. O-139, Edition 2.0*. Available online at: http://iala-aism.org/product/marking-of-man-made-offshore-structures-o-139/.